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ENCYCLOPÆDIA BRITANNICA.

ASSOCIATION, the act of associating, or constituting a society, or partnership, in order to carry on some scheme or affair with more advantage.—The word is Latin, *associatio;* and compounded of *ad*, to, and *socio*, to join.

Association of Ideas, is where two or more ideas constantly and immediately follow or succeed one another in the mind, so that one shall almost infallibly produce the other, whether there be any natural relation between them or not. See METAPHYSICS.

Where there is a real affinity or connexion in ideas, it is the excellency of the mind, to be able to collect, compare, and range them in order, in its inquiries: but where there is none, nor any cause to be assigned for their accompanying each other, but what is owing to mere accident or habit, this unnatural association becomes a great imperfection, and is, generally speaking, a main cause of error, or wrong deductions in reasoning. Thus the idea of goblins and sprights, it has been observed, has really no more affinity with darkness than with light; and yet let a foolish maid inculcate these ideas often on the mind of a child, and raise them there together, it is possible he shall never be able to separate them again so long as he lives, but darkness shall ever bring with it those frightful ideas. With regard to this instance, however, it must at the same time be observed, that the connection alluded to appears far from being either unnatural or absurd. See the article APPARITION.

Such wrong combinations of ideas, Mr Locke shows, are a great cause of the irreconcileable opposition between the different sects of philosophy and religion: for we cannot imagine, that all who hold tenets different from, and sometimes even contradictory to, one another, should wilfully and knowingly impose upon themselves, and refuse truth offered by plain reason: but some loose and independent ideas are, by education, custom, and the constant din of their party, so coupled in their minds, that they always appear there together: these they can no more separate in their thoughts, than if they were but one idea, and they operate as if they were so. This gives sense to jargon, demonstration to absurdities, consistency to nonsense, and is the foundation of the greatest, and almost of all the errors in the world.

Association forms a principal part of Dr Hartley's mechanical theory of the mind. He distinguishes it into synchronous and successive; and ascribes our simple and complex ideas to the influence of this principle or habit. Particular sensations result from previous vibrations conveyed through the nerves to the medullary substance of the brain; and these are so intimately associated together, that any one of them, when impressed alone, shall be able to excite in the mind the ideas of all the rest. Thus we derive the ideas of natural bodies from the association of the several sensible qualities with the names that express them, and with each other. The sight of part of a large building suggests the idea of the rest instantaneously, by a synchronous association of the parts; and the sound of the words, which begin a familiar sentence, brings to remembrance the remaining parts, in order, by successive association. Dr Hartley maintains, that simple ideas run into complex ones by association; and apprehends, that by pursuing and perfecting this doctrine, we may some time or other be enabled to analyze those complex ideas, that are commonly called the *ideas of reflection*, or *intellectual ideas*, into their several component parts, i. e. into the simple ideas of sensation of which they consist; and that this doctrine may be of considerable use in the art of logic, and in explaining the various phenomena of the human mind.

Association of Parliament. In the reign of King William III. the parliament entered into a solemn association to defend his Majesty's person and government against all plots and conspiracies; and all persons bearing offices civil or military, were enjoined to subscribe the association to stand by King William, on pain of forfeitures and penalties, &c. by stat. 7 and 8 W. III. c. 27.

Association, African. This is an institution which was formed in the year 1788, for the purpose of promoting discoveries in the interior parts of Africa. Out of the number of the members, of which this society consists, five are elected for the management of its funds and correspondence, and for the appointment of persons to whom the missions are assigned. Mr Ledyard was the first who was sent out, for accomplishing the object of the society. He undertook the adventurous task, of traversing from east to west, the widest part of the African continent, in the latitude which was ascribed to the Niger; and with this view he arrived at Cairo in August 1788. But before his projected journey commenced, he died, and the hopes that were entertained of this enterprising and persevering traveller were disappointed. Mr Lucas was next chosen by the committee,

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committee. In October 1788, he embarked for Tripoli; and he was instructed to proceed over the desert of Zaara to Fezzan, to collect all the information that could be obtained, respecting the interior of the African continent, and to transmit it by way of Tripoli. He was then to return by way of Gambia, or the coast of Guinea. But his peregrinations terminated at Mesurata. The difficulties and dangers which presented themselves deterred him from proceeding farther. He transmitted to the society only the result of his conferences with the traders to Fezzan, with whom he was travelling; and soon after returned to England.

The society still persevered in its object, and in the year 1790, appointed Major Houghton, with instructions to sail for the mouth of the Gambia, and to traverse the country from west to east. He arrived on the coast in November the same year, immediately commenced his journey, ascended the river Gambia to Medina, 900 miles distant from his mouth, and thence proceeded to Bambouk, and to the adjoining kingdom of Kasson, where, in September the year following, he unfortunately terminated his travels with his life, near to the town of Jarra.

Mr Park was engaged by the society in the same service in 1795, and pursuing the route of Major Houghton, more successfully explored the banks of the Niger, to Sego and to Silla, the first of that great line of populous cities which divide the southern from the northern deserts of Africa. The information which Mr Park collected, during his adventurous journey, was communicated to the society in 1798. In a second journey, commenced in 1805, this enterprising traveller perished, after having reached the Niger; but the circumstances of his death have not been ascertained with perfect certainty.

Mr Horneman, who had offered himself to the committee in 1796, departed from London in July 1797, and proceeding by Cairo, commenced his journey westward with the caravan, in September 1798. In November following, he arrived at Mourzouk in Fezzan, from which his last despatches to the society were transmitted by way of Tripoli, but no accounts of his death ever reached the society.

John L. Burckhardt, the son of a citizen of Basle in Switzerland, was engaged by the society in 1808. After some preparatory steps, he set out in March 1809. He remained two years and a half at Aleppo; thence he went to Egypt. Unfortunately no caravan set out for the interior of Africa for a series of years. He was thus disappointed in his leading object; but he made two journeys up the Nile, and visited Mecca, Medina, and Mount Sinai. Diseases brought on by fatigue and the climate, at length put a period to his life in September 1817. See Africa, Supplement.

ASSOILZIE, in *Law*, to absolve or free.

ASSONANCE, in *Rhetoric* and *Poetry*, a term used where the words of a phrase or a verse have the same sound, or termination, and yet make no proper rhyme. These are usually accounted vicious in English; though the Romans sometimes used them with elegancy; as, *Militem comparavit, exercitum ordinavit, aciem lustravit.*

ASSONANT RHYMES, is a term particularly applied to a kind of verses common among the Spaniards, where a resemblance of sound serves instead of a natural rhyme. Thus *ligera, cubierta, tierra, mesa,* may answer each other in a kind of *assonant* rhyme, having each an *e* in the penult syllable, and an *a* in the last.

ASSUAN See Syene.

ASSUMPSIT, in the *Law of England*, a voluntary or verbal promise, whereby a person assumes, or takes upon him to perform or pay any thing to another.

A promise is in the nature of a verbal convenant, and wants nothing but the solemnity of writing and sealing to make it absolutely the same. If therefore it be to do any explicit act, it is an express contract, as much as any covenant; and the breach of it is an equal injury. The remedy indeed is not exactly the same: since, instead of an action of covenant, there only lies an action upon the case, for what is called an *assumpsit* or undertaking of the defendant; the failure of performing which is the wrong or injury done to the plaintiff, the damages whereof a jury are to estimate and settle. As, if a builder promises, undertakes, or assumes to Caius, that he will build and cover his house within a time limited, and fails to do it; Caius has an action on the case against the builder for this breach of his express promise, undertaking, or assumpsit; and shall recover a pecuniary satisfaction for the injury sustained by such delay. So also in the case of a debt by simple contract, if the debtor promises to pay it and does not, this breach of promise entitles the creditor to his action on the case, instead of being driven to an action of debt. Thus likewise a promissory note, or note of hand not under seal, to pay money at a day certain, is an express assumpsit; and the payee at common law, or by custom and act of parliament the indorsee, may recover the value of the note in damage, if it remains unpaid. Some agreements indeed, though never so expressly made, are deemed of so important a nature, that they ought not to rest in verbal promise only, which cannot be proved but by the memory (which sometimes will induce the perjury of witnesses. To prevent which, the statute of frauds and perjuries, 29 Car. II. c. 3. enacts, that in the five following cases no verbal promise shall be sufficient to ground an action upon, but at the least some note or memorandum of it shall be made in writing, and signed by the party to be charged therewith: 1. Where an executor or administrator promises to answer damages out of his own estate. 2. Where a man undertakes to answer for the debt, default, or miscarriage, of another. 3. Where any agreement is made upon consideration of marriage. 4. Where any contract or sale is made of lands, tenements, or hereditaments, or any interest therein. 5. And lastly, where there is any agreement that is not to be performed within a year from the making hereof. In all these cases a mere verbal assumpsit is void.

From these express contracts the transition is easy to those that are only implied by law. Which are such as reason and justice dictate, and which therefore the law presumes that every man has contracted to perform; and, upon this presumption, makes him answerable to such persons as suffer by his non-performance.

Thus, 1. If I employ a person to transact any business for me, or perform any work, the law implies that I undertook, or assumed, to pay him so much as his labour deserved; and if I neglect to make him amends, he has a remedy for his injury by bringing his action on the case upon this implied assumpsit: wherein he is at

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at liberty to suggest that I promised to pay him so much as he reasonably deserved, and then to aver that his trouble was really worth such a particular sum, which the defendant has omitted to pay. But this valuation of his trouble is submitted to the determination of a jury; who will assess such a sum in damages as they think he really merited. This is called an *assumpsit* on a *quantum meruit*.

2. There is also an implied assumpsit on a *quantum valebat*, which is very similar to the former; being only where one takes up goods or wares of a tradesman, without expressly agreeing for the price. There the law concludes, that both parties did intentionally agree that the real value of the goods should be paid; and an action on the case may be brought accordingly, if the vendee refuses to pay that value.

3. A third species of implied assumpsit is when one has had and received money belonging to another without any valuable consideration given on the receiver's part; for the law construes this to be money had and received for the use of the owner only; and implies that the person so receiving, promised and undertook to account for it to the true proprietor. And, if he unjustly detains it, an action on the case lies against him for the breach of such implied promise and undertaking; and he will be made to repair the owner in damages, equivalent to what he has detained in such violation of his promise. This is a very extensive and beneficial remedy, applicable to almost every case where the defendant has received money which *ex æquo et bono* he ought to refund. It lies for money paid by mistake, or on a consideration which happens to fail, or through imposition, extortion, or oppression, or where undue advantage is taken of the plaintiff's situation.

4. Where a person has laid out and expended his own money for the use of another at his request, the law implies a promise of repayment, and an action will lie on this assumpsit.

5. Likewise, fifthly, upon a stated account between two merchants, or other persons, the law implies that he against whom the balance appears has engaged to pay to the other; though there be not any actual promise. And from this implication it is frequent for actions on the case to be brought, declaring that the plaintiff and defendant had settled their accounts together, *insimul computassent* (which gives name to this species of assumpsit); and that the defendant engaged to pay the plaintiff the balance, but has since neglected to do it. But if no account has been made up, then the legal remedy is by bringing a writ of *account, de computo;* commanding the defendant to render a just account to the plaintiff, or show the court good cause to the contrary. In this action, if the plaintiff succeeds, there are two judgments; the first is, that the defendant do account (*quod computet*) before auditors appointed by the court; and when such account is finished, then the second judgment is, that he do pay the plaintiff so much as he is found in arrear.

6. The last class of contracts, implied by reason and construction of law, arises upon this supposition, that every one who undertakes any office, employment, trust, or duty, contracts with those who employ or intrust him, to perform it with integrity, diligence, and skill: and if by his want of either of those qualities any injury accrues to individuals, they have therefore their remedy in damages by a special action on the case. A few instances will fully illustrate this matter. If an officer of the public is guilty of neglect of duty, or a palpable breach of it, of non-feasance, or of mis-feasance; as, if the sheriff does not execute a writ sent to him, or if he wilfully makes a false return thereof; in both these cases the party aggrieved shall have on action *on the case* for damages to be assessed by a jury. If a sheriff or gaoler suffers a prisoner who is taken upon mesne process (that is, during the pendency of a suit) to escape, he is liable to an action *on the case*. But if, after judgment, a gaoler or sheriff permits a debtor to escape, who is charged in execution for a certain sum; the debt immediately becomes his own, and he is compellable by action of *debt*, being for a sum liquidated and ascertained, to satisfy the creditor in his whole demand. An advocate or attorney that betray the cause of their client, or, being retained, neglect to appear at the trial, by which the cause miscarries, are liable to an action on the case, for a reparation to their injured client. There is also in law always an implied contract with a common innkeeper, to secure his guest's goods in his inn; with a common carrier or barge-master, to be answerable for the goods he carries; with a common farrier, that he shoes a horse well, without laming him; with a common taylor, or other workman, that he performs his business in a workmanlike manner: in which if they fail, an action on the case lies to recover damages for such breach of their general undertaking. Also, if an innkeeper, or other victualler, hangs out a sign and opens his house for travellers, it is an implied engagement to entertain all persons who travel that way; and upon this universal assumpsit an action on the case will lie against him for damages, if he without good reason refuses to admit a traveller. In contracts likewise for sales, if the seller doth upon the sale warrant it to be good, the law annexes a tacit contract to this warranty, that if it be not so, he shall make compensation to the buyer; else it is an injury to good faith, for which an action on the case will lie to recover damages.

ASSUMPTION, a festival in the Romish church, in honour of the miraculous ascent of the Virgin Mary into heaven: the Greek church, who also observe this festival, celebrate it on the 15th of August with great ceremony.

ASSUMPTION, in *Logic*, is the minor or second proposition, in a categorical syllogism.

ASSUMPTION is also used for a consequence drawn from the proposition whereof an argument is composed.

ASSUMPTION, an island in North America, in the gulf of St Lawrence, at the mouth of the great river of the same name. It is covered with trees. W. Long. 60. 40. N. Lat. 49. 30.

ASSUMPTION, a large and handsome town of Proper Paraguay, on the river of the same name in South America. It is a bishop's see, is well peopled, and seated in a country fruitful in corn and fruits, whose trees are always green. There is likewise a quantity of pasture, and the air is temperate and salutary. W. Long. 58. 40. S. Lat. 24. 50.

ASSUMPTIVE ARMS, in *Heraldry*, are such as a person has a right to assume, with the approbation of his sovereign, and of the heralds: thus, if a person who has no right by blood, and has no coat of arms, shall

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shall captivate in any lawful war any gentleman, nobleman, or prince, he and his heirs are, in that case, entitled to bear the shield of that prisoner for ever.

ASSURANCE, or INSURANCE, in *Commerce*. See INSURANCE. See also ASSURANCE in the SUPPLEMENT.

ASSUROR, a merchant, or other person, who makes out a policy of assurance, and thereby insures a ship, house, or the like.

ASSUS, or Assos, in *Ancient Geography*, a town of Troas (though by others supposed to be of Mysia), and the same with Apollonia (Pliny); but different from the Apollonia on the river Rhyndacus. Ptolemy places it on the sea-coast, but Strabo more inland; if he does not mean the head of an inland bay, as appears from Diodorus Siculus. It was the country of Cleanthes the Stoic philosopher, who succeeded Zeno. St Luke and others of St Paul's companians, in his voyage (Acts xx. 13. 14), went by sea from Troas to Assos: but St Paul went by land thither, and meeting them at Assos, they all went together to Myteleue. It is now called Bairam. E. Long. 26. 20. N. Lat. 39. 10.

ASSYRIA, an ancient kingdom of Asia, concerning the extent, commencement, and duration of which, historians differ greatly in their accounts. Several ancient writers, in particular Ctesias and Diodorus Siculus, have affirmed, that the Assyrian monarchy, under Ninus and Semiramis, comprehended the greater part of the known world. Had this been the case, it is not likely that Homer and Herodotus would have omitted a fact so remarkable. The sacred records intimate, that none of the ancient states or kingdoms were of considerable extent; for neither Chedorlaomer, nor any of the neighbouring princes, were tributary or subject to Assyria; and we find nothing of the greatness or power of this kingdom in the history of the judges and succeeding kings of Israel, though the latter kingdom was oppressed and enslaved by many different powers in that period. It is highly probable, therefore, that Assyria was originally of small extent. According to Ptolemy, it was bounded on the north by Armenia Major; on the west by the Tigris; on the south by Susiana; and on the east by Media.

It is probable, that the origin and revolutions of the Assyrian monarchy were as follows.—The founder of it was Ashur, the second son of Shem, who went out of Shinar, either by the appointment of Nimrod, or to elude the fury of a tyrant; conducted a large body of adventurers into Assyria; and laid the foundation of Nineveh (Gen. x. 11.). These events happened not long after Nimrod had established the Chaldæan monarchy, and fixed his residence at Babylon. The Persian historians suppose that the kings of Persia of the first dynasty were the same with the kings of Assyria, of whom Zohah, or Nimrod, was the founder of Babel. (Herbelot Orient. Bibl. v. *Bagdad*). It does not, however appear, that Nimrod reigned in Assyria. The kingdoms of Babylon and Assyria were originally distinct and separate (Micah, v. 6.); and in this state they remained until Ninus conquered Babylon and made it tributary to the Assyrian empire. Ninus the successor of Asher (Gen. x. 11. Diod. Sic. lib. 1.), seized on Chaldæa, after the death of Nimrod, and united the kingdoms of Assyria and Babylon. This great prince is said to have subdued Asia, Persia, Media,

Playfair's Chronology.

Egypt, &c. If he did so, the effects of his conquests were of no duration; for in the days of Abraham, we do not find that any of the neighbouring kingdoms were subject to Assyria. He was succeeded by Semiramis; a princess of an heroic mind; bold, enterprising, fortunate; but of whom many fabulous things have been recorded. It appear, however, that there were two princesses of the same name, who flourished at very different periods. One of them was the consort of Ninus; and the other lived five generations before Nitocris queen of Nebuchadnezzar (Euseb. Chron. p. 58. Herod. lib. i. c. 184.). This fact has not been attended to by many writers.

Whether there was an uninterrupted series of kings from Ninus to Sardanapalus, or not, is still a question. Some suspicion has arisen, that the list which Ctesias has given of the Assyrian kings is not genuine; for many names in it are of Persian, Egyptian, and Grecian extraction.

Nothing memorable has been recorded concerning the successors of Ninus and Semiramis. Of that effeminate race of princes it is barely said, that they ascended the throne, lived in indolence, and died in their palace at Nineveh. Diodorus (lib. ii.) relates, that, in the reign of Teutames, the Assyrians, solicited by Priam their vassal, sent to the Trojans a supply of 20,000 foot and 200 chariots, under the command of Memnon, son of Tithonus president of Persia: But the truth of his relation is rendered doubtful by the accounts of other writers.

Sardanapalus was the last of the ancient Assyrian kings. Contemning his indolent and voluptuous course of life, Arbaces, governor of Media, withdrew his allegiance, and rose up in rebellion against him. He was encouraged in this revolt by the advice and assistance of Belesis, a Chaldean priest, who engaged the Babylonians to follow the example of the Medes. These powerful provinces, aided by the Persians and other allies, who despised the effeminacy, or dreaded the tyranny of their Assyrian lords, attacked the empire on all sides. Their most vigorous efforts were, in the beginning, unsuccessful. Firm and determined, however, in their opposition, they at length prevailed, defeated the Assyrian army, besieged Sardanapalus in his capital, which they demolished, and became masters of the empire, B. C. 821.

After the death of Sardanapalus, the Assyrian empire was divided into three kingdoms, viz. the Median, Assyrian, and Babylonian. Arbaces retained the supreme power and authority, and fixed his residence at Ecbatana in Media. He nominated governors in Assyria and Babylon, who were honoured with the title of *kings*, while they remained subject and tributary to the Median monarchs. Belesis received the government of Babylon as the reward of his services; and Phul was intrusted with that of Assyria. The Assyrian governor gradually enlarged the boundaries of his kingdom, and was succeeded by Tiglath-pileser, Salmanasar, and Sennacherib, who asserted and maintained their independency. After the death of Assar-haddon, the brother and successor of Sennacherib, the kingdom of Assyria was split, and annexed to the kingdoms of Media and Babylon. Several tributary princes afterwards reigned in Nineveh; but no particular account of them is found in the annals of ancient nations. We hear

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hear no more of the kings of Assyria, but of those of Babylon. Cyaxares king of Media assisted Nebuchadnezzar king of Babylon, in the siege of Nineveh, which they took and destroyed, B. C. 606. The Chaldean or Babylonish kingdom was transferred to the Medes, after the reign of Nabonadius, son of Evilmerodach, and grandson of Nebuchadnezzar. He is styled Belshazzar in the sacred records, and was conquered by Cyrus, B. C. 538.

ASSYTHMENT. See ASSITHMENT.

ASTA, an inland town of Liguria, a colony (Ptolemy) on the river Tanarus: now *Asti.* E. Long. 8. 15. N. Lat. 44. 40.

ASTA *Regia*, a town of Bætica, (Pliny); situated at the mouth of the Bætis which was choked up with mud, to the north of Cadiz: 16 miles distant from the port of Cadiz, (Antonine). Its ruins show its former greatness. Its name is Phœnician, denoting a *frith* or arm of the sea, on which it stood. It is said to be the same with XERA; which see.

ASTABAT, a town of Armenia, in Asia, situated near the river Aras, 12 miles south of Nakshivan. The land about it is excellent, and produces very good wine. There is a root peculiar to this country, called *ronas;* which runs in the ground like liquorice, and serves for dyeing red. It is very much used all over the Indies, and in it they have a great trade. E. Long. 46. 30. N. Lat. 39. 0.

ASTANDA, in antiquity, a royal courier or messenger, the same with ANGARUS.—King Darius of Persia is said by Plutarch, in his book on the fortune of Alexander, to have formerly been an *astanda.*

ASTAROTH, or ASHTAROTH, in antiquity, a goddess of the Sidonians.—The word is Syriac, and signifies *sheep*, especially when their udders are turgid with milk. From the fecundity of these animals, which in Syria continue to breed a long time, they formed the notion of a deity, whom they called *Astaroth*, or *Astarte.* See ASTARTE.

ASTAROTH, in *Ancient Geography*, the royal residence of Og king of Bashan; whether the same with Astaroth Carnaim, is matter of doubt: if one and the same, it follows from Eusebius's account, that it lay in Bashan, and to the east of Jordan, because in the confines of Arabia.

ASTARTE, in Pagan mythology, (the singular of Astaroth), a Phœnician goddess, called in scripture the *queen of heaven*, and the *goddess of the Sidonians.* —Solomon, in compliment to one of his queens, erected an altar to her. In the reign of Ahab, Jezebel caused her worship to be performed with much pomp and ceremony; she had 400 priests; the women were employed in weaving hangings or tabernacles for her; and Jeremiah observes, that "the children gathered the wood, the fathers kindled the fire, and the women kneaded the dough, to make cakes for the queen of heaven."

ASTARTE, in *Ancient Geography*, a city on the other side Jordan; one of the names of Rabbath Ammon, in Arabia Petræa, (Stephanus).

ASTEISM, in *Rhetoric*, a genteel irony, or handsome way of deriding another. Such, e. gr. is that of Virgil:

Qui Bavium non odit, amet tua carmina, Mævi, &c.

Diomed places the characteristic of this figure, or species of irony, in that it is not gross and rustic, but ingenious and polite.

ASTELL, MARY, an English lady who was an eminent writer, was born at Newcastle-upon-Tyne in the year 1668. Her father, who was a merchant, committed the education of his daughter to her uncle, who was a clergyman. Convinced of the general injury done to young ladies at that period by the deficiency of their education, he taught her the Latin and French languages, and instructed her in the principles of logic, mathematics, and natural philosophy. Having spent 20 years of her life in Newcastle, she retired to London, where she continued the pursuit of her studies; and, deeply affected with the general ignorance of her sex, she employed the first fruits of her pen to rouse them to a proper emulation, in a work, "A serious Proposal to the Ladies, wherein a Method is offered for the Improvement of their Minds," printed in 12mo, at London 1697. The chief object of that book was to erect a seminary for female education. A certain lady, supposed to be the queen, formed the design of devoting 10,000l. to this honourable purpose; but Bishop Burnet having suggested, that it would have too much the appearance of a nunnery, the design did not take effect.

Disappointed in the article of marriage with an eminent clergyman, she next wrote a book entitled "Reflections on Marriage," which was published in 1700. This lady was a zealous advocate for the religious system commonly called *orthodox;* and in politics, defended the doctrine of nonresistance. About this time she published some controversial pieces, among which are the following: "Moderation truly stated;" "A Fair Way with the Dissenters;" "An Impartial Enquiry into the causes of the Rebellion;" and "A Vindication of the Royal Martyrs;" all printed in 4to in 1704. Her most finished performance was, "The Christian religion as professed by a Daughter of the Church of England," published in 1705, in a large octavo volume. Dr Waterland speaks of this book in very favourable terms; and such was the intrepidity of this lady, that she has attacked both Locke and Tillotson in the controversial part. In the evening of her life Mrs Astell was attacked with the severe disease of a cancer in her breast; the amputation of which she bore with singular fortitude. At the advanced age of 63 she died in the year 1731.

Mrs Astell appears to have been a woman of uncommon talents as a writer and scholar; rigid in her principles, and austere in her manners. Since a new era of female education has commenced, such an author as Mrs Astell would have attracted little notice; but at a period of society when few women could read, and scarcely any could write, it was highly honourable for a female to suggest hints, however imperfect, for the improvement of female education. It may farther be remarked, that it deserves to be mentioned, that about a century ago a lady informed the public by her pen, that "women, who ought to be retired, are for this reason designed for speculation," and that "great improvements might be made in the sciences, were not women enviously excluded from this their proper business." Deeming her time more valuable than to be wasted by trifling visitors, and abhorring the practice

of

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of teaching servants to lie, she would humorously accost such visitors by saying, "Mrs Astell is not at home." (*Gen. Biog.*).

ASTER, STARWORT. See BOTANY *Index*.

ASTER, or *Stella Marina*, in *Zoology*. See ASTERIAS, HELMINTHOLOGY *Index*.

ASTERABAD, a small province in the north-east part of Persia, sometimes included in that of Mazanderan. It is bounded by the Caspian sea on the west, by lofty mountains on the south, on the north by the river Ashor, and extends to the 58th degree of longitude on the east. It nearly coincides with the ancient Hyrcania, and is the native province of the present king of Persia. It is a mountainous country, in some parts fruitful, in others sandy and barren. Asterabad is the chief town. E. Long. 54. N. Lat. 36. 50.

ASTERIA, in *Zoology*, a name by which some authors have called the *falco palumbarius*, or *goshawk*. See FALCO, ORNITHOLOGY *Index*.

ASTERIA is also the name of a gem, usually called the *cat's eye*, or *oculus cati*. It is a very singular and very beautiful stone, and somewhat approaches to the nature of the opal, in having a bright included colour, which seems to be lodged deep in the body of the stone, and shifts about, as it is moved, in various directions; but it differs from the opal in all other particulars, especially in its want of the great variety of colours seen in that gem, and in its superior hardness. It is usually found between the size of a pea and the breadth of a sixpence; is almost always of a semicircular form, broad and flat at the bottom, and rounded and convex at the top; and it is naturally smooth and polished. It has only two colours, a pale brown and a white; the brown seeming the ground, and the white playing about in it, as the fire colour in the opal. It is considerably hard, and will take a fine polish, but is usually worn with its native shape and smoothness. It is found in the East and West Indies, and in Europe. The island of Borneo affords some very fine ones, but they are usually small; they are very common in the sands of rivers in New Spain: and in Bohemia they are not unfrequently found immersed in the same masses of jasper with the opal.

ASTERIA is also the name of an extraneous fossil, called in English the *star-stone*. The fossils are small, short, angular, or sulcated columns, between one and two inches long, and seldom above a third of an inch in diameter: composed of several regular joints; when separated, each resembles a radiated star. They are, not without reason, supposed to be a part of some sea-fish petrified, probably the asterias or sea-star. The asteria is also called *astrites*, *astroites*, and *asteriscus*. They may be reduced to two kinds: those whose whole bodies make the form of a star; and those which in the whole are irregular, but are adorned as it were with constellations in the parts. Dr Lister, for distinction's sake, only gives the name *asteria* to the former sort, distinguishing the latter by the appellation of *astroites*; other naturalists generally use the two indiscriminately. The asteria spoken of by the ancients, appears to be of this latter kind. The quality of moving in vinegar, as if animated, is scarce perceivable in the astroites, but is signal in the asteria. The former must be broken in small pieces before it will move; but the latter will move, not only in a whole joint, but in two or three knit together. The curious frequently meet with these stones in many parts of England: at Cleydon in Oxfordshire they are found rather larger than common, but of a softer substance; for, on being left a small space of time in a strong acid, they may easily be separated at the joints in small plates.

ASTERIAS, STAR-FISH, or SEA-STAR. See HELMINTHOLOGY *Index*.

ASTERIAS, the ancient name of the bittern. See ARDEA, ORNITHOLOGY *Index*.

ASTERISK, a mark in form of a star (*), placed over a word or sentence, to refer the reader to the margin, or elsewhere, for a quotation, explanation, or the like.

ASTERIUS, or ASTURIUS, a Roman consul, in 449. We have under his name, "A Conference on the Old and New Testament," in Latin verse: in which each strophe contains, in the first verse, an historical fact in the Old Testament; and in the second, an application of that fact to some point in the New.

ASTERN, a sea phrase, used to signify any thing at some distance behind the ship; being the opposite of AHEAD, which signifies the space before her. See AHEAD.

ASTEROPODIUM, a kind of extraneous fossil, of the same substance with the asteriæ or star-stones, to which they serve as a base. See ASTERIA and STAR-STONE.

ASTHMA. See MEDICINE *Index*.

ASTI, a city of Montferrat in Italy, seated on the Tanara, and capital of the county of the same name. It is a bishop's see, and well fortified with strong walls and deep ditches; and is divided into the city, borough, citadel, and castle, which contain altogether 22,000 inhabitants. There are a great many churches and convents, as well as other handsome buildings; and its territory is well watered, beautiful, and fruitful. It was repeatedly taken and retaken by the French and Austrians during the late wars. E. Long. 8. 15. N. Lat. 44. 58.

ASTIGI, in *Ancient Geography*, a colony, and conventus juridicus, of Bætica, surnamed *Augusta Firma*, situated on the Singulus, which falls into the Bætis; called also *Colonia Astigitana* (Pliny): Now *Ecya*, midway between Seville and Cordova. W. Long. 5°. N. Lat. 37. 20.

ASTOMI, in anthropology, a people feigned without mouths. Pliny speaks of a nation of Astomi in India, who lived only by the smell or effluvia of bodies taken in by the nose.

ASTORGA, a very ancient city of Spain, in the kingdom of Leon, with a bishop's see, is seated on the river Tuerta, and well fortified both by art and nature. It stands in a most agreeable plain, about 150 miles north-west of Madrid. There are excellent trouts in the river. W. Long. 6. 20. N. Lat. 42. 20.

ASTRACAN, a province of Russia, and the most easterly part of Europe; bounded on the north by Bulgaria and Baskiria; on the south by the Caspian sea; on the west, by the Volga, which divides it from the Nagayan Tartars and Don Cossacks; and on the east, by the great ridge of mountains which part it from Great Tartary. The province extends from the 46th to the 52d degree of latitude. The summer is long, and intensely hot: the winter continues about three

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months so severe, that the Volga is frozen hard enough to bear loaded sledges. The soil is rich and fertile; but the Tartars who inhabit it are strangers to agriculture. On the western and southern sides of the Volga, are heaths of a prodigious extent, sandy, desert, and uncultivated; these, however produce vast quantities of fine transparent salt in pits, where the sun bakes and incrustates it to the thickness of an inch on the surface of the water. There are pits in the neighbourhood of Astracan which yield this excellent salt in such abundance, that any person may carry it off, paying at the rate of one farthing a poost, which is equal to forty pounds. The metropolis, Astracan, is situated within the boundaries of Asia, on an island called *Dolgoi*, about 60 English miles above the place where the Volga disembogues itself into the Caspian sea. The city derives its name from Hadgee Tarkan, a Tartar, by whom it was founded. It was conquered by Iwan Basilowitz, recovered by the Tartars in the year 1668, and retaken by the czar, who employed for this purpose a great number of flat-bottomed vessels, in which he transported his forces down the Volga from Casan.

The city of Astracan is about two miles and a half in circumference, surrounded by a brick wall, which is now in a ruinous condition: but, if we comprehend the suburbs, the circuit will be near five miles. The number of inhabitants amounts to 70,000, including Armenians and Tartars, as well as a few Persians and Indians. The garrison consists of six regiments of the best Russian troops, who, when this place was alarmed from the side of Persia, had in the adjacent plain erected a great number of small batteries, to scour the fields, and obstruct the approach of the enemy. The houses of Astracan are built of wood, and generally mean and inconvenient. The higher parts of the city command a prospect of the Volga, which is here about three miles in breadth, and exhibits a noble appearance. The marshy lands on the banks of it render the place very sickly in the summer: the earth, being impregnated with salt, is extremely fertile, and produces abundance of fruit, the immoderate use of which is attended with epidemical distempers. Sickness is likewise the consequence of those annual changes in the atmosphere produced by the floods in spring and autumn. All round the city of Astracan, at the distance of two miles, are seen a great number of gardens, orchards, and vineyards, producing all sorts of herbs and roots. The grapes are counted so delicious, that they are preserved, in sand, and transported to court by land-carriage at a prodigious expence: yet the wine of Astracan is very indifferent. The summer being generally dry, the inhabitants water their gardens by means of large wheels worked by wind or horses, which raise the water to the highest part of the garden, from whence it runs in trenches to refresh the roots of every single tree and plant. The neighbouring country produces hares and partridges, plenty of quails in summer, with wild and water-fowl of all sorts in abundance.

About ten miles below Astracan is a small island called *Bosmaise*, on which are built large storehouses for the salt, which is made about twelve miles to the eastward, and, being brought thither in boats, is conveyed up the Volga, in order to supply the country as far as Moscow and Twere. The quantity of salt annually dug for these purposes amounts to some millions of pounds, the exclusive property of which is claimed by the crown, and yields a considerable revenue; for the soldiers and bulk of the people live almost entirely on bread and salt. The neighbourhood of these salt-works is of great advantage to the fisheries, which extend from hence to the Caspian sea, and reach to the south-east as far as Yack, and even 100 miles above Zaritzen. The principal fish here caught are sturgeon and belluga. These, being salted, are put on board of vessels, and sent away in the spring, for the use of the whole empire, even as far as Petersburg: but as fish may be kept fresh as long as it is frozen, the winter is no sooner set in, than they transport great quantities of it by land through all the provinces of Russia. Of the roes of the fish called *belluga*, which are white, transparent, and of an agreeable flavour, the fishers here prepare the caviare, which is in so much esteem all over Europe. These fisheries were first established by one Tikon Demedoff, a carrier, who settled in this place about 60 years ago, his whole wealth consisting of two horses. By dint of skill and industry, he soon grew the richest merchant in this country: but his success became so alluring to the crown, that of late years it hath engrossed some of the fisheries as well as the salt works.

From the latter end of July to the beginning of October, the country about Astracan is frequently infested with myriads of locusts, which darken the air in their progression from the north to the southward; and, wherever they fall, consume the whole verdure of the earth. These insects can even live for some time under water: for when the wind blows across the Volga, vast numbers of them fall in clusters, and are rolled ashore; and their wings are no sooner dry, than they rise and take flight again.

Heretofore the inhabitants of Astracan traded to Khuva and Bokhara; but at present these branches are lost, and their commerce is limited to Persia and the dominions of Russia. Even the trade to Persia is much diminished by the troubles of that country; nevertheless, the commerce of Astracan is still considerable. Some years ago, the city maintained about 40 vessels, from 100 to 200 tons burden, for the Caspian traffic. Some of these belong to the government, and are commanded by a commodore, under the direction of the admiralty. This office is generally well stocked with naval stores, which are sold occasionally to the merchants. The trading ships convey provisions to the frontier towns of Terkie and Kislar, situated on the Caspian sea; and transport merchandise to several parts of Persia. The merchants of Astracan export to Persia, chiefly on account of the Armenians, red leather, linens, woollen cloths, and other European manufactures. In return, they import the commodities of Persia, particularly those manufactured at Casan; such as silk sashes intermixed with gold, for the use of the Poles; wrought silks and stuffs mixed with cotton; rice, cotton, rhubarb, and a small quantity of other drugs; but the chief commodity is raw silk. The government has engrossed the article of rhubarb, the greater part of which is brought into Russia by the Tartars of Yakutski, bordering on the eastern Tartars belonging to China. They travel through Siberia to Samura, thence to Casan, and lastly to Moscow. The

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revenue of Astracan is computed at 150,000 rubles, or 33,000l. arising chiefly from salt and fish. The city is ruled by a governor, under the check of a chancery. He is nevertheless arbitrary enough, and exercises oppression with impunity. The officers of the admiralty and custom-house having very small salaries, are open to corruption, and extremely rapacious. At christening feasts, which are attended with great intemperance, the guests drink a kind of cherry-brandy out of large goblets; and every person invited throws a present of money into the bed of the mother, who sits up with great formality to be saluted by the company.

The Indians have a Pagan temple at Astracan, in which they pay their adoration, and make offerings of fruit to a very ugly deformed idol. The priests of this pagod use incense, beads, cups, and prostrations. The Tartars, on the contrary, hold idol-worship in the utmost abomination.

ASTRÆA, in *Astronomy*, a name which some give to the sign Virgo, by others called *Erigone*, and sometimes *Isis*. The poets feign that Justice quitted heaven to reside on earth, in the golden age; but, growing weary of the iniquities of mankind, she left the earth, and returned to heaven, where she commenced a constellation of stars, and from her orb still looks down on the ways of men.

ASTRAGAL, in *Architecture*, a little round moulding, which in the orders surrounds the top of the shaft or body of the column. It is also called the *talon* and *tondino;* it is used at the bottoms as well as tops of columns, and on other occasions: it properly represents a ring, on whatever part of a column it is placed; and the original idea of it was that of a circle of iron put round the trunk of a tree, used to support an edifice, to prevent its splitting. The astragal is often cut into beads and berries, and is used in the ornamented entablatures to separate the several faces of the architrave.

ASTRAGAL, in *Gunnery*, a round moulding encompassing a cannon, about half a foot from its mouth.

ASTRAGALOMANCY, a species of divination performed by throwing small pieces, with marks corresponding to the letters of the alphabet; the accidental disposition of which formed the answer required. This kind of divination was practised in a temple of Hercules, in Achaia. The word is derived from αστραγαλος, and μαντεια, *divination*.

ASTRAGALUS, MILK-VETCH, or LIQUORICE-VETCH. See BOTANY *Index*.

ASTRAGALUS. See ANATOMY *Index*.

ASTRANTIA, MASTERWORT. See BOTANY *Index*.

ASTRICTION, in *Law*. See THIRLAGE.

ASTRICTION, among physicians, denotes the operation of astringent medicines.

ASTRINGENTS, in the *Materia Medica*, substances distinguished by a rough austere taste, and changing solutions of iron, especially those made in the vitriolic acid, into a dark purple or black colour; such are galls, tormentil root, bistort root, balaustines, terra japonica, acacia, &c. See MATERIA MEDICA *Index*.

ASTROGNOSIA, the science of the fixed stars, or the knowledge of their names, constellations, magnitudes, &c.

ASTROITES, or STAR-STONE, in *Natural History*. See ASTERIA and STAR-STONE.

ASTROLABE, the name for a stereographic projection of the sphere, either upon the plane of the equator, the eye being supposed to be in the pole of the world; or upon the plane of the meridian, when the eye is supposed in the point of the intersection of the equinoctial and horizon.

ASTROLABE is also the name of an instrument formerly used for taking the altitude of the sun or stars at sea.

ASTROLABE, among the ancients, was the same as our armillary sphere.

ASTROLOGY, a conjectural science, which teaches to judge of the effects and influences of the stars, and to foretel future events by the situation and different aspects of the heavenly bodies.

This science has been divided into two branches, *natural* and *judiciary*. To the former belongs the predicting of natural effects; as, the changes of weather, winds, storms, hurricanes, thunder, floods, earthquakes, &c. This art properly belongs to natural philosophy; and is only to be deduced, *à posteriori*, from phenomena and observations. Judiciary or judicial astrology, is that which pretends to foretel moral events; i. e. such as have a dependency on the free will and agency of man; as if they were directed by the stars. This art, which owed its origin to the practices of knavery on credulity, is now universally exploded by the intelligent part of mankind.

The professors of this kind of astrology maintain, "That the heavens are one great volume or book, wherein God has written the history of the world; and in which every man may read his own fortune, and the transactions of his time. The art, say they, had its rise from the same hands as astronomy itself: while the ancient Assyrians, whose serene unclouded sky favoured their celestial observations, were intent on tracing the paths and periods of the heavenly bodies, they discovered a constant settled relation or analogy between them and things below; and hence were led to conclude these to be the Parcæ, the Destinies, so much talked of, which preside at our births, and dispose of our future fate.

"The laws, therefore, of this relation being ascertained by a series of observations, and the share each planet has therein; by knowing the precise time of any person's nativity, they were enabled, from their knowledge in astronomy, to erect a scheme or horoscope of the situation of the planets at this point of time; and, hence, by considering their degrees of power and influence, and how each was either strengthened or tempered by some other, to compute what must be the result thereof."

Thus the astrologers.—But the chief province now remaining to the modern professors, is the making of calendars or almanacks.

Judicial astrology is commonly said to have been invented in Chaldea, and thence transmitted to the Egyptians, Greeks, and Romans; though some will have it of Egyptian origin, and ascribe the invention to Cham. But it is to the Arabs that we owe it. At Rome the

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Astrology. the people were so infatuated with it, that the astrologers, or, as they were then called, the *mathematicians*, maintained their ground in spite of all the edicts of the emperors to expel them out of the city. See GENETHLIACI.

Add, that the Bramins, who introduced and practised this art among the Indians, have thereby made themselves the arbiters of good and evil hours, which gives them great authority: they are consulted as oracles, and they have taken care never to sell their answers but at good rates.

The same superstition has prevailed in more modern ages and nations. The French historians remark, that in the time of Queen Catherine de Medicis, astrology was so much in vogue, that the most inconsiderable thing was not to be done without consulting the stars. And in the reigns of King Henry III. and IV. of France, the predictions of astrologers were the common theme of the court conversation. This predominant humour in that court was well rallied by Barclay, in his *Argenis*, lib. ii. on occasion of an astrologer, who had undertaken to instruct King Henry in the event of a war then threatened by the faction of the Guises.

Astrology ‖ Astronomical Sector.

ASTRONIUM. See BOTANY *Index*.

ASTRONOMICAL, something relating to ASTRONOMY.

ASTRONOMICAL Calendar, an instrument engraven on copperplates, printed on paper, and pasted on a board, with a brass slider carrying a hair: it shows by inspection the sun's meridian altitude, right ascension, declination, rising, setting, amplitude, &c. to a greater degree of exactness than the common globes.

ASTRONOMICAL Sector, a very useful mathematical instrument, made by the late ingenious Mr Graham; a description of which is given in the course of the following article.

ASTRONOMY.

ASTRONOMY is that science which treats of the motions of the heavenly bodies, and explains the laws by which these motions are regulated.

It is the most sublime and the most perfect of all the sciences. No subject has been longer studied, or has made greater progress. There is a vast interval between the rude observations of the earlier astronomers, and the precision and general views which direct our present observers. To ascertain the apparent motions of the heavenly bodies was a difficult task, and required the united observations of ages. To unravel these intricate mazes, and detect and demonstrate the real motions, demanded the most patient perseverance, judgment, and dexterity. To ascertain the laws of these motions, and to resolve the whole of them into one general fact, required the exertions of a sagacity scarcely to be expected in human nature. Yet all this has been accomplished; and even the most minute movement of the heavenly bodies has been shewn to depend upon the same general law with all the rest, and even to be a consequence of that law. Astronomy, therefore, is highly interesting, were it only because it exhibits the finest instance of the length that the reasoning faculties can go. It is the triumph of philosophy and of human nature. But this is not all. It has conferred upon mankind the greatest benefits, and may truly be considered as the grand improver and conductor of navigation.

The following treatise will be divided into four parts. In the *first* part, we shall give a sketch of the history of astronomy; in the *second*, we shall treat of the apparent motions of the heavenly bodies; in the *third*, of their real motions; and in the *fourth*, of gravitation, or of that general fact to which all their motions may be referred, and from which they proceed.

PART I. HISTORY OF ASTRONOMY.

History. THE antiquity of this science may be gathered from what was spoken by the Deity at the time of creating the celestial luminaries, "Let them be for signs and seasons," &c. whence it is thought probable that the human race never existed without some knowledge of astronomy among them. Indeed, besides the motives of mere curiosity, which of themselves may be supposed to have excited people to a contemplation of the glorious celestial canopy, as far as that was possible, it is easily to be seen that some parts of the science answer such essential purposes to mankind, that they could not possibly be dispensed with.

1 Astronomy supposed to be understood by Adam and the Antediluvians.

By some of the Jewish rabbins, Adam, in his state of innocence, is supposed to have been endowed with a knowledge of the nature, influence, and uses of the heavenly bodies; and Josephus ascribes to Seth and his posterity an extensive knowledge of astronomy. But whatever may be in this, the long lives of the Antediluvians certainly afforded such an excellent opportunity for observing the celestial bodies, that we cannot but suppose the science of astronomy to have been considerably advanced before the flood. Josephus says, that longevity was bestowed upon them for the very purpose of improving the sciences of geometry and astronomy. The latter could not be learned in less than 600 years: "for that period (says he) is the *grand year*." By which it is supposed he meant the period wherein the sun and moon came again into the same situation as they were in the beginning thereof, with regard to the nodes, apogee of the moon, &c. "This period (says Cassini), whereof we find no intimation in any monument of any other nation, is the finest period that ever was invented: for it brings out the solar year more exactly than that of Hipparchus and Ptolemy; and the lunar month within about one second of what is determined by modern astronomers. If the Antedilu-

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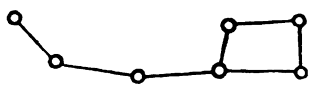
vians had such a period of 600 years, they must have known the motion of the sun and moon more exactly than their descendants knew them some ages after the flood."

2 Astronomical knowledge of the Chinese.

On the building of the tower of Babel, Noah is supposed to have retired with his children born after the flood, to the north-eastern part of Asia, where his descendants peopled the vast empire of China. "This (says Dr Long) may perhaps account for the Chinese having so early cultivated the study of astronomy; their being so well settled in an admirable police, and continuing so many hundred years as they did in the worship of the true God." The vanity of that people indeed has prompted them to pretend a knowledge of astronomy almost as early as the flood itself. Some of the Jesuit missionaries have found traditional accounts among the Chinese, of their having been taught this science by their first emperor Fo-hi, supposed to be Noah; and Kempfer informs us, that this personage discovered the motions of the heavens, divided time into years and months, and invented the twelve signs into which they divide the zodiac, which they distinguish by the following names.

3 Their names for the signs of the zodiac.

1. The mouse. 2. The ox or cow. 3. The tiger. 4. The hare. 5. The dragon. 6. The serpent. 7. The horse. 8. The sheep. 9. The monkey. 10. The cock or hen. 11. The dog; and, 12. The bear. They divide the heavens into 28 constellations, four of which are assigned to each of the seven planets; so that the year always begins with the same planet; and their constellations answer to the 28 mansions of the moon used by the Arabian astronomers. These constellations, in the Chinese books of astronomy, are not marked by the figures of animals, as was in use among the Greeks, and from them derived to the other European nations, but by connecting the stars by straight lines; and Dr Long informs us, that in a Chinese book in thin 4to, shown him by Lord Pembroke, the stars were represented by small circles joined by lines; so that the Great Bear would be marked thus,



To the emperor Hong-ti, the grandson of Noah, they attribute the discovery of the pole-star, the invention of the mariner's compass, of a period of 60 years, and some kind of sphere. This extraordinary antiquity, however, is with good reason suspected, as is likewise their knowledge in the calculation of eclipses; of which Du Halde assures us, that 36 are recorded by Confucius himself, who lived 551 years before Christ; and P. Trigault, who went to China in 1619, and read more than 100 volumes of their annals, says, "It is certain that the Chinese began to make astronomical observations soon after the flood; that they have observed a great number of eclipses, in which they have noted down the hour, day, month, and year, when they happened, but neither the duration nor the quantity; and that these eclipses have been made use of for regulating their chronology."

"But out of this abundance (says Dr Long), it is much to be regretted, that so very few of their observations have been particularized; for beside what has been mentioned above, we meet with no very ancient observations of the Chinese, except a winter solstice in the year 1111, and a summer solstice in the year 882, before Christ. Martini indeed speaks of a summer solstice 2342 years before that period. But M. Cassini, who calculated it, found that there must have been an error in the Chinese computation of 500 years at least. An error of equal magnitude appears to have been committed in the conjunction of the five planets, which it is pretended they observed between the years 2513 and 2435 before Christ. In short, some have supposed, that none of these are real observations, but the result of bungling calculations; and it has been hinted, but surely on too slight a foundation, that even those good fathers themselves were greatly to be suspected. But let us come to things which are not contested.

"P. Gaubil informs us, that at least 120 years before Christ, the Chinese had determined by observation the number and extent of their constellations as they now stand; the situation of the fixed stars with respect to the equinoctial and solstitial points; and the obliquity of the ecliptic. He farther says, he cannot tell by what means it is that they foretel eclipses: but this is certain, that the theory by which they do predict them was settled about the same time; and that they were acquainted with the true length of the solar year, the method of observing meridian altitudes of the sun by the shadow of a gnomon, and of learning from thence his declination and the height of the pole, long before. We learn, moreover, from the same missionary, that there are yet remaining among them some treatises of astronomy, which were written about 200 years before Christ, from which it appears, that the Chinese had known the daily motion of the sun and moon, and the times of the revolutions of the planets, many years before that period.

"We are informed by Du Halde, that, in the province of Honan, and city Teng-foang, which is nearly in the middle of China, there is a tower, on the top of which it is said that *Tcheou-cong*, the most skilful astronomer that ever China produced, made his observations. He lived 1200 years before Ptolemy, or more than 1000 years before Christ, and passed whole nights in observing the celestial bodies and arranging them into constellations. He used a very large brass table placed perfectly horizontal, on which was fixed a long upright plate of the same metal, both of which were divided into degrees, &c. By these he marked the meridian altitudes; and from thence derived the times of the solstices, which were their principal epocha."

Dr Long represents the state of astronomy in China as at present very low; occasioned, he says, principally by the barbarous decree of one of their emperors*, to have all the books in the empire burnt, excepting such as related to agriculture and medicine. We are informed, however, by the Abbe Grosier, in his description of China, that astronomy is cultivated in Pekin in the same manner as in most of the capital cities of Europe. A particular tribunal is established there, the jurisdiction of which extends to every thing relating to the observation of celestial phenomena. Its members are, an inspector; two presidents, one of them a Tartar and the other a Chinese; and a certain number of mandarins who perform the duty of assessors; but for near a century and a half the place of the Chinese president has been filled by an European. Since that time particular attention has been paid to the

* See *China*.

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the instruction of the astronomical pupils; and the presidents have always considered it as their duty to make them acquainted with the system and method of calculations made use of in Europe. Thus two-thirds of the astronomical pupils, maintained at the emperor's expence, in all about 200, have a tolerable notion of the state of the heavens, and understand calculation so well as to be able to compose ephemerides of sufficient exactness. The missionaries have never been the authors of any of these ephemerides: their employment is to revise the labours of the Chinese mathematicians, verify their calculations, and correct any errors into which they have fallen. The Portuguese mission still continues to furnish astronomers for the academy, as it did at the first.

The astronomical tribunal is subordinate to that of ceremonies. When an eclipse is to be observed, information must be given to the emperor of the day and hour, the part of the heavens where it will be, &c. and this intelligence must be communicated some months before it happens; the eclipse must also be calculated for the longitude and latitude of the capital city of every province of the empire. These observations, as well as the diagram which represents the eclipse, are preserved by the tribunal of ceremonies, and another called the *calao*, by whom it is transmitted to the different provinces and cities of the empire. Some days before the eclipse, the tribunal of ceremonies causes to be fixed upon a public place, in large characters, the hour and minute when the eclipse will commence, the quarter of the heavens in which it will be visible, with the other particulars relating to it. The mandarins are summoned to appear in state at the tribunal of astronomy, and to wait there for the moment in which the phenomenon will take place. Each of them carries in his hand a sheet of paper, containing a figure of the eclipse and every circumstance attending in. As soon as the observation begins to take place, they throw themselves on their kness, and knock their heads against the earth, and a horrid noise of drums and cymbals immediately commences throughout the whole city: a ceremony proceeding from an ancient superstitious notion, that by such a noise they prevented the luminary from being devoured by the celestial dragon; and though this notion is now exploded in China, as well as everywhere else, such is the attachment of the people to ancient customs, that the ceremonial is still observed. While the mandarins thus remain prostrated in the court, others, stationed on the observatory, examine, with all the attention possible, the beginning, middle, and end of the eclipse, comparing what they observe with the figure and calculations given. They then write down their observations, affix their seal to them, and transmit them to the emperor; who, on his part, has been no less assiduous to observe the eclipse with accuracy. A ceremonial of this kind is observed through the whole empire.

The Japanese, Siamese, and inhabitants of the Mogul's empire, have also, from time immemorial, been acquainted with astronomy; and the celebrated observatory at BENARES, is a monument both of the ingenuity of the people and of their skill in the science.

4 Indian astronomy.

Mr Bailly has been at great pains to investigate the progress of the Indians in astronomical knowledge, and gives a splendid account of their proficiency in the science, as well as of the antiquity of their observations. He has examined and compared four different astronomical tables of the Indian philosophers. 1. Of the Siamese, explained by M. Cassini in 1689. 2. Those brought from India by M. le Gentil of the Academy of Sciences. 3. and 4. Two other manuscript tables found among the papers of the late M. de Lisle. All of these tables have different epochs, and differ in form, being also constructed in different ways; yet they all evidently belong to the same astronomical system: the motions attributed to the sun and the moon are the same, and the different epochs are so well connected by the mean motions, as to demonstrate that they had only one, whence the others were derived by calculation. The meridians are all referred to that of Benares above mentioned. The fundamental epoch of the Indian astronomy is a conjunction of the sun and moon, which took place at no less a distance of time that 3102 years before the Christian era. Mr Bailly informs us, that, according to our most accurate astronomical tables, a conjunction of the sun and moon actually did happen at that time. But though the bramins pretend to have ascertained the places of the two luminaries at that time, it is impossible for us at this time to judge of the truth of their assertions, by reason of the unequal motion of the moon; which, as shall afterwards be more particularly taken notice of, now performs its revolution in a shorter time than formerly.

Our author informs us, that the Indians at present calculate eclipses by the mean motions of the sun and moon observed 5000 years ago; and with regard to the solar motion, their accuracy far exceeds that of the best Grecian astronomers. The lunar motions they had also settled, by computing the spaces through which that luminary had passed in 1,600,984 days, or somewhat more than 4383 years. They also make use of the cycle of 19 years attributed by the Greeks to Meton; and their theory of the planets is much better than that of Ptolemy, as they do not suppose the earth to be the centre of the celestial motions, and they believe that Mercury and Venus turn round the sun. Mr Bailly also informs us, that their astronomy agrees with the most modern discoveries of the decrease of the obliquity of the ecliptic, the acceleration of the motion of the equinoctial points, with many other particulars too tedious to enumerate in this place.

5 Astronomy of the Americans.

It appears also, that even the Americans were not unacquainted with astronomy, though they made use only of the solar, and not of the lunar motions, in their division of time. The Mexicans have had a strange predilection for the number 13. Their shortest periods consisted of 13 days; their cycle of 13 months, each containing 20 days; and their century of four periods of 13 years each. This excessive veneration for the number 13, according to Siguenza, arose from its being supposed the number of their greater gods. What is very surprising, though asserted as a fact by Abbé Clavigero, is that having discovered the excess of a few hours in the solar above the civil year, they made use of intercalary days, to bring them to an equality: but with this difference in regard to the method established by Julius Cæsar in the Roman calendar, that they did not interpose a day every four years, but 13 days (making use even here of this favourite num-

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ber) every 52 years, which produces the same regulation of time.

6
Of the Chaldeans and Egyptians.

Among those nations who first began to make any figure in ancient history, we find the Chaldeans and Egyptians most remarkable for their astronomical knowledge. Both of them pretended to an extravagant antiquity, and disputed the honour of having been the first cultivators of the science. The Chaldeans boasted of their temple of Belus; and of Zoroaster, whom they placed 5000 years before the destruction of Troy: the Egyptians boasted of their colleges of priests, where astronomy was taught; and of the monument of Osymandyas, in which we are told was a golden circle 365 cubits in circumference and one cubit thick. The upper face was divided into 365 equal parts, answering to the days of the year; and on every division were written the name of the day, and the heliacal rising of the several stars for that day, with the prognostications from their rising, principally, as Long conjectures, for the weather.

The Chaldeans certainly began to make observations very soon after the confusion of languages; for when Alexander the Great took Babylon, Calisthenes, by his order, inquired after the astronomical observations recorded in that city, and obtained them for 1903 years back. Nothing, however, now remains of the Chaldean astronomy, excepting some periods of years which they had formed for the more ready computation of the heavenly bodies. But though they must have laboured under great disadvantages for want of proper instruments, in those early ages, Gemina, as quoted by Petarius in his Uranologion, informs us, that they had determined, with tolerable exactness, the length both of a synodical and periodical month. They had also discovered that the motion of the moon was not uniform, and even attempted to assign those parts of her orbit in which it was quicker or slower. Ptolemy also assures us, that they were not unacquainted with the motion of the moon's nodes and that of her apogee, supposing that the former made a complete revolution in $6585\frac{1}{3}$ days, or 18 years 15 days and 8 hours; which period, containing 223 complete lunations, is called the Chaldean *Saros*. The same author also gives us, from Hipparchus, several observations of lunar eclipses which had been made at Babylon about 720 years before Christ; but though he might very probably meet with many of a more ancient date, it was impossible to mention them particularly, on account of the imperfect state of the Chaldean chronology, which commenced only with the era of Nabonassar, 747 years before Christ. Aristotle likewise informs us, that they had many observations of the occultations of fixed stars and planets by the moon; and from hence, by a very natural and easy inference, they were led to conclude that the eclipses of the sun were occasioned also by the moon, especially as they constantly happened when the latter was in the same part of the heavens with the sun. They had also a considerable share in arranging the stars into constellations. Nor had the comets, by which astronomers in all ages have been so much perplexed, escaped their observation: for both Diodorus Siculus and Appollinus Myndius, in Seneca, inform us, that many of the Chaldeans held these to be lasting bodies, which have stated revolutions as well as the planets, but in orbits vastly more extensive; on which account they are only seen by us while near the earth, but disappear again when they go into the higher regions. Others of them were of opinion, that the comets were only meteors raised very high in the air, which blaze for a while, and disappear when the matter of which they consist is consumed or dispersed. Dialling was also known among them long before the Greeks were acquainted with any such thing.

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It is evident, indeed, that the countries both of Chaldea and Egypt were exceedingly proper for astronomical observations, on account of the general purity and serenity of the air. The tower or temple of Belus, which was of an extraordinary height, with stairs winding round it up to the top, is supposed to have been an astronomical observatory; and the lofty pyramids of Egypt, whatever they were originally designed for, might possibly answer the same purpose. Indeed these very ancient monuments show the skill of this people in practical astronomy, as they are all situated with their four fronts exactly facing the cardinal points. Herodotus ascribes the Egyptian knowledge in astronomy to Sesostris, whom Sir Isaac Newton makes contemporary with Solomon; but if this was the case, he could not be the instructor of the Egyptians in astronomical matters, since we find that Moses, who lived 500 years before Solomon, was skilled in all the wisdom of the Egyptians, in which we are undoubtedly to include astronomy.

From the testimony of some ancient authors, we learn that they believed the earth to be spherical, that they knew the moon was eclipsed by falling into its shadow, and that they made their observations with the greatest exactness. They even pretended to foretel the appearance of comets, as well as earthquakes and inundations; which extraordinary knowledge is likewise ascribed to the Chaldeans. They attempted to measure the magnitude of the earth and sun; but the methods they took to find out the latter were very erroneous. It does not indeed appear with certainty that they had any knowledge of the true system of the universe; and by the time of the emperor Augustus, their astronomical knowledge was entirely lost.

From Chaldea the science of astronomy most probably passed into Phenicia; though some are of opinion that the Phenicians derived their knowledge of this science from the Egyptians. They seem, however, to have been the first who applied astronomy to the purposes of navigation; by which they became masters of the sea, and of almost all the commerce in the world. They became adventurous in their voyages, steering their ships by one of the stars of the Little Bear; which being near the immoveable point of the heavens called the *Pole*, is the most proper guide in navigation. Other nations made their observations by the Great Bear: which being too distant from the pole could not guide them in long voyages; and for this reason they never durst venture far from the coasts. 7 Of the Phenicians.

8
Astronomy of the Greeks.

The first origin of astronomical knowledge among the Greeks is unknown. Sir Isaac Newton supposes that most of the constellations were invented about the time of the Argonautic expedition: but Dr Long is of opinion that many of them must have been of a much older date; and that the shepherds, who were certainly

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certainly the first observers, gave names to them according to their fancy; from whence the poets invented many of their fables. Several of the constellations are mentioned by Hesiod and Homer, the two most ancient writers among the Greeks, who lived about 870 years before Christ: Hesiod desiring the farmer to regulate the time of sowing and harvest by the rising and setting of the Pleiades; and Homer informing us, that observations from the Pleiades, Orion, and Arcturus, were used in navigation. Their astronomical knowledge, however, was greatly improved by

9 Improved by Thales.

Thales the Milesian, who travelled into Egypt, and brought from thence the first principles of the science. He is said to have determined the height of the pyramids by measuring their shadows at the time the sun was 45 degrees high, and when of consequence the lengths of the shadows of objects are equal to their perpendicular heights. But his reputation was raised to the highest pitch among his countrymen, by the prediction of an eclipse, which happened just at the time that the armies of Alyattes king of Lydia, and Cyaxares the Mede, were about to engage; and being regarded as an evil omen by both parties, inclined them to peace. To him Callimachus attributes the forming of the constellation of the Little Bear; the knowledge of which he certainly introduced into Greece. He also taught the true length of the year; determined the cosmical setting of the Pleiades in his time to have been 25 days after the autumnal equinox; divided the earth into five zones by means of the polar circles and tropics; taught the obliquity of the ecliptic; and showed that the equinoctial is cut by the meridians at right angles, all of which intersect each other at the poles. He is also said to have observed the exact time of the solstices, and from thence to have deduced the true length of the solar year; to have observed eclipses of the sun and moon; and to have taught that the moon had no light but what she borrowed from the sun. According to Stanley, he also determined the diameter of the sun to be one-720th part of his annual orbit. "But (says Dr Long) these things should be received with caution. There are some reasons which might be assigned for supposing that the knowledge of Thales in these matters was much more circumscribed: and indeed it is not unreasonable to suppose, that that veneration for the ancients which leads authors to write professedly on the history of ancient times, may have induced them to ascribe full as much knowledge to those who lived in them as was really their due."

10 By Anaximander, &c.

The successors of Thales, Anaximander, Anaximenes, and Anaxagoras, contributed considerably to the advancement of astronomy. The first is said to have invented or introduced the gnomon into Greece; to have observed the obliquity of the ecliptic; and taught that the earth was spherical, and the centre of the universe, and that the sun was not less than it. He is also said to have made the first globe, and to have set up a sun-dial at Lacedemon, which is the first we hear of among the Greeks; though some are of opinion that these pieces of knowledge were brought from Babylon by Pherycides, a contemporary of Anaximander. Anaxagoras also predicted an eclipse which happened in the fifth year of the Peloponnesian war; and taught that the moon was habitable, consisting of hills, valleys, and waters, like the earth. His contemporary, Pythagoras, however, greatly improved not only astronomy and mathematics, but every other branch of philosophy. He taught that the universe was composed of four elements, and that it had the sun in the centre; that the earth was round, and had antipodes; and that the moon reflected the rays of the sun; that the stars were worlds, containing earth, air, and ether; that the moon was inhabited like the earth; and that the comets were a kind of wandering stars, disappearing in the superior parts of their orbits, and becoming visible only in the lower parts of them. The white colour of the milky-way he ascribed to the brightness of a great number of small stars; and he supposed the distances of the moon and planets from the earth to be in certain harmonic proportions to one another. He is said also to have exhibited the oblique course of the sun in the ecliptic and the tropical circles, by means of an artificial sphere; and he first taught that the planet Venus is both the evening and morning star. This philosopher is said to have been taken prisoner by Cambyses, and thus to have become acquainted with all the mysteries of the Persian magi; after which he settled at Crotona in Italy, and founded the Italian sect.

11 Doctrines of Pythagoras.

About 440 years before the Christian era, Philolaus, a celebrated Pythagorean, asserted the annual motion of the earth round the sun; and soon after Hicetas, a Syracusan, taught its diurnal motion on its own axis. About this time also flourished Meton and Euctemon at Athens, who took an exact observation of the summer solstice 432 years before Christ; which is the oldest observation of the kind we have, excepting what is delivered by the Chinese. Meton is said to have composed a cycle of 19 years, which still bears his name; and he marked the risings and settings of the stars, and what seasons they pointed out: in all which he was assisted by his companion Euctemon. The science, however, was obscured by Plato and Aristotle, who embraced the system afterwards called the *Ptolemaic*, which places the earth in the centre of the universe.

Eudoxus the Cnidian was a contemporary with Aristotle, though considerably older, and is greatly celebrated on account of his skill in astronomy. He was the first who introduced geometry into the science, and he is supposed to be the inventor of many propositions attributed to Euclid. Having travelled into Egypt in the earlier part of his life, and obtained a recommendation from Agesilaus to Nectanebus king of Egypt, he, by his means, got access to the priests, who had the knowledge of astronomy entirely among them, after which he taught in Asia and Italy. Seneca tells us that he brought the knowledge of the planetary motions from Egypt into Greece; and Archimedes, that he believed the diameter of the sun to be nine times that of the moon. He was also well acquainted with the method of drawing a sun-dial upon a plane; from whence it may be inferred that he understood the doctrine of the projection of the sphere: yet, notwithstanding what has been said concerning the observations of Eudoxus, it is not certain that his sphere was not taken from one much more ancient, ascribed to Chiron the Centaur. The reason given for this supposition is, that had the places of the stars been taken from his own observations, the constellations must have been half a sign farther advanced than they are said to be in his writings.

Soon

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Soon after Eudoxus, Calippus flourished, whose system of the celestial sphere is mentioned by Aristotle; but he is better known from a period of 76 years, containing four corrected metonic periods, and which had its beginning at the summer solstice in the year 330 before Christ. But about this time, or rather earlier, the Greeks having begun to plant colonies in Italy, Gaul, and Egypt, these became acquainted with the Pythagorean system, and the notions of the ancient Druids concerning astronomy. Julius Cæsar informs us, that the latter were skilled in this science; and that the Gauls in general were able sailors, which at that time they could not be without a competent knowledge of astronomy: and it is related of Pythoas, who lived at Marseilles in the time of Alexander the Great, that he observed the altitude of the sun at the summer solstice by means of a gnomon. He is also said to have travelled as far as Thule to settle the climates.

12 State of astronomy in Egypt after the death of Alexander.

After the death of Alexander the Great, science flourished in Egypt more than in any other part of the world; and a famous school was set up at Alexandria under the auspices of Ptolemy Philadelphus, a prince instructed in all kinds of learning, and the patron of all those who cultivated them; and this school continued to be the seminary of all kinds of literature, till the invasion of the Saracens in 650. Timocharis and Arystillus, who first cultivated the astronomical science in this school, began to put it on a new footing; being much more careful in their observations, and exact in noting down the times when they were made, than their predecessors. Ptolemy assures us, that Hipparchus made use of their observations, by means of which he discovered that the stars had a motion in longitude of about one degree in an hundred years; and he cites many of their observations, the oldest of which is before the erection of this school, in the year 295, when the moon just touched the northern star in the forehead of the Scorpion; and the last of them was in the 13th year of Philadelphus, when Venus hid the former star of the four in the left wing of Virgo.

From this time the science of astronomy continued greatly to advance. Aristarchus, who lived about 270 years before Christ, strenuously asserted the Pythagorean system, and gave a method of determining the distance of the sun by the moon's dichotomy. Eratosthenes, born at Cyrene in 271 B. C. determined the measure of a great circle of the earth by means of a gnomon. His reputation was so great, that he was invited from Athens to Alexandria by Ptolemy Euergetes, and made by him keeper of the royal library at that place. At his instigation the same prince set up those armillas or spheres, which Hipparchus and Ptolemy the astronomer afterwards employed so successfully in observing the heavens. He also found the distance between the tropics to be eleven such parts as the whole meridian contains eighty-three. About the same time Berosus a native of Chaldea, flourished at Athens. He is by some said to have brought many observations from Babylon, which are ascribed to the Greeks; while others contend, that the latter owe little or nothing of their astronomical knowledge to the Babylonians. The celebrated Archimedes, who next to Sir Isaac Newton holds the first place among mathematicians, was nothing inferior as an astronomer to what he was as a geometrician. He determined the distance of the moon from the earth, of Mercury from the moon, of Venus from Mercury, of the sun from Venus, of Mars from the sun, of Jupiter from Mars, and of Saturn from Jupiter; as likewise the distance of the fixed stars from the orbit of Saturn. That he made astronomical observations, is not to be doubted; and it appears from an epigram of the poet Claudian, that he invented a kind of planetarium, or orrery, to represent the phenomena and motions of the heavenly bodies.

13 Discoveries of Archimedes.

14 Of Hipparchus.

Hipparchus was the first who applied himself to the study of every part of astronomy, his predecessors having chiefly considered the motions and magnitudes of the sun and moon. Ptolemy also informs us, that he first discovered the orbits of the planets to be eccentric, and on this hypothesis wrote a book against Eudoxus and Calippus. He gives many of his observations: and says, that by comparing one of his with another made by Aristarchus 145 years before, he was enabled to determine the length of the year with great precision. Hipparchus also first found out the anticipation of the moon's nodes, the eccentricity of her orbit, and that she moved slower in her apogee than in her perigee. He collected the accounts of such ancient eclipses as had been observed by the Chaldeans and Egyptians. He formed hypotheses concerning the celestial motions, and constructed tables of those of the sun and moon, and would have done the same with those of the other planets if he could have found ancient observations sufficient for the purpose; but, these being wanting, he was obliged to content himself with collecting fit observations for that purpose, and endeavouring to form theories of the five planets. By comparing his own observations on the Spica Virginis with those of Timochares at Alexandria made 100 years before, he discovered that the fixed stars changed their places, and had a slow motion of their own from west to east. He corrected the Calippic period, and pointed out some errors in the method laid down by Eratosthenes for measuring the circumference of the earth. By means of geometry, which was now greatly improved, he was enabled to attempt the calculation of the sun's distance in a more correct manner than any of his predecessors; but unhappily it required so much accuracy in observation as was found impracticable. His greatest work, however, was his catalogue of the fixed stars, which he was induced to attempt by the appearance of a new star. The catalogue is preserved by Ptolemy, and contains the longitudes and latitudes of 1022 stars, with their apparent magnitudes. He wrote also concerning the intervals between eclipses both solar and lunar, and is said to have calculated all that were to happen for no less than 600 years from his time.

15 Makes the first catalogue of fixed stars.

16 System of Ptolemy.

Little progress was made in astronomy from the time of Hipparchus to that of Ptolemy, who flourished in the first century. The principles on which his system is built are indeed erroneous: but his work will always be valuable on account of the number of ancient observations it contains. It was first translated out of the Greek into Arabic in the year 827, and into Latin from the Arabic in 1230. The Greek original was unknown in Europe till the beginning of the 15th century,

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History. century, when it was brought from Constantinople, then taken by the Turks, by George a monk of Trapezond, who translated it into Latin. Various editions were afterwards published: but little or no improvement was made by the Greeks in this science.

17 Astronomy of the Arabians.

During the long period from the year 800 to the beginning of the 14th century, the western parts of Europe were immersed in deep ignorance and barbarity. However, several learned men arose among the Arabians. The caliph Al Mansur was the first who introduced a taste for the sciences in his empire. His grandson Al Mamun, who ascended the throne in 814, was a great encourager of the sciences, and devoted much of his own time to the study of them. He made many astronomical observations himself, and determined the obliquity of the ecliptic to be 23° 35′. He employed many able mechanics in constructing proper instruments, which he made use of for his observations; and under his auspices a degree of the earth was measured a second time in the plain of Singar, on the border of the Red sea. From this time astronomy was studiously cultivated by the Arabians; and Elements of Astronomy were written by Alferganus, who was partly cotemporary with the caliph Al Mamun. But the most celebrated of all their astronomers is Albategnius, who lived about the year of Christ 880. He greatly reformed astronomy, by comparing his own observations with those of Ptolemy. Thus he calculated the motion of the sun's apogee from Ptolemy's time to his own; determined the precession of the equinoxes to be one degree in 70 years; and fixed the sun's greatest declination at 23.35′. Finding that the tables of Ptolemy required much correction, he composed new ones of his own fitted to the meridian of Aracta, which were long held in estimation by the Arabians. After his time, though several eminent astronomers appeared among the Saracens, none made any very valuable observations for several centuries, excepting Ebn Younis astronomer to the caliph of Egypt; who observed three eclipses with such care, that by means of them we are enabled to determine the quantity of the moon's acceleration since that time.

Other eminent Saracen astronomers were, Arzachel a Moor of Spain, who observed the obliquity of the ecliptic, and constructed tables of sines, or half chords of double arcs, dividing the diameter into 300 parts; and Alhazen, his cotemporary, who first showed the importance of the theory of refractions in astronomy; writing also upon the twilight, the height of the clouds, and the phenomenon of the horizontal moon.

Ulug Beg, a grandson of the famous Tartar prince Timur Beg, or Tamerlane, was a great proficient in practical astronomy. He is said to have had very large instruments for making his observations; particularly a quadrant as high as the church of Sancta Sophia at Constantinople, which is 180 Roman feet. He composed astronomical tables from his own observations for the meridian of Samarcand his capital, so exact as to differ very little from those afterwards constructed by Tycho Brahe; but his principal work is his catalogue of the fixed stars, made from his own observations in the year of Christ 1437. The accuracy of his observations may be gathered from his determining the height of the pole at Samarcand to be 39° 37′ 23″.

Besides these improvements, we are indebted to the Arabians for the present form of trigonometry. Menelaus, indeed, an eminent Greek astronomer who flourished about the year 90, had published three books of Spherics, in which he treated of the geometry necessary to astronomy, and which show great skill in the sciences; but his methods were very laborious, even after they had been improved and rendered more simple by Ptolemy: but Geber the Arabian, instead of the ancient method, proposed three or four theorems, which are the foundation of our modern trigonometry. The Arabians also made the practice still more simple, by using sines instead of the chords of double arcs. The arithmetical characters they had from the Indians. 18

Revival of astronomy in Europe.

During the greatest part of this time, almost all Europe continued ignorant not only of astronomy but of every other science. The emperor Frederick II. first began to encourage learning in 1230; restoring some universities, and founding a new one in Vienna. He also caused the works of Aristotle, and the Almagest or Astronomical Treatise of Ptolemy, to be translated into Latin; and from the translation of this book we may date the revival of astronomy in Europe. Two years after its publication, John de Sacro Bosco, or of Halifax, an Englishman, wrote his four books *De Sphæra*, which he compiled from Ptolemy Albategnius, Alferganus, and other Arabian astronomers: this work was so much celebrated, that for 300 years it was preferred in the schools to every other; and has been thought worthy of several commentaries, particularly by Clavius in 1531. In 1240, Alphonso king of Castile caused the tables of Ptolemy to be corrected: for which purpose he assembled many persons skilled in astronomy, Christians, Jews, and Moors; by whom the tables called *Alphonsine* were composed, at the expence of 40,000, or according to others 400,000 ducats. About the same time Roger Bacon, an English monk, published many things relative to astronomy; particularly of the places of the fixed stars, solar rays, and lunar aspects. Vitellio, a Polander, wrote a treatise on Optics about 1270, in which he showed the use of refractions in astronomy. 19

Improvements of Purbach.

From this time to that of Purbach, who was born in 1423, few or no improvements were made in astronomy. He wrote a commentary on Ptolemy's Almagest, some treatises on Arithmetic and Dialling, with tables for various climates. He not only used spheres and globes, but constructed them himself; and formed new tables of the fixed stars, reduced to the middle of that age. He composed also new tables of sines for every ten minutes, which Regiomontanus afterwards extended to every single minute, making the whole sine 60, with 6 ciphers annexed. He likewise corrected the tables of the planets, making new equations to them, because the Alphonsine tables were very faulty in this respect. In his solar tables he placed the sun's apogee in the beginning of Cancer; but retained the obliquity of the ecliptic 23° 33½′, to which it had been reduced by the latest observations. He made new tables for computing eclipses, of which he observed some, and had just published a theory of the planets, when he died in 1461. 20

Of Regiomontanus.

John Muller of Monteregio (Koningsberg), a town of Franconia, from whence he was called *Regiomontanus*,

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nus, was the scholar and successor of Purbach. He completed the epitome of Ptolemy's Almagest which Purbach had begun; and after the death of the latter, went to Rome, where he made many astronomical observations. Having returned to Nuremberg in 1471, he was entertained by a wealthy citizen named *Bernard Walther*, who having a great love for astronomy, caused several instruments to be made under the direction of Regiomontanus, for observing the altitude of the sun and stars, and other celestial phenomena. Among these was an armillary astrolabe, like that which had been used by Hipparchus and Ptolemy at Alexandria, and with which many observations were made. He also made ephemerides for 30 years to come, showing the lunations, eclipses, &c. He wrote the Theory of the Planets and Comets, and a Treatise of Triangles yet in repute for several extraordinary cases. He is said to have been the first who introduced the use of tangents into trigonometry; and to have published in print (the art of printing having been lately invented) the works of many of the most celebrated ancient astronomers. After his death, which happened at Rome, Walther made a diligent search for all his instruments and papers which could be found: and continued his observations with the instruments he had till his death. The observations of both were collected by order of the senate of Nuremberg, and published there by John Schoner in 1544; afterwards by Snellius at the end of the Observations made by the landgrave of Hesse in 1618; and lastly, in 1666, with those of Tycho Brahe. Walther, however, as we are told by Snellius, found fault with his armilla, not being able to give any observation with certainty to less than ten minutes. He made use of a good clock, which also was a late invention in those days.

21 Of Werner.

John Werner, a clergyman, succeeded Walther as astronomer at Nuremberg; having applied himself with great assiduity to the study of that science from his infancy. He observed the motion of the comet in 1500; and published several tracts, in which he handled many capital points of geometry, astronomy, and geography, in a masterly manner. He published a translation of Ptolemy's Geography, with a commentary, which is still extant. In this he first proposed the method of finding the longitude at sea by observing the moon's distance from the fixed stars; which is now so successfully put in practice. He also published many other treatises on mathematics and geography; but the most remarkable of all his treatises, are those concerning the motion of the eighth sphere or of the fixed stars, and a short theory of the same. In this he showed, by comparing his own observations of the stars Regulus, Spica Virginis, and the bright star in the southern scale of the Balance, made in 1514, with the places assigned to the same stars by Ptolemy, Alphonsus, and others, that the motion of the fixed stars, now called *the precession of the equinoctial points*, is one degree ten minutes in 100 years, and not one degree only, as former astronomers had made it. He made the obliquity of the ecliptic 23° 28′, and the first star of Aries 26° distant from the equinoctial point. He also constructed a planetarium representing the celestial motions according to the Ptolemaic hypothesis, and made a great number of meteorological observations with a view towards the prediction of the weather. The obliquity of the ecliptic was settled by Dominic Maria the friend of Copernicus, at 23° 29′, which is still held to be just.

22 Pythagorean syst restored Copernic

The celebrated Nicholas Copernicus next makes his appearance, and is undoubtedly the great reformer of the astronomical science. He was originally bred to the practice of medicine, and had obtained the degree of doctor in that faculty: but having conceived a great regard for the mathematical sciences, especially astronomy, he travelled into Italy, where he for some time was taught by Dominic Maria, or rather assisted him in his astronomical operations. On his return to his own country, being made one of the canons of the church, he applied himself with the utmost assiduity to the contemplation of the heavens, and to the study of the celestial motions. He soon perceived the deficiency of all the hypotheses by which it had been attempted to account for these motions; and for this reason he set himself to study the works of the ancients, with all of whom he also was dissatisfied excepting Pythagoras; who, as has been already related, placed the sun in the centre, and supposed all the planets, with the earth itself, to revolve round him. He informs us, that he began to entertain these notions about the year 1507; but not being satisfied with stating the general nature of his hypothesis, he became desirous of determining the several periodical revolutions of the planets, and thence of constructing tables of their motions which might be more agreeable to truth than those of Ptolemy and Alphonsus. The observations he was enabled to make, however, must have been extremely inaccurate: as he tells us, that if with the instruments he made use of he should be able to come within ten minutes of the truth, he would rejoice no less than Pythagoras did when he discovered the proportion of the hypothenuse to the other two sides of a right-angled triangle. His work was completed in the year 1530; but he could not be prevailed upon to publish it till towards the end of his life, partly through diffidence, and partly through fear of the offence which might be taken at the singularity of the doctrines set forth in it. At last, overcome by the importunities of his friends, he suffered it to be published at their expence, and under the inspection of Schoner and Osiander, with a dedication to Pope Paul III. and a preface, in which it was attempted to palliate as much as possible the extraordinary innovations it contained. During the time of its publication the author himself was attacked with a bloody flux, succeeded by a palsy; so that he received a copy only a few hours before his death, which happened on the 23d of May 1543.

After the death of Copernicus, the astronomical science was greatly improved by Schoner, Nonius, Appian, and Gemma Frisius. Schoner survived Copernicus only four years; however, he greatly improved the methods of making celestial observations, reformed and explained the calendar, and published a treatise of cosmography. Nonius had applied himself very early to the study of astronomy and navigation; but finding the instruments at that time in use excessively inaccurate, he applied himself to the invention of others which should be less liable to inconvenience. Thus he invented the astronomical quadrant, in which he divided the degrees into minutes by a number of concentric circles.

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circles. The first of these was divided into 90 equal parts, the second into 89, the third into 88, and so on, as low as 46; and thus, as the index of the quadrant would always fall upon one or other of the divisions, or very near it, the minutes might be known by computation. He published many treatises on mathematical subjects, particularly one which detected the errors of Orontius, who had imagined that he could square the circle, double the cube, &c. by finding two mean proportionals betwixt two right lines. Appian's chief work was entitled *The Cæsarean Astronomy;* and was published at Ingolstadt in 1540, dedicated to the emperor Charles V. and his brother Ferdinand. In this he showed how to resolve astronomical problems by means of instruments, without either calculations or tables; to observe the places of the stars and planets by the astrolabe; and to foretel eclipses and describe the figures of them: the whole illustrated by proper diagrams. In his second book he describes the method of dividing an astronomical quadrant, and of using it properly. His treatise concludes with the observation of five comets. Gemma Frisius wrote a commentary on a work of Appian entitled his *Cosmography*, with many observations of eclipses. He invented also the astronomical ring, and several other instruments, which, though they could not boast of much exactness superior to others, were yet of considerable utility in taking observations at sea; and he is also memorable for being the first who proposed a time-keeper for determining the longitude at sea.—George Joachim Rheticus was a scholar of Copernicus, to attend whose lectures he gave up his professorship of mathematics at Wittemberg. For the improvement of astronomical calculations, he began to construct a table of sines, tangents, and secants, for every minute and ten seconds of the quadrant. In this work he first showed the use of secants in trigonometry, and greatly enlarged the use of tangents, first invented by Regiomontanus; but he assigned for the radius a much larger number of places than had been done before, for the greater exactness of calculation. This great work he did not live to accomplish; but it was completed by his disciple Valentine Otho, and published at Heidelberg in 1594.

23
Several illustrious persons apply to the study of astronomy.

During this century, the list of astronomers was dignified by some very illustrious names. About the year 1561, William IV. landgrave of Hesse Cassel, applied himself to the study of astronomy. With the assistance of Rothman and Burgius, the former an astronomer, the latter an excellent mathematical instrument-maker, he erected an observatory on the top of his palace at Cassel, and furnished it with such instruments as were then in use, made in the best manner the artists of that age could execute. With these he made a great number of observations, which were by Hevelius preferred to those of Tycho Brahe, and which were published by Snellius in 1618. From these observations he determined the longitudes and latitudes of 400 stars, which he inserted in a catalogue where their places are rectified to the beginning of the year 1593.

24
Observations of Tycho Brahe.

Tycho Brahe began his observations about the same time with the landgrave of Hesse, already mentioned. He observed the great conjunction of Saturn and Jupiter in 1563; and finding the instruments he could procure very inaccurate, he made a quadrant capable of showing single minutes, and likewise a sextant four cubits radius. In 1571, he discovered a new star in the chair of Cassiopeia; which induced him, like Hipparchus, to make a catalogue of the stars. This contained the places of 777 stars, rectified to the year 1600; but instead of the moon, which was used by the ancients to connect the places of the sun and stars, Tycho substituted Venus, as having little or no parallax, and yet being like the moon visible both day and night. By the recommendation of the landgrave of Hesse, he obtained from the king of Denmark the island of Huenna, opposite to Copenhagen, where an observatory was built. The first stone of this building, afterwards called *Uraniburg*, was laid in the year 1576. It was of a square form, one side of it being about 60 feet in length; and on the east and west sides were two round towers of 32 feet diameter each. The instruments were larger and more solid than had ever been seen before by any astronomer. They consisted of quadrants, sextants, circles, semicircles, armillæ both equatorial and zodiacal, parallactic rulers, rings, astrolabes, globes, clocks, and sun-dials. These instruments were so divided as to show single minutes; and in some the arch might be read off to 10 seconds. Most of the divisions were diagonal: but he had one quadrant divided according to the method invented by Nonius; that is, by 47 concentric circles. The whole expence is said to have amounted to 200,000 crowns. The method of dividing by diagonals, which Tycho greatly admired, was the invention of Mr Richard Chanceler, an Englishman: Tycho, however, shows, that it is not accurately true when straight lines are employed, and the circles at equal distances from each other; but that it may be corrected by making circular diagonals, which if continued would pass through the centre.

25
Account of Uraniburg, his observatory.

Tycho employed his time at Uraniburg to the best advantage; but falling into discredit on the death of the king, he was obliged to remove to Holstein, and at last found means to get himself introduced to the emperor, with whom he continued to his death. He is well known to have been the inventor of a system of astronomy, which bears his name; and which he vainly endeavoured to establish on the ruins of that of Copernicus: but the simplicity and evident consonancy to the phenomena of nature, displayed in all parts of the Copernican system, soon got the better of the unnatural and complicated system of Tycho. His works, however, which are very numerous, discover him te have been a man of vast abilities. After his death the castle of Uraniburg quickly fell to decay, and indeed seems to have been purposely pulled down; for, in 1652, when Mr Huet went to Sweden, it was almost level with the ground, and few traces of the walls could be discerned. None of the neighbouring inhabitants had ever heard of the name of Tycho or Uraniburg, excepting one old man, whom Mr Huet found out with great difficulty, and who had been a servant in the family! All the discoveries of Purback, Regiomontanus, and Tycho, were collected and published in the year 1621, by Longomontanus, who had been Tycho's favourite scholar.

26
Discoveries of Kepler.

While Tycho resided at Prague with the emperor, he invited thither John Kepler, afterwards so famous for his discoveries. Under the tuition of so great an astronomer, the latter quickly made an amazing progress.

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progress. He found that his predecessors had erred in supposing the orbits of the planets to be circular, and their motions uniform: on the contrary, he perceived, from his own observations, that they were elliptical, and their motions unequal, having the sun in one of the foci of their orbits; but that, however they varied in absolute velocity, a line drawn from the centre of the sun to the planet, and revolving with it, would always describe equal areas in equal times. He discovered, in the year 1618, that the squares of the periodical times are as the cubes of the distances of the planets; two laws which have been of the greatest importance to the advancement of astronomy. He seems to have had some notion of the extensive power of the principle of gravity: for he tells us, that gravity is a mutual power betwixt two bodies; that the moon and earth tend towards each other, and would meet in a point nearer the earth than the moon in the proportion of the superior magnitude of the former, were they not hindered by their projectile motions. He adds also, that the tides arise from the gravitation of the waters towards the moon: however, he did not adhere steadily to these principles, but afterwards substituted others as the causes of the planetary motions.

Cotemporary with Kepler were Mr Edward Wright, and Napier baron of Merchiston. To the former we owe several very good meridional observations of the sun's altitude, made with a quadrant of six feet radius, in the years 1594, 1595, and 1596; from which he greatly improved the theory of the sun's motion, and computed more exact tables of his declination than had been done by any person before. He published also, in 1599, an excellent treatise, entitled, "Certain Errors in Navigation discovered and detected." To the latter we are indebted for the knowledge of logarithms; a discovery, as was justly observed by Dr Halley, one of the most useful ever made in the art of numbering. John Bayer, a German, who lived about the same time, will ever be memorable for his work, entitled, *Uranometria*, which is a very complete celestial atlas, or a collection of all the constellations visible in Europe. To this he added a nomenclature, in which the stars in each constellation are marked with the letters of the Greek alphabet; and thus every star in the heavens may be referred to with the utmost precision and exactness. About the same time also, astronomy was cultivated by many other persons; abroad, by Maginus, Mercator, Maurolycus, Homelius, Schultet, Stevin, &c.; and by Thomas and Leonard Digges, John Dee, and Robert Flood, in England: but none of them made any considerable improvement.

27 **Invention of telescopes, and consequent discoveries.**

The beginning of the 17th century was distinguished not only by the discovery of logarithms, but by that of telescopes; a sort of instruments by which astronomy was brought to a degree of perfection utterly inconceivable by those who knew nothing of them. The question concerning the inventor is discussed under the article OPTICS; but whoever was entitled to this merit, it is certain that Galileo was the first who brought them to such perfection as to make any considerable discoveries in the celestial regions. With instruments of his own making, Galileo discovered the inequalities in the moon's surface, the satellites of Jupiter, and the ring of Saturn; though this last was unknown to him after he had seen it, and the view he got made him conclude that the planet had a threefold body, or that it was of an oblong shape like an olive. He discovered spots on the sun, by means of which he found out the revolution of that luminary on his axis; and he discovered also that the milky way and nebulæ were full of small stars. It was not, however, till some time after these discoveries were made, that Galileo and others thought of applying the observations on Jupiter's satellites to the purpose of finding the longitude of places on the surface of the earth; and even after this was thought of, astronomers found it so difficult to construct tables of their motions, that it was not till after many observations had been made in distant places of the world, that Cassini was able to determine what positions of the satellites were most proper for finding out the longitude. At last he perceived that the entrance of the first satellite into the shadow of Jupiter, and the exit of it from the same, were the most proper for this purpose: that next to these the conjunctions of the satellites with Jupiter, or with one another, may be made use of; especially when any two of them, moving in contrary directions, meet with each other: and lastly, that observations on the shadows of the satellites, which may be seen on the disk of Jupiter, are useful, as also the spots which are seen upon his face, and are carried along it with greater velocity than has hitherto been discovered in any of the other heavenly bodies.

28 **Logarithmic tables composed.**

While astronomers were thus busy in making new discoveries, the mathematicians in different countries were no less earnestly employed in constructing logarithmic tables to facilitate their calculations. Benjamin Ursinus, an excellent mathematician of Brandenburg, calculated much larger tables of logarithms than had been done by their noble inventor, and published them in 1625. They were improved by Henry Briggs, Savilian professor of Oxford; who by making unity the logarithm of ten, thus rendered them much more convenient for the purposes of calculation. Logarithmic tables of sines and tangents were also composed by Mr Briggs and Adrian Vlacq at Goude, so that the business of calculation was now rendered nearly as easy as possible.

29 **Transit of Venus first observed by Mr Horrox.**

In 1733, Mr Horrox, a young astronomer of very extraordinary talents, discovered that Venus would pass over the disk of the sun on the 24th of November 1639. This event he announced only to one friend, a Mr Crabtree; and these two were the only persons in the world who observed this transit the first time it had ever been viewed by human eyes. Mr Horrox made many useful observations at the time; and had even formed a new theory of the moon, so ingenious as to attract the notice of Sir Isaac Newton: but the hopes of astronomers from the abilities of this excellent young man were blasted by his death in the beginning of January 1640.

30 **Foundation of the Academy of Sciences at Paris and Royal Society at London.**

About the year 1638 many learned men began to assemble at Paris in order to hold conferences on different scientific subjects, which was the first foundation of the Royal Academy of Sciences in that capital. This practice was introduced in France by Mersennus, and soon after at London by Oldenburg; which laid the foundation of the Royal Society there. About this time also the celebrated astronomer Hevelius flourished at Dantzic, building an observatory in his own house,

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house, and furnishing it with excellent instruments of his own construction; particularly octants and sextants of brass of three and four feet radius, as well as telescopes, with which he constantly observed the spots and phases of the moon, and from which observations he afterwards compiled his excellent and beautiful work entitled *Selenographia*. This noble building, together with all the books and instruments it contained, was consumed by fire on the 26th of September 1679; but the memory, as well as the form and construction of the instruments, is preserved in a curious work of the ingenious inventor, entitled *Machina Cœlestis;* though almost the whole impression of this book was involved in the same fate with the instruments it describes. The damage sustained on this occasion was estimated at 30,000 crowns.

The celebrated English mechanic Dr Hooke, who was cotemporary with Hevelius, had in the mean time invented instruments with telescopic sights, which he preferred to those used by Hevelius so much, that a dispute commenced, which procured Hevelius a visit from Dr Halley. The latter had at that time taken a voyage to St Helena, at the desire of the Royal Society, in order to observe and form a catalogue of the stars in the southern hemisphere. The result of his observations with Hevelius's instruments was, that three several observations on the Spica Virginis and Regulus differed only a few seconds from each other. They were the invention of Tycho Brahe, and are described under the article OPTICS. At this visit Halley and Hevelius observed an occultation of Jupiter by the moon, and determined the diameter of the latter to be 30′, 33″.

In 1671 the royal observatory in Paris was finished, and the use of it assigned to Mr Cassini, after it had been furnished with instruments at a very great expence: and the observatory at Greenwich being likewise built five years after, Mr Flamstead was appointed astronomer-royal. The observations in both these places, however, have been so numerous, that it is in vain to attempt any account of them.

31
Improvements in telescopes.

Before the middle of the 17th century the construction of telescopes had been greatly improved, particularly by Fontana and Huygens. The latter constructed one of 123 feet, which is still preserved in the museum of the Royal Society at London. With this he observed the moon and planets for a long time, and discovered that Saturn was encompassed with a ring. The French, however, still outdid the English artists; and by means of telescopes of 200 and 300 feet focus, Mr Cassini was enabled to see all the five satellites of Saturn, his belts, and the shadows of Jupiter's satellites passing over his body. In 1666 Mr Azout applied a micrometer to telescopes, for the purpose of measuring the diameters of the planets, and small distances in the heavens; however, an instrument of this kind had been before invented by Mr Gascoigne, though it was but little known abroad.

Notwithstanding all these discoveries by means of telescopes, it was evident that they still continued in a very imperfect state, and their imperfections at the time appeared to be without remedy. One defect was the enormous length requisite to admit of any very considerable magnifying power; and another was the incorrectness of the image arising from the aberration of the rays, as was then supposed, by the spherical figure of the glass. To obviate these inconveniences, Mersennus is said to have first proposed, in a letter to Descartes, the use of reflectors instead of lenses in the construction of telescopes; but this he did in such an obscure manner, that the latter laboured to persuade him of the falsehood of the principle on which his scheme was founded. In 1663, however, James Gregory of Aberdeen showed how such a telescope might be constructed. He showed also, that, in order to form a perfect image of an object in this manner, the figure of the speculum ought to be parabolic; but Sir Isaac Newton, who applied himself to the framing of telescopes of the reflecting kind, found it impracticable to grind them of the desired figure. Laying aside the idea of reflecting telescopes, therefore, he applied himself to the execution of a scheme formed by Descartes, viz. that of grinding lenses of the figure of one of the conic sections. In prosecuting this plan, he discovered, that the greatest errors to which telescopes were subject arose from the different refrangibility of the rays of light, for which he could not then find any remedy. He therefore returned to the scheme he had just abandoned; and, in the year 1672, presented to the Royal Society two reflectors which were constructed with spherical speculums, as he could not procure any other. The inconveniences arising from the different refrangibility of the rays of light, have since been in the fullest manner corrected by Mr Dollond, the excellency of whose achromatic telescopes is too well known to need any encomium.

About the beginning of the 18th century, the practical part of astronomy seemed to languish for want of proper instruments. Roemer, indeed, had invented some new ones, and Dr Hooke had turned his attention towards this subject in a very particular manner; but either through want of skill in the artists, or some other unfortunate circumstance, it happened that nothing effectual was done. But at the very time when this was the case with practical astronomy, the speculative part was carried in a manner to its utmost pitch by the labours of the immortal Newton, whose Principia gave an entire new face to the science. It was not, however, for many years relished by the foreign philosophers, though almost immediately adopted at home, and has continued ever since to spread its reputation farther and farther, so that now it is in a manner established all over the world. "But (says Dr Long) that, after Newton's system had for so long a time been neglected, it should all at once be universally received and approved of, is not to be attributed to chance, or the caprice of fashion, as some who are ignorant of it are apt to think, and from thence to expect that some other system will hereafter take its place, and bury it in oblivion. The system of Newton, like that of Copernicus, is so agreeable to the phenomena of nature, and so well put together, that it *must* last as long as truth and reason endure, although some may perhaps bring the word attraction into disuse; and though it may no longer be thought inherent in matter, yet the laws of gravitation, as they are now called, and on which this system is founded, will never be forgotten."

It was also in Britain that the first improvements in astronomical instruments took place. The celebrated

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mechanic and watchmaker, Graham, carried the accuracy of his instruments to a degree which surprised every one.

32 Astronomical instruments first improved in England.

He also greatly improved the principles of watch-work, and made clocks to go with much greater regularity than before. The old eight-feet mural arch at Greenwich was also constructed by him; as was a small equatorial sector for making observations out of the meridian; but he is chiefly remarkable for contriving the zenith sector of 24 feet radius, and afterwards one of $12\frac{1}{2}$ feet, by which Dr Bradley discovered the aberration of the fixed stars. The reflecting telescope, which had been invented by Gregory, and executed by Newton, was greatly improved by Mr Hadley, and a very complete and powerful instrument of that kind was presented to the Royal Society in 1719. The same gentleman has also immortalized his memory by the invention of the reflecting quadrant, which he presented to the Society in 1731, which is now in universal use at sea; and without which all improvements of the lunar theory would have been useless for determining the longitude, through the want of an instrument proper to make the observations with. It however appears, that an instrument, exactly similar to this in its principles, had been invented by Sir Isaac Newton, and a description of it, together with a drawing, given by the inventor to Dr Halley, when he was preparing for his voyage to discover the variation of the needle in 1701. About the middle of this century, the constructing and dividing of large astronomical instruments was carried to a great degree of perfection by Mr John Bird; reflecting telescopes were equally improved by Mr Short, who first executed the divided object-glass micrometer. This had indeed been thought of by M. Louville, and several other persons long before; and a description of one nearly agreeing with that of Mr Short had been published in the Philosophical Transactions for 1753: but had it not been for the great skill of Mr Short in figuring and centering glasses of this kind, it is very probable the scheme might never have been executed. About this time also Mr Dollond brought refracting telescopes to such perfection, that they became superior to reflectors of equal length; though all of them are now excelled by those of Mr Herschel, whose telescopic discoveries have been far more numerous and surprising than those of any other astronomer.

33 Improvements within this last century.

We shall close this history with a short account of the labours of the principal astronomers since the building the royal observatories at Paris and Greenwich, and the appointment of Mr Flamstead to the office of astronomer royal. This gentleman not only made observations on the sun, moon, planets, and comets which appeared in his time, but on the fixed stars also, of which he gave a catalogue of 3000; many of them so small that they cannot be discerned without the help of a telescope: he also published new solar tables, and a theory of the moon according to Horrox. He published a very curious tract on the doctrine of the sphere, in which he shewed how to construct eclipses of the sun and moon, as well as occultations of the fixed stars by the moon, geometrically; and it was upon his observations that Halley's tables and Newton's theory of the moon were constructed. Mr Cassini also distinguished himself very considerably. He erected the gnomon, and drew the famous meridian line in the church of Petronia at Bologna. He enjoyed his office more than 40 years, making many observations on the sun, moon, planets, and comets, and greatly amended the elements of their motions; though the result of his labours was much inferior to Mr Flamstead's. The office was continued in his family, and his grandson still enjoys it. Rœmer, a celebrated Danish astronomer, first discovered the progressive motion of light by observing the eclipses of Jupiter, and read a dissertation upon it before the Royal Academy of Sciences at Paris in the year 1675. He was also the first who made use of a meridional telescope.

Mr Flamstead was succeeded in 1719 by Dr Halley, "the greatest astronomer (says M. de la Lande) without contradiction in England;" and, adds Dr Long, "I believe he might have said in the whole world." He had been sent, at the age of 21, by King Charles II. to the island of St Helena, in order to make a catalogue of the southern stars, which was published in 1679. In 1705, he published his *Synopsis Astronomiæ Cometicæ*, in which, after immense calculation, he ventured to predict the return of one in 1758 or 1759. He also published many learned dissertations in the Philosophical Transactions concerning the use that might be made of the next transit of Venus in determining the distance of the sun from the earth. He was the first who discovered the acceleration of the moon, and gave a very ingenious method of finding her parallax by three observed phases of a solar eclipse. He composed tables of the sun, moon, and all the planets; and, in the nine years in which he was at Greenwich, made near 1500 observations of the moon; all which he compared with the tables, and noted the differences; and these, he thought, would return in about 18 years. He recommended the method of determining the longitude by means of the moon's distance from the sun and certain fixed stars. He was convinced of its superior excellence; and it has since been adopted by all the most eminent astronomers in Europe. It is at present the only sure guide to the mariner; and the great perfection to which it is now brought is much owing to the industry and exertions of Dr Maskelyne, the present astronomer-royal, to whom we are indebted for the publication of the Nautical Almanack, the Requisite Tables, and other works of the utmost service to practical astronomy.

34 True figure of the earth discovered.

In the mean time an attempt was made in France to measure a degree of the earth, which occasioned a very warm dispute concerning the figure of it. Cassini, from Picart's measure, concluded that the earth was an oblong spheroid; but Newton, from a consideration of the laws of gravity and the diurnal motion of the earth, had determined the figure of it to be an oblate spheroid, and flatted at the poles. To determine this point, Louis XV. resolved to have two degrees of the meridian measured; one under, or very near the equator; and the other as near the pole as possible. For this purpose the Royal Academy of Sciences sent M. Maupertuis, Clairault, Camus, and Le Monier, to Lapland. They were accompanied by the abbé Outhier, a correspondent of the same academy. They were joined by M. Celsius professor of anatomy at Upsal; and having set out from France in the spring of the year 1736, returned to it in 1737, after having fully

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fully accomplished their errand. On the southern expedition were despatched M. Godin, Condamine, and Bouguer, to whom the king of Spain joined Don George Juan and Don Anthony de Ulloa, two very ingenious gentlemen and officers of the marine. They left Europe in 1735; and after enduring innumerable hardships and difficulties in the execution of their commission, returned to Europe at different times, and by different ways, in the years 1744, 1745, and 1746. The result of this arduous task was a confirmation of Newton's investigation. Picart's measure was revised by Cassini and De la Caille; and, after his errors were corrected, it was found to agree very well with the other two. On this occasion too it was discovered, that the attraction of the great mountains of Peru had an effect on the plumb-line of one of their largest instruments, drawing it seven or eight seconds from the true perpendicular.

Dr Halley, dying in 1742, was succeeded by Dr Bradley, who, though inferior as a mathematician, greatly exceeded him as a practical astronomer. He was the first who made observations with an accuracy sufficient to detect the lesser inequalities in the motions of the planets and fixed stars. Thus he discovered the aberration of light, the nutation of the earth's axis, and was able to make the lunar tables much more perfect than they had ever been. He also observed the places, and computed the elements of the comets which appeared in the years 1723, 1736, 1743, and 1757. He made new and most accurate tables of the motions of Jupiter's satellites, from his own observations and those of Dr Pound; and from a multitude of observations of the sun, moon, and stars, was enabled to give the most accurate table of mean refractions yet extant, as well as the best methods of computing the variations of those refractions arising from the different states of the air as indicated by the thermometer and barometer. In 1750, having procured a very large transit instrument made by Mr Bird, and a new mural quadrant of brass eight feet radius, he began to make observations with redoubled industry; so that betwixt this time and his death, which happened in 1762, he made observations for settling the places of all the stars in the British catalogue, together with near 1500 places of the moon, much the greater part of which he compared with the tables of Mr Mayer.

35 Improvements by the French astronomers.

In the mean time the French astronomers were assiduous in their endeavours to promote the science of astronomy. The theory of the moon, which had been given in a general way by Sir Isaac Newton, began to be particularly considered by Messrs Clairault, D'Alembert, Euler, Mayer, Simpson, and Walmsly; though Clairault, Euler, and Mayer, distinguished themselves beyond any of the rest, and Mr Euler has been particularly happy in the arrangement of his tables for the ease and expedition of computation. He was excelled in exactness, however, by Mayer, who published his tables in the Gottingen Acts for 1753. In these the errors in longitude never exceeded two minutes; and having yet farther improved them, he sent a copy to the lords of the British admiralty in 1755; and it was this copy which Dr Bradley compared with his observations, as already mentioned. His last corrections of them were afterwards sent over by his widow; for which she and her children received a reward of 3000l.

Accurate tables for Jupiter's satellites were also composed by Mr Wargentin, a most excellent Swedish astronomer, and published in the Upsal Acts in 1741; which have since been corrected by the author in such a manner as to render them greatly superior to any ever published before.

36 Of M. de la Caille.

Amongst the many French astronomers who contributed to the advancement of the science, we are particularly indebted to M. de la Caille, for a most excellent set of solar tables, in which he has made allowances for the attractions of Jupiter, Venus, and the moon. In 1750 he went to the Cape of Good Hope, in order to make observations in concert with the most celebrated astronomers in Europe, for determining the parallax of the moon, as well as of the planet Mars, and from thence that of the sun; from whence it appeared that the parallax of the sun could not greatly exceed 10 seconds. Here he re-examined and adjusted the places of the southern stars with great accuracy, and measured a degree of the meridian at that place. In Italy the science was cultivated with the greatest assiduity by Signior Bianchini, Father Boscovich, Frisi, Manfredi, Zanotti, and many others; in Sweden by Wargentin already mentioned, Blingenstern, Mallet, and Planman; and in Germany, by Euler elder and younger, Mayer, Lambert, Grischow, &c. In the year 1760 all the learned societies in Europe began to prepare for observing the transit of Venus over the sun, foretold by Dr Halley upwards of 80 years before it happened, showing, at the same time, the important use which might be made of it. Unfortunately, however, for the cause of science, many of the astronomers sent out to observe this phenomenon were prevented by unavoidable accidents from reaching the places of their destination, and others were disappointed by the badness of the weather. It happened also, that the circumstances of the phenomenon were much less favourable for the purpose of determining the sun's parallax than had been expected by Dr Halley, owing to the faults of the tables he had made use of: so that, notwithstanding all the labours of astronomers at that time, they were not able to determine the matter: and even after their observations in 1769, when the circumstances of the transit were more favourable, the parallax of the sun remained still uncertain.

Dr Bradley was succeeded in his office of astronomer-royal by Mr Bliss, Savilian professor of astronomy at Oxford; who, being in a very declining state of health at the time of his accession to the office, did not enjoy it long. He was succeeded by the learned Nevil Maskelyne, D. D. the present astronomer-royal, whose name will be rendered immortal by his assiduity and success in bringing the lunar method of determining the longitude at sea into general practice.

Such was the general state of astronomy, when Dr Herschel's great discovery of augmenting the power of telescopes, beyond the most sanguine hopes of astronomers, opened at once a scene altogether unlooked for. By this indefatigable observer we are made acquainted with a new primary planet attended by six secondaries belonging to our solar system; so that the latter now appears to have double the bounds formerly assigned to it; this new planet being at least twice the distance of Saturn from the sun. In the still farther distant celestial regions, among the fixed stars, his observations

vations

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History. vations are equally surprising; of which we shall only say with Dr Priestley*, "Mr Herschel's late discoveries in and beyond the bounds of the solar system, the great views that he has given of the arrangement of the stars, their revolutions, and those of the immense systems into which they are formed, are peculiarly calculated to inspire an ardent desire of seeing so great a scene a little more unfolded. Such discoveries as these give us a higher idea of the value of our being, by raising our ideas of the system of which we are a part; and with this an earnest wish for the continuance of it."

* Exper. and Observ. vol. vi. Pref.

PART II. OF THE APPARENT MOTIONS OF THE HEAVENLY BODIES.

WHEN we cast our eyes up towards the heavens, we perceive a vast hollow hemisphere at an unknown distance, of which our eyes seem to constitute the centre. The earth stretches at our feet like an immense plain, and at a certain distance appears to meet and to bound the heavenly hemisphere. Now the circle all around, where the earth and the heavens seem to meet and touch each other, is called the *horizon*. We can scarcely avoid supposing, that besides the hemisphere which we perceive, there is another, exactly similar, concealed from our view by the earth, and that the earth, therefore, is somehow or other suspended in the middle of this heavenly sphere, with all its inhabitants. A little observation turns this suspicion into certainty. For in a clear evening the heavenly hemisphere is seen studded with stars, and its appearance is changing every instant. New stars are continually rising in the east, while others in the mean time are setting in the west. Those stars, that, towards the beginning of the evening, were just seen above the eastern horizon, late at night are seen in the middle of the starry hemisphere, and may be traced moving gradually westward, till at last they sink altogether under the horizon. If we look to the north, we soon perceive that many stars in that quarter never set at all, but move round and round, describing a complete circle in 24 hours. These stars describe their circles round a fixed point in the heavens; and the circles are the smaller, the nearer the star is to the fixed point. This fixed point is called the *north pole*. There must be a similar fixed point in the southern hemisphere, called the *south pole*. Thus the heavenly sphere appears to turn round two fixed points, called the poles, once every 24 hours. The imaginary line which joins the points is called the *axis* of the world.

37 Appearance of the heavens.

In order to have precise notions of the motions of the heavenly bodies, it is necessary to be able to assign precisely the place in which they are. This is done by means of several imaginary lines, or rather circles, supposed described upon the surface of the sphere; and these circles, as is usual with mathematicians, are divided into 360 equal parts called degrees. Every degree is divided into 60 minutes: every minute into 60 seconds, and so on. That great circle of the sphere, which is perpendicular to the axis of the world, and of course 90° distant from either pole, is called the *equator*. The smaller circles, which the stars describe in consequence of their diurnal motions, are called *parallels*, because they are obviously parallel to the equator.

The equator divides the heavenly sphere into two equal parts, the north and the south; but to be able to assign the position of the stars, it is necessary to have another circle, passing through the poles, and cutting the equator perpendicularly. This circle is called a *meridian*. It is supposed, not only to pass through the poles, but to pass also through the point directly over the head of the observer, and the point of the sphere exactly opposite to that. The first of these points is called the *zenith*, the second is called the *nadir*.

The meridian divides the circles described by the stars into two equal parts; and when they reach it they are either at their greatest height above the horizon, or they are at their least height. The situation of the pole is easily determined; for it is precisely half way between the greatest and least height of those stars which never set. When we advance towards the north we perceive that the north pole does not remain stationary, but rises towards the zenith, nearly in proportion to the space we pass over. On the other hand it sinks just as much when we travel towards the south. Hence we learn that the surface of the earth is not plane, as one would at first suppose, but curved.

All the heavenly bodies appear to describe a complete circle round the earth in 24 hours. But besides these motions which are common to them all, there are several of them which possess motions peculiar to themselves. The sun, the most brilliant of all the heavenly bodies, is obviously much farther to the south during winter than during summer. He does not, therefore, keep the same station in the heavens, nor describe the same circle every day. The moon not only changes her form, diminishes, and increases; but if we observe the stars, near which she is situated one evening, the next evening we shall find her considerably to the eastward of them; and every day she removes to a still greater distance, till in a month she makes a complete tour of the heavens, and approaches them from the west. There are eight other stars, besides, which are continually changing their place; sometimes we observe them moving to the westward, sometimes to the eastward, and sometimes they appear stationary for a considerable time. These stars are called *planets*. There are other bodies which appear only occasionally, move for some time with immense celerity, and afterwards vanish. These bodies are called *comets*. But the greater number of the heavenly bodies always retain nearly the same relative distance from each other, and are therefore called *fixed stars*. It will be necessary for us to consider the nature and apparent motions of all these bodies. We shall, therefore, divide this first part of our treatise, into the following heads: 38

38 Arrangement.

1. Of the Sun.
2. Of the Moon.
3. Of the Planets.
4. Of the Comets.
5. Of the Fixed Stars.
6. Of the figure of the Earth.

These topics shall be the subjects of the following chapters.

CHAP.

Chap. I. *Of the Sun.*

The sun, as the most conspicuous and most important of all the heavenly bodies, would naturally claim the first place in the attention of astronomers. Accordingly its motions were first studied, and they have had considerable influence on all the other branches of the science. We shall subdivide this part of our subject into three parts. In the first, we shall give an account of the apparent motions of the sun; in the second, we shall treat of the division of time, which is regulated by these apparent motions; and in the third, we shall consider the figure and structure of the sun, as far as they have been determined by astronomers. These shall be the subjects of the following sections.

Sect. I. *Apparent Motions of the Sun.*

39 Annual motion of the sun.

That the sun has a peculiar motion of its own, independent of the diurnal motion common to all the heavenly bodies, and in a direction contrary to that motion, is easily ascertained, by observing with care the changes which take place in the starry hemisphere during a complete year. If we note the time at which any particular star rises, we shall find that it rises somewhat sooner every successive day, till at last we lose it altogether in the west. But if we note it after the interval of a year, we shall find it rising precisely at the same hour as at first. Those stars which are situated nearly in the track of the sun, and which set soon after him, in a few evenings lose themselves altogether in his rays, and afterwards make their appearance in the east before sunrise. The sun then moves towards them in a direction contrary to his diurnal motion. It was by observations of this kind that the ancients ascertained his orbit. But at present this is done with greater precision, by observing every day the height of the sun when it reaches the meridian, and the interval of time which elapses between his passing the meridian and that of the stars. The first of these observations gives us the sun's daily motion northward or southward, in the direction of the meridian; and the second gives us his motion eastward in the direction of the parallels; and by combining the two together, we obviously obtain his orbit: But it will be necessary to be somewhat more particular.

40 Method of drawing a meridian line.

These observations cannot be made without drawing a meridian line, or a line, which, if produced, would pass through both the poles of the earth, and the spot where the observer is placed. It is obvious, that such a line is in the same plane with the meridian as the heavenly hemisphere. A meridian line may be found thus: On an horizontal plane describe three or four concentric circles, as E, G, H, fig. 1. Plate LIX. and in the common centre fix perpendicularly a wire CB, having a well-defined point. When the sun shines in the morning, observe where the shadow of the top of the wire, as CD, touches one of the circles; and in the afternoon mark where the extremity of the shadow CF just touches the same circle: then through the centre C draw the line CE, bisecting the arc DF, and CE will be a meridian, as required. If the same be done with as many of the circles as the shining of the sun will admit of, and the mean of all the bisecting lines CE be chosen as a meridian, there will be no doubt of its accuracy, particularly if the observations be made about midsummer, which is the best time. After a meridian line is thus found, another parallel to it may be readily drawn at any convenient distance: the method is this: Hang a thread and plummet exactly over the south end of the known meridian line, and let another thread and plummet be hung over the south end of the plane upon which a meridian is to be drawn; then let a person observe when the shadow of the thread falls on the given meridian, and immediately give a signal to another person, who must at that moment mark two points on the shadow of the second thread, through which two points the new meridian must be described.

Apparent Motions of the Heavenly Bodies.

41 Altitude of the sun.

The height of the sun from the horizon, when it passes the meridian, or the arch of the meridian between the sun and the horizon, is called the *sun's altitude*. The ancients ascertained the sun's altitude in the following manner: They erected an upright pillar at the south end of a meridian line, and when the shadow of it exactly coincided with that line, they accurately measured the shadow's length, and then, knowing the height of the pillar, they found, by an easy operation in plane trigonometry, the altitude of the sun's upper limb: whence, after allowing for the apparent semidiameter, the altitude of the sun's centre was known. But the methods now adopted are much more accurate. In a known latitude, a large astronomical quadrant, of six, eight, or ten feet radius, is fixed truly upon the meridian; the limb of this quadrant is divided into minutes, and smaller subdivisions, by means of a vernier; and it is furnished with a telescope (having cross hairs, &c. turning properly upon the centre). By this instrument the altitude of the sun's centre is very carefully measured, and the proper deductions made.

42 Method of ascertaining the sun's motion.

With a similar instrument we may ascertain the apparent motions of the sun in the following manner, beginning our observations about the 20th of March. On this day we must note some fixed star which comes to the meridian exactly at the same time as the sun does; for the stars may be seen in the daytime with an astronomical telescope. On the following day, both the altitude of the sun, and the situation of the stars when the sun is on the meridian, must be observed; the sun's meridian altitude will be about 23′ 40″ greater than on the former day, and the star will be found on the meridian about 3 m. 39 sec. in time before the sun. Make similar observations for a few days, and it will be found, at the end of a week, that the sun's meridian altitude will be increased 2° 46′, and the star will be on the meridian 25 m. 26 sec. in time before the sun, or it will be $6^\circ\ 21\frac{1}{3}'$ westward of the meridian when the sun is upon it. During this period of seven days, therefore, the sun has been moving towards the east, and has increased his altitude by regular gradations. In fig. 2. let EQ represent a portion of the equator, QS the meridian on which the sun is, QS his altitude above the equator, E the place of the star, and ES part of the path of the sun: then, in the spherical triangle EQS, right-angled at Q, there are given $EQ = 6^\circ\ 21\frac{1}{3}'$, and $QS = 2^\circ\ 46'$, to find the angle E. By the rules of spherical trigonometry, we have, tangt. of $E = \frac{\text{tangt. of SQ}}{\text{sine of QE}} = \frac{\cdot 0483250}{\cdot 1107463} = \cdot 4364479$,

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·4364479=tangt. of 23° 34′ 43″, the angle E required.

43 Ecliptic.

The orbit in which the sun moves is called the *ecliptic*. It does not coincide with the equator, but cuts it, forming with it an angle, which in the year 1769 was determined by Dr Maskelyne, at 23° 28′ 10″, or 23°.46944. This angle is called the *obliquity of the ecliptic*.

44 Seasons explained.

The different seasons of the year are occasioned by the combination of this proper motion of the sun with his diurnal motion. The two points in which the ecliptic cuts the equator, are called the *equinoxes*, or *equinoctial points;* because on the days that the sun is in them, he describes by his diurnal motion the equator, which being divided into two equal parts by the horizon, the day is then equal to the night in every part of the earth. One of these equinoxes is called the *vernal*, because the sun is in it about the 20th of March, or the beginning of the spring. As the sun advances in his orbit from that point, his meridian altitude becomes greater and greater every day. The visible arches of the parallels which it describes, become continually greater; and with them the length of the day increases, till the sun reaches his greatest altitude, or distance from the equator: then the day is the longest of the year. And as at that period the variations in the sun's altitude are scarcely sensible for some time, as far at least as it affects the length of the day; the point of the orbit, where the sun's altitude is a maximum, has for that reason been called the *summer solstice*. The parallel which the sun describes when in that point, is called the *tropic of Cancer*. From the solstice the sun descends again towards the equator, crosses it again at the autumnal equinox, and goes southward till its altitude becomes a minimum. This point of the orbit is called the *winter solstice*. The day is then the shortest of the year, and the parallel which the sun describes, is called the *tropic of Capricorn*. From the winter solstice the sun again approaches the equator, and returns to the vernal equinox.

Such is the constant course of the sun and of the seasons. The interval between the vernal equinox and the summer solstice, is called the *spring;* the interval between this solstice and the autumnal equinox, is called *summer;* that between the autumnal equinox and the winter solstice, is *autumn;* and that between this solstice and the vernal equinox, is *winter*.

The different altitudes of the pole in different climates, occasion remarkable peculiarities in the seasons, with which it is proper to be acquainted. At the equator the poles are situated in the horizon, which last circle cuts all the parallels into two equal parts. Hence the day and the night are constantly of the same length all the year round. On the equinoxes the sun is in the zenith at noon. His altitude is the least possible at the solstices, and is then equal to the complement of the inclination of the ecliptic. During the summer solstice, the shadows of bodies illuminated by the sun are directed towards the south; but they are directed towards the north at the winter solstice; changes which never take place in our northern climates. Under the equator then there are in reality two summers and two winters. The same thing takes place in all countries lying between the tropics. Beyond them there is only one summer and one winter in the year. The sun is never in the zenith. The length of the longest day increases, and that of the shortest day diminishes, as we advance toward the poles; and when the distance between the zenith and the pole is only equal to the inclination of the ecliptic, the sun does not set at all on the days of the summer solstice, nor rise on that of the winter solstice. Still nearer the pole, the period in which he never sets in summer, and never rises in winter, gradually increases from a few days to several months; and, under the pole itself, the equator then coinciding with the horizon, the sun never sets when it is upon the same side of the equator with the pole, and never rises while it is in the opposite side.

The intervals of time between the equinoxes and solstices are not equal. There are about seven days more between the vernal and autumnal equinox, than between the autumnal and vernal. Hence we learn, that the motion of the sun in its orbit is not uniform. Numerous observations, made with precision, have ascertained, that the sun moves fastest in a point of his orbit situated near the winter solstice, and slowest in the opposite point of his orbit near the summer solstice. When in the first point, the sun moves in 24 hours 1°.01943; in the second point, he moves only 0°.95319. The daily motion of the sun is constantly varying in every place of its orbit, between these two points. The medium of the two is 0°.98632, or 59′ 11″, which is the daily motion of the sun about the beginning of October and April. It has been ascertained, that the variation in the angular velocity of the sun, is very nearly proportional to the mean angular distance of it from the point of its orbit where its velocity is greatest. 45 Motion not uniform.

It is natural to think, that the distance of the sun from the earth varies as well as its angular velocity. This is demonstrated by measuring the apparent diameter of the sun. Its diameter increases and diminishes in the same manner, and at the same time, with its angular velocity; but in a ratio twice as small. About the beginning of January, his apparent diameter is about 32′ 39″, and at the beginning of July it is about 31′ 34″, or more exactly, according to De la Place, 32′ 35″=1955″ in the first case, and 31′ 18″=1878″ in the second. 46 Diameter varies.

Opticians have demonstrated, that the distance of any body is always reciprocally as its apparent diameter. The sun must follow the same law; therefore, its distance from the earth increases in the same proportion that its apparent diameter diminishes. That point of the orbit in which the sun is nearest the earth, is called *perigeon*, or *perigee;* and the point of the orbit in which that luminary is farthest distant from the earth, is called *apogee*. When the sun is in the first of these points, his apparent diameter is greatest, and his motion swiftest; but when he is in the other point, both his diameter and the rapidity of his motion are the smallest possible. 47 Sun's distance varies.

From these remarks it is obvious that if the orbit of the sun be a circle, the earth is not situated in the centre of that circle, otherwise the distance of the sun from the earth would remain always the same, which is contrary to fact. It is possible therefore, that the variation in his angular velocity may not be *real*, but only apparent. Thus in fig. 3. let AMPN be the orbit

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orbit of the sun, C the centre of that orbit, and E the position of the earth at some distance from the centre. It is obvious that P is the sun's perigee, and A its apogee. Now as the sun's apparent orbit is a circle having the earth in its centre, it is evident that this orbit must be AMPN, and that the angular motion of the sun will be measured upon that circle. Suppose now that the sun in his apogee moves from A to A′, it is obvious that his apparent or angular motion will be the segment *a a′* of the apparent orbit, considerably smaller than AA′, so that at the apogee the angular motion of the sun will be less than his real motion. Again: let the sun in his perigee move from P to P′, describing a segment precisely equal to the segment AA′. This segment as seen from the earth will be referred to *p p′*, which in that case will be the sun's angular motion, evidently considerably greater than his real motion.

Hence it is obvious that even on the supposition that the sun moved equably in his orbit, his angular motion as seen from the earth would still vary, that is, would be smallest at the apogee, and greatest at the perigee; and that the angular and real motion would only coincide in the points M and N, where the real and apparent orbits cut each other. From the figure it is obvious also, that the angular velocity would increase gradually from the apogee to the perigee, and diminish gradually from the perigee to the apogee, which likewise corresponds with observation. Now the line EC, which is the distance of the earth from the centre of the sun's orbit, is called the *eccentricity* of that orbit. The variation in the angular motion of the sun may be owing to this eccentricity.

48 Sun's motion varies.

But if it were owing to this cause alone, it is easy to demonstrate that in that case the diminution of his angular velocity would follow the same ratio as the diminution of his diameter. The fact however is, that the angular velocity diminishes in a ratio twice as great as the diameter of the sun does. The variation of the angular velocity cannot then be owing to the eccentricity alone. Hence it follows, that the variation of the motion of the sun is not merely apparent, but real; and that its velocity in its orbit actually diminishes, as his distance from the earth increases. Two causes then combine to produce the variation in the sun's angular velocity; namely, 1. The increase and diminution of his distance from the earth; and, 2. The real increase and diminution of his velocity in proportion to this variation of distance. These two causes combine in such a manner that the daily angular motion of the sun diminishes as the square of his distance increases, so that the product of the angular velocity multiplied into the square of the distance is a constant quantity. But this law is so important that it will be necessary to be more particular.

The observation that the sun's angular motion in his orbit is inversely proportional to the square of his distance from the earth, was first made by Kepler. The discovery was made by a careful comparison of the sun's diurnal motion with his apparent diameter, which were found to follow that law; and it is evident that the one is the angular motion of the sun, and the other his distance from the earth, which is inversely proportional to his apparent diameter. Let ASB (fig. 4.) be the sun's orbit, E the earth, and S the sun. Suppose a line ES joining the centres of the earth and sun to move round along with the sun. This line is called the *radius vector*. It is obvious, that when S moves to S′, ES, moving along with it, is now in the situation ES′, having described the small sector ESS′. In the same time that S performs one revolution in its orbit, the radius vector ES will describe the whole area ABS, enclosed within the sun's orbit. Let SS′ be the sun's angular motion during one day. It is obvious that the small sector ESS′ is proportional to the square of ES, multiplied by SS′: for the radius vector is the sun's distance from the earth, and SS′ his angular motion. Hence this sector is a constant quantity, whatever the angular motion of the sun be; and the whole area SEA increases as the number of days which the sun takes in moving from S to A. Hence results that remarkable law, first pointed out by Kepler, that *the areas described by the radius vector are proportional to the times*. Suppose the sun to describe SS′ in one day, and SA in 20 days, then the area SES′ is to the area SEA as 1 to 20; or the area SEA is 20 times greater than the area SES′.

49 Describes areas proportional to the times.

The knowledge of these facts enables us to draw upon paper, from day to day, lines proportional to the length of the radius vector of the solar orbit, and having the same relative position as these lines. If we join the extremity of these lines, by making a curve pass through them, we shall perceive that this curve is not exactly circular. Let E in fig. 5. represent the earth, and E *a*, E *b*, E *c*, E *d*, E *f*, &c. the position and length of the radius vector during every day of the year: if we join together the points *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*, *l*, *m*, *n*, *o*, by drawing the curve *a e i m*, through them, it is obvious that this curve is not a circle, but elongated towards *a* and *i*, the points which represent the sun's greatest and least distance from the earth. The resemblance of this curve to the ellipse induced Kepler to compare them together, and he ascertained their identity. Hence it follows, that the orbit of the sun is an *ellipse*, having the earth in one of its foci. The centre C of the ellipse is the point where its greater axis is cut perpendicularly by its smaller axis. The distance CE, between the earth and that centre, is the eccentricity of the sun's orbit. The eccentricity of this orbit is not great. Let the earth's mean distance from the sun be represented by 10,000; it has been ascertained that the eccentricity is equal to 168 of these parts. Hence the sun's orbit does not differ much from a circle.

50 His orbit an ellipse.

To form a precise notion of the elliptical motion of the sun, let us suppose a point to move uniformly in the circumference of a circle, whose centre coincides with the centre of the earth, and whose radius is equal to the sun's distance from the earth when in his perigee. Let us suppose also, that the sun and the point set out together from the perigee, and that the motion of the point is equal to the sun's mean angular motion. While the radius vector of the point moves uniformly round the earth, the radius vector of the sun moves with unequal velocity, describing always areas proportional to the times. At first it gets before the radius vector of the point, and forms with it an angle, which, after having increased till it reached a certain limit, diminishes again and becomes equal to zero, when the sun is in apogee; then the radius vector of the sun and of the point

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point coincide both with each other, and with the greater axis of the ellipse. After passing the apogee the radius vector of the point gets before that of the sun, and forms with it angles exactly equal to the angles formed by the same lines in the former half of the ellipse, at the same distance from the perigee. At the perigee, the radius vector of the sun and of the point again coincide with each other, and with the greater axis of the ellipse. The angle which the radius vector of the sun makes with that of the point, which indicates how much the one precedes the other, is called the *equation of the centre*. It is always greatest when the motions of the point and of the sun are equal, and it vanishes altogether when there is the greatest difference between these motions. The angular motion of the point is called the *mean motion*, and that of the sun the *real motion*. The place of the point in the orbit is called the *mean place*. Now, if to the mean place in the orbit, we add or subtract the equation of the centre, it is obvious that we have the sun's real place for any given time. The angular motion of the point is known with precision for a given time, a day for instance, by ascertaining the exact length of time which the sun takes in making a complete revolution round its orbit. For if we ascertain how many days that revolution requires, we have only to divide the whole orbit by that number to prove the portion of it traversed by the point in one day. The equation of the centre can only be found by approximation. Its maximum in the year 1750 was $1^{\circ}.9268$.

51 Equation of the centre explained.

In computations we begin always at that part of the orbit where the motion of the sun is slowest. The distance of the imaginary point from that part, is called the *mean anomaly*. A table is made of the equation of the centre, corresponding to each degree of the mean anomaly. By adding or subtracting these equations from the mean anomaly, we obtain the true anomaly or place of the sun for any given time.

52 Signs of the zodiac.

The ecliptic is usually divided, by astronomers, into 12 equal parts, called signs, each of which of course contains 30 degrees. They are usually called the signs of the zodiac; and beginning at the equinox, where the sun intersects and rises above the equator, have these names and marks: Aries ♈, Taurus ♉, Gemini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagittarius ♐, Capricornus ♑, Aquarius ♒, Pisces ♓. Of these signs, the first six are called *northern*, lying on the north side of the equator; the last six are called *southern*, being situated to the south of the equator. The signs from Capricornus to Gemini are called *ascending*, the sun approaching or rising to the north pole while it passes through them; and the signs from Cancer to Sagittarius are called *descending*, the sun, as it moves through them, receding or descending from the north pole.

The *longitude* of the sun is his distance in the ecliptic from the first point of Aries. His *right ascension* is the arch of the equator intercepted between the first point of Aries, and the meridian circle which passes through his longitude. The distance of the sun from the equator, measured upon a meridian circle, is called his *declination*, and it is either north or south according to the situation of the sun.

53 Orbit varies in position.

It has been observed that the position of the larger axis of the elliptical orbit of the sun, is not constant. The angular distance of the perigee from the vernal equinox, counted according to the sun's movement, was $278^{\circ}.6211$ at the beginning of 1750; but it has, relative to the stars, an annual motion of about $11''.89$ in the same direction as the sun.

The orbit of the sun is gradually approaching to the equator. Its obliquity diminishes in a century at the rate of about $1''.50$.

The precision of modern astronomers has enabled them to ascertain small irregularities in the sun's elliptical motion, which observation alone would scarcely have been able to bring under precise laws. These irregularities will be considered afterwards.

54 Distance of the sun.

To determine the distance of the sun from the earth, has always been an interesting problem to astronomers, and they have tried every method which astronomy or geometry possesses in order to resolve it. The amplest and most natural, is that which mathematicians employ to measure distant terrestrial objects. From the two extremities of a base whose length is known, the angles which the visual rays from the object, whose distance is to be measured, make with the base, are measured by means of a quadrant; their sum subtracted from 180°, give the angle which these rays form at the object where they intersect. This angle is called the *parallax*, and when it is once known, it is easy, by means of trigonometry, to ascertain the distance of the object. Let AB, in fig. 6. be the given base, and C the object whose distance we wish to ascertain. The angles CAB and CBA, formed by the rays CA and CB with the base, may be ascertained by observation; and their sum subtracted from 180° leaves the angle ACB, which is the parallax of the object C. It gives us the apparent size of the base AB as seen from C.

When this method is applied to the sun, it is necessary to have the largest possible base. Let us suppose two observers on the same meridian, observing at the same instant the meridian altitude of the centre of the sun, and his distance from the same pole. The difference of the two distances observed, will be the angle under which the line which separates the observers will be seen from the centre of the sun. The position of the observers gives this line in parts of the earth's radius. Hence, it is easy to determine, by observation, the angle at which the semidiameter of the earth would be seen from the centre of the sun. This angle is the sun's *parallax*. But it is too small to be determined with precision by that method. We can only conclude from it, that the sun's distance from the earth is at least equal to 10,000 diameters of the earth. We shall find afterwards, that other methods have been discovered for finding the parallax with much greater precision. It amounts very nearly to $8''.8$: hence it follows, that the distance of the sun from the earth amounts to 23,405 semi-diameters of the earth.

Sect. II. *Of the Division of Time.*

Motion is peculiarly adapted for measuring time. For, as a body cannot be in different places in the same time, it can only arrive from one part to another, by passing successively through all the intermediate spaces. And if it be possible to ascertain, that in every point of the line which it describes it is actuated by the very same force, we can conclude with confidence, that it will

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will describe the line with a uniform motion. Of course the different parts of the line will be a measure of the time employed to traverse them. When a pendulum at the end of every oscillation is precisely in the same circumstances, the length of the oscillations is the same, and time may be measured by their number. We might employ also, for the same purpose, the revolutions of the heavenly sphere, which appear perfectly uniform. But all nations have agreed to employ the revolutions of the sun for that purpose.

55
Astronomical day.

In common language, the *day* is the interval of time which elapses from the rising to the setting of the sun; the *night* is the interval that the sun continues below the horizon. The *astronomical day* embraces the whole interval which passes during a complete revolution of the sun. It is the interval of time which passes from 12 o'clock at noon, till the next succeeding noon. It begins when the sun's centre is on the meridian of that place. It is divided into 24 hours, reckoning in a numerical succession from 1 to 24: the first 12 are sometimes distinguished by the mark P. M. signifying *post meridiem*, or after noon; and the latter 12 are marked A. M. signifying *ante meridiem*, or before noon. But astronomers generally reckon through the 24 hours from noon to noon; and what are by the civil or common way of reckoning, called morning hours, are by astronomers reckoned in the succession from 12, or midnight, to 24 hours. Thus 9 o'clock in the morning of February 14th, is, by astronomers, called February the 13th at 21 hours.

56
Sidereal day.

An astronomical day is somewhat greater than a complete revolution of the heavens, which forms a *sidereal day*. For if the sun cross the meridian at the same instant with a star, the day following it will come to the meridian somewhat later than the star, in consequence of its motion eastward, which causes it to leave the star; and after a whole year has elapsed, it will have crossed the meridian just one time less than the star. A sidereal day is less than the solar day, for it is measured by 360°, whereas the mean solar day is measured by $360^\circ\ 59'\ 8''$ nearly. If an astronomical day be $=1$, then a sidereal day is $=0.997269722$; or the difference between the measures of a mean solar day, and a sidereal day, viz. $59'\ 8''$, reduced to time, at the rate of 24 hours to 360°, gives $3'\ 56''$; from which we learn that a star which was on the meridian with the sun on one noon, will return to that meridian $3'\ 56''$ previous to the next noon: therefore, a clock which measures mean days by 24 hours, will give 23 h. 56 m. 4 sec. for the length of a sidereal day.

57
Days vary in length.

Astronomical or solar days, as they are also called, are not equal. Two causes conspire to produce their inequality, namely, the unequal velocity of the sun in his orbit, and the obliquity of the ecliptic. The effect of the first cause is sensible. At the summer solstice, when the sun's motion is slowest, the astronomical day approaches nearer the sidereal, than at the winter solstice when his motion is most rapid.

To conceive the effect of the second cause, it is necessary to recollect that the excess of the astronomical day above the sidereal is owing to the motion of the sun, referred to the equator. The sun describes every day a small arch of the ecliptic. Through the extremities of this arch suppose two meridian great circles drawn, the arc of the equator, which they intercept, is the sun's motion for that day referred to the equator; and the time which that arc takes to pass the meridian is equal to the excess of the astronomical day above the sidereal. But it is obvious, that at the equinoxes, the arc of the equator is smaller than the corresponding arc of the eclptic in the proportion of the cosine of the obliquity of the ecliptic to radius: at the solstices, on the contrary, it is greater in the proportion of radius to the cosine of the same obliquity. The astronomical day is diminished in the first case, and lengthened in the second.

58
Mean astronomical day.

To have a mean astronomical day, independent of these causes of inequality, astronomers have supposed a second sun to move uniformly on the ecliptic, and to pass over the extremities of the axis of the sun's orbit, at the same instant with the real sun. This removes the inequality arising from the inequality of the sun's motion. To remove the inequality arising from the obliquity of the ecliptic, astronomers suppose a third sun passing through the equinoxes at the same instant with the second sun, and moving along the equator in such a manner that the angular distances of the two suns at the vernal equinox shall be always equal. The interval between two consecutive returns of this third sun to the meridian forms the *mean astronomical day*. *Mean time* is measured by the number of the returns of this third sun to the meridian; and true time is measured by the returns of the real sun to the meridian. The arc of the equator, intercepted between two meridian circles drawn through the centres of the true sun, and the imaginary third sun, reduced to time, is what is called the *equation of time*. This will be rendered plainer by the following diagram.

Let Z♈♋♎ (fig. 7.) be the earth; ZFR♋ its axis; *abcde*, &c. the equator; ABCDE, &c. the northern half of the ecliptic from ♈ to ♎, on the side of the globe next the eye; and MNOP, &c. the southern half on the opposite side from W to ♈. Let the points at A, B, C, D, E, F, &c. quite round from ♈ to ♈ again bound equal portions of the ecliptic, gone through in equal times by the real sun; and those at *a*, *b*, *c*, *d*, *e*, *f*, &c. equal portions of the equator described in equal times by the fictitious sun; and let Z♈♋ be the meridian.

As the real sun moves obliquely in the ecliptic, and the fictitious sun directly in the equator, with respect to the meridian; a degree, or any number of degrees, between ♈ and F on the ecliptic, must be nearer the meridian Z♈♋, than a degree, or any corresponding number of degrees, on the equator from ♈ to *f*; and the more so, as they are the more oblique: and therefore the true sun comes sooner to the meridian every day whilst he is in the quadrant ♈ F, than the fictitious sun does in the quadrant ♈ *f*; for which reason, the solar noon precedes noon by the clock, until the real sun comes to F, and the fictitious to *f*; which two points, being equidistant from the meridian, both suns will come to it precisely at noon by the clock.

Whilst the real sun describes the second quadrant of the ecliptic FGHIKL from Cancer to ♎, he comes later to the meridian every day than the fictitious sun moving through the second quadrant of the equator from *f* to ♎; for the points at G, H, I, K, and L, being farther from the meridian, their corresponding points at *g*, *h*, *i*, and *l*, must be later of coming to it;

and

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and as both suns come at the same moment to the point W, they come to the meridian at the moment of noon by the clock.

In departing from Libra, through the third quadrant, the real sun going through MNOPQ towards ♑ at R, and the fictitious sun through *m n o p q* towards *r*, the former comes to the meridian every day sooner than the latter, until the real sun comes to ⊙, and the fictitious to *r*, and then they come both to the meridian at the same time.

Lastly, As the real sun moves equably through STUVW, from ⊙ towards ♈; and the fictitious sun through *s t u v w*, from *r* towards ♈, the former comes later every day to the meridian than the latter, until they both arrive at the point ♈, and then they make it noon at the same time with the clock.

Having explained one cause of the difference of time shown by a well-regulated clock and a true sun-dial, supposing the sun, not the earth, as moving in the ecliptic; we now proceed to explain the other cause of this difference, namely, the inequality of the sun's apparent motion; which is slowest in summer, when the sun is farthest from the earth, and swiftest in winter when he is nearest to it.

If the sun's motion were equable in the ecliptic, the whole difference between the equal time as shown by the clock, and the unequal time as shown by the sun, would arise from the obliquity of the ecliptic. But the sun's motion sometimes exceeds a degree in 24 hours, though generally it is less: and when his motion is slowest, any particular meridian will revolve sooner to him than when his motion is quickest; for it will overtake him in less time when he advances a less space than when he moves through a larger.

Now, if there were two suns moving in the plane of the ecliptic, so as to go round it in a year; the one describing an equal arc every 24 hours, and the other describing sometimes a less arc in 24 hours, and at other times a larger, gaining at one time of the year what it lost at the opposite; it is evident, that either of these suns would come sooner or later to the meridian than the other, as it happened to be behind or before the other; and when they were both in conjunction, they would come to the meridian at the same moment.

As the real sun moves unequably in the ecliptic, let us suppose a fictitious sun to move equably in a circle coincident with the plane of the ecliptic. Let ABCD (fig. 8.) be the ecliptic or orbit in which the real sun moves, and the dotted circle *a b c d* the imaginary orbit of the fictitious sun; each going round in a year according to the order of letters, or from west to east. Let HIKL be the earth turning round its axis the same way every 24 hours; and suppose both suns to start from A and *a*, in a right line with the plane of the meridian EH, at the same moment: the real sun at A, being then at his greatest distance from the earth, at which time his motion is slowest; and the fictitious sun at *a*, whose motion is always equable, because his distance from the earth is supposed to be always the same. In the time that the meridian revolves from H to H again, according to the order of the letters HIKL, the real sun has moved from A to F; and the fictitious with a quicker motion from *a* to *f*, through a large arc: therefore, the meridian EH will revolve sooner from H to *h* under the real sun at F, than from HE to *k* under the fictitious sun at *f*; and consequently it will then be noon by the sun-dial sooner than by the clock.

As the real sun moves from A towards C, the swiftness of his motion increases all the way to C, where it is at the quickest. But notwithstanding this, the fictitious sun gains so much upon the real, soon after his departing from A, that the increasing velocity of the real sun does not bring him up with the equally-moving fictitious sun till the former comes to C, and the latter to *c*, when each has gone half round its respective orbit; and then being in conjunction, the meridian EH, revolving to EK, comes to both suns at the same time, and therefore it is noon by them both at the same moment.

But the increased velocity of the real sun now being at the quickest, carries him before the fictitious one; and therefore, the same meridian will come to the fictitious sun sooner than to the real: for whilst the fictitious sun moves from *a* to *g*, the real sun moves through a greater arc from C to G: consequently the point K has its noon by the clock when it comes to *k*, but not its noon by the sun till it comes to *l*. And although the velocity of the real sun diminishes all the way from C to A, and the fictitious sun by an equable motion is still coming nearer to the real sun, yet they are not in conjunction till the one comes to A and the other to *a*, and then it is noon by them both at the same moment.

True time is obtained by adding or subtracting this equation to the mean time. The mean and apparent solar days are never equal, except when the sun's daily motion in right ascension is 59′ 8″; this is nearly the case about April 15th, June 15th, September 1st, and December 24th: on these days the equation is nothing, or nearly so; it is at the greatest about November 1st, when it is 16 m. 14 sec.

59 Year.

The return of the sun to the same equinox marks the years, in the same way as his return to the same meridian indicates the days. It has been ascertained, that before the sun returns again to the same equinox, an interval of 365.242222 days elapses, or 365 days, 5 hours, 48 minutes, and 47 seconds. This is called the *tropical year:* The sun takes a larger interval of time to return again to the same star. The *sidereal year* is the interval which the sun employs to return from one star to another. It is greater than the tropical year by 0.014162 days, or 20 m. 23 sec.; therefore the length of the sidereal year is 365 days, 6 h. 9 m. and 10 sec. From this it follows, that the equinoxes do not retain the same place in the ecliptic, but that they have a retrograde motion, or contrary to that of the sun, in consequence of which they describe every year an arc equal to the mean space which the sun passes over in 20′ 23″, or about 50″; so that they would make a complete revolution in 25972 years. This is called the *precession of the equinoxes.*

60 Method of computing the equation of time.

Dr Maskelyne has invented a rule for computing the equation of time, in which the precession of the equinoxes, as well as the two causes mentioned above, are included. Let APLQ, fig. 9. be the ecliptic, ALQ the equator, A the first point of Aries, P the point where the sun's apparent motion is slowest, S any place of the sun; draw S *v* perpendicular to the equator,

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equator, and take $An = AP$. When the sun begins to move from P, suppose a star to begin to move from n, with the sun's mean motion in right ascension or longitude, viz. at the rate of 59′ 8″ in a day, and when n passes the meridian let the clock be adjusted to 12. Take $nm = Ps$, and when the star comes to m, if the sun moved uniformly with his mean motion, he would be found at s; but at that time let S be the place of the sun. Let the sun S, and consequently v, be on the meridian; and then as m is the place of the imaginary star at that instant, mv must be the equation of time. The sun's mean place is at s, and as $An = AP$, and $nm = Ps$, we have $Am = APs$, consequently $mv = Av - Am = Av - APs$. Let a be the mean equinox, or the point where it would have been if it had moved with its mean velocity, and draw az perpendicular to AQ; then $Am = Az + zm = Aa \times \text{cosine } zAa + zm$: or because the cosine of zAa the obliquity of the ecliptic, 23° 28′, is $= \frac{11}{12}$ very nearly, $Am = \frac{11}{12}Aa + zm$: hence $mv = Av - zm - \frac{11}{12}Aa$. Here Av is the sun's true right ascension, zm the mean right ascension or mean longitude; and $\frac{11}{12}Aa$ (viz. Ax) is the equation of the equinoxes in right ascension; therefore the equation of time is equal to the difference of the sun's true right ascension and his mean longitude, corrected by the equation of the equinoxes in right ascension.—When Am is less than Av, mean or true time precedes apparent; when it is greater, apparent time precedes mean. That is, when the sun's true right ascension is greater than his mean longitude corrected as above shewn, we must add the equation of time to the apparent to obtain the mean time; and when it is less, we must subtract. To convert mean time into apparent, we must subtract in the former case, and add in the latter.

Tables of the equation of time are computed by this rule, for the use of astronomers: they are either calculated for the noon of each day, as given in the Nautical and some other almanacks; or for every degree of the sun's place in the ecliptic. But a table of this kind will not answer accurately for many years, on account of the precession and other causes, which render a frequent revisal of the calculations necessary.

61 Smaller divisions of time.

The smaller divisions of time were anciently measured by the phases of the moon. It is well known that the moon changes once every 29 or 30 days, and that the interval from one new moon to another is called a *lunation*, or, in common language, a *month*. There are about twelve lunations in a year. Hence the year was divided into twelve months. In ancient times people were placed upon eminences on purpose to watch the first appearance of the new moon, when their month began. It was customary for these persons to proclaim the first appearance of the moon. Hence the first day of every month was called *Calendæ*; from which term the word calendar is derived. Almost all nations have divided the year into twelve months, because the seasons nearly return in that period. But they soon perceived that twelve lunar months were far from making a complete year or revolution of the sun. They were anxious, however, to be able to divide the solar year into a precise number of lunar months, because many of the feasts depended upon particular new moons. Various contrivances were fallen upon for this purpose without much success, till at last Meton, a Greek philosopher, announced that 19 years contained exactly 235 lunations: an affirmation which is within $2\frac{1}{8}$ hours of being exact. To make every year correspond as nearly as possible to the lunar, he divided the year into 12 months, consisting alternately of 30 and 29 days each; at the end of every three years an intercalary month of 30 days was added, and at the end of the 19th year there was added an intercalary month of 29 days. So that at the end of 19 years the solar and lunar years began again on the same day their cycle of 19 years. This discovery of Meton appeared so admirable to the Greeks, that they engraved it in letters of gold in their public places. Hence the number which denotes the current year of that cycle is denominated *golden number*.

As the moon changes its appearance in a very remarkable degree every seven days, almost all nations have subdivided the month into periods of seven days, called *weeks*; the ancient Greeks were almost the only people who did not employ that division.

62 Roman year.

The Roman year in the time of Romulus consisted of 10 months only, of 30 or 31 days each, so that its length was 304 days only. Numa added 50 days to that year, and thus made it 354 days; and he added two additional months of 29 and 28 days by shortening some of the ancient months. He made the year commence on the first of January. Numa's year was still more than 11 days shorter than a complete revolution of the sun. To make it correspond with the seasons, it was necessary to intercalate three days; and these intercalations being left entirely to the priests, were converted into a state engine; being omitted, inserted, altered, and varied, as it suited the purposes of those magistrates whose views they favoured. The consequence was, what might have been expected, the most complete confusion and want of correspondence between the year and the seasons.

63 Reformed by Julius Cæsar,

Julius Cæsar undertook to remedy this inconvenience. He was both dictator and high pontiff, and of course the reformation of the calendar was his peculiar province. That the undertaking might be properly executed, he invited Sosigenes, an Egyptian mathematician, to come to his assistance. It was agreed upon to abandon the motions of the moon altogether, and to make the year correspond with those of the sun.

The reformation was made in the year 47 before the Christian era. Ninety days were added to that year, which was from that circumstance called *the year of confusion*, consisting of 445 days. Instead of 354 days, the year of Numa, Sosigenes made the year to consist of 365 days, dispersing the additional days among those months which had only 29 days. As the revolution of the sun employs nearly six hours more than 365 days, an additional day was intercalated every fourth year, so that every such year was to consist of 366 days. The additional day was inserted after the 23d of February, or the 7th before the calends of March; the day before the annual feast celebrated in commemoration of the flight of Tarquin from Rome. That feast was held the 6th before the calends of March.

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The intercalated day was also called the 6th before the calends of March. So that every fourth year there were two days denominated the 6th before the calends of March. Hence that year was called *bissextile*. In Britain it is denominated *leap year*. After the death of Julius Cæsar there was a degree of confusion respecting the intercalations, from the ignorance of the priests. Augustus corrected the mistake, and after that time the Julian period went on without any interruption.

It is obvious that the Julian year, though a great improvement upon the ancient Roman, was still imperfect. It went on the supposition that the revolution of the sun occupied precisely 365 days and 6 hours, which is about 11 minutes more than the truth. This error in the interval which elapsed between the reformation of Julius Cæsar and the year 1582, had accumulated till it amounted to 10 days; of course the year began 10 days later than it ought to have begun; and the same error had taken place respecting the seasons and the equinoctial points. Various attempts had been made to correct this error; at last it was corrected by Pope Gregory XIII. The Gregorian calendar commenced in the year 1582; the changes which he introduced were two in number. He ordered, that after the 4th of October 1582, ten days should be omitted, so that the day which succeeded the 4th was reckoned not the 5th but the 15th of the month. This corrected the error which had crept into the Julian year. To prevent any such error from accumulating again, he ordered that the secular years 1700, 1800, 1900, should not be bissextile but common years; that the secular year 2000 should be bissextile, the next three secular years common, the fourth again bissextile, and so on, as in the following table.

64 and by Gregory XIII.

1600 bissextile.	2100 common.	2600 common.
1700 common.	2200 ib.	2700 ib.
1800 ib.	2300 ib.	2800 bissextile.
1900 ib.	2400 bissextile.	2900 common.
2000 bissextile.	2500 common.	3000 ib.

In short these secular years only are bissextile whose number, omitting the cyphers, is divisible by 4.

The Gregorian calendar is sufficiently exact for the purposes of common life, though it does not correspond precisely with the revolution of the sun. The error will amount to a day in 3600 years, so that in the year 5200 it will be necessary to omit the additional day which ought to be added according to the rule laid down above.

The Gregorian calendar was immediately adopted by all the Roman Catholic kingdoms in Europe, but the Protestant states refused at first to accede to it. It was adopted by most of them on the continent about the beginning of the 18th century; but in England the change did not take place till 1752. From that year 11 days were omitted; the omission of the additional day in 1700 having made the difference between the Julian and Gregorian calendar amount to 11 days. The Julian calendar is called the *old style*, the Gregorian, the *new style*. At present the difference between them is 12 days, in consequence of the omission of the additional day in 1800.

Sect. III. *Of the Nature of the Sun.*

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The smallness of the sun's parallax is a demonstration of its immense size. We are certain that at the distance at which the sun appears to us under an angle of $0^{\circ}.53424$, the earth would be seen under an angle not exceeding $0^{\circ}.009$. Now, as the sun is obviously a spherical body as well as the earth; and as spheres are to each other as the cubes of their diameters, it follows from this, that the sun is at least 200,000 times bigger than the earth. By the exactest observations it has been ascertained, that the diameter of the sun is nearly 883,000 miles.

Dark spots are very frequently observed upon the surface of the sun. These were entirely unknown before the invention of telescopes, though they are sometimes of sufficient magnitude to be discerned by the naked eye, only looking through a smoked glass to prevent the brightness of the luminary from destroying the sight. The spots are said to have been first discovered in the year 1611; and the honour of the discovery is disputed betwixt Galileo and Scheiner, a German Jesuit at Ingolstadt. But whatever merit Scheiner might have in the priority of the discovery, it is certain that Galileo far exceeded him in accuracy, though the work of Scheiner has considerable merit, as containing observations selected from above 3000, made by himself. Since his time the subject has been carefully studied by all the astronomers in Europe.

65 Solar spots when first discovered.

There is great variety in the magnitudes of the solar spots; the difference is chiefly in superficial extent of length and breadth; their depth or thickness is very small; some have been so large, as by computation to be capable of covering the continents of Asia and Africa; nay, the whole surface of the earth, or even five times its surface. The diameter of a spot, when near the middle of the disk, is measured by comparing the time it takes in passing over a cross hair in a telescope, with the time wherein the whole disk of the sun passes over the same hair; it may also be measured by the micrometer; and by either of these methods we may judge how many times the diameter of the spot is contained in the diameter of the sun. Spots are subject to increase and diminution of magnitude, and seldom continue long in the same state. They are of various shapes; most of them having a deep black nucleus surrounded by a dusky cloud, whereof the inner parts near the black are a little brighter than the outskirts. They change their shapes, something in the manner that our clouds do; though not often so suddenly; thus, what is of a certain figure to-day, shall to-morrow, or perhaps in a few hours, be of a different one; what is now but one spot, shall in a little time be broken into two or three; and sometimes two or three spots shall coalesce, and be united into one. Dr Long, many years since, while he was viewing the image of the sun through a telescope cast upon white paper, saw one roundish spot, by estimation not much less than the diameter of our earth, break into two, which receded from one another with prodigious velocity. This observation was singular at the time; for though several writers had taken notice of this after it was done, none of them had been making any observation at the time it was actually doing.

66 Dr Long's account of them.

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The number of spots on the sun is very uncertain; sometimes there are a great many, sometimes very few; and sometimes none at all. Scheiner made observations on the sun from 1611 to 1629; and says he never found its disk quite free of spots, excepting a few days in December 1624. At other times he frequently saw 20, 30, and in the year 1625 he was able to count 50 spots on the sun at a time. In an interval afterwards of 20 years, from 1650 to 1670, scarce any spots were to be seen, and since that time some years have furnished a great number of spots, and others none at all; but since the beginning of the last century, not a year passed wherein some were not seen; and at present, says Mr Cassini, in his *Elemens d'Astronomie* published in 1740, they are so frequent, that the sun is seldom without spots, and often shows a good number of them at a time.

From these phenomena, it is evident, that the spots are not endowed with any permanency; nor are they at all regular in their shape, magnitude, number, or in the time of their appearance or continuance. Hevelius observed one that arose and vanished in 16 or 17 hours; nor has any been observed to continue longer than 70 days, which was the duration of one in the year 1676. Those spots that are formed gradually, are gradually dissolved; while those that arise suddenly, are for the most part suddenly dissolved. When a spot disappears, that part where it was generally becomes brighter than the rest of the sun, and continues so for several days: on the other hand, those bright parts (called *faculæ*, as the others are called *maculæ*) sometimes turn to spots.

67 The solar spots move from west to east.

The solar spots appear to have a motion which carries them across the sun's disk. Every spot, if it continues long enough without being dissolved, appears to enter the sun's disk on the east side, to go from thence with the velocity continually increasing till it has gone half its way; and then to move slower and slower, till it goes off at the west side; after which it disappears for about the same space of time that it spent in crossing the disk, and then enters upon the east side again, nearly in the same place, and crosses it in the same track, and with the same unequal motion as before. This apparent inequality in the motion of the spots is purely optical, and is in such proportion as demonstrates them to be carried round equably or in a circle, the plane of which continued passes through or near the eye of a spectator upon the earth.

Besides the real changes of the spots already mentioned, there is another which is purely optical, and is owing to their being seen on a globe differently turned towards us. If we imagine the globe of the sun to have a number of circles drawn upon its surface, all passing through the poles, and cutting his equator at equal distances, these circles which we may call meridians, if they were visible, would appear to us at unequal distances, as in fig. 2. Now, suppose a spot were round, and so large as to reach from one meridian to another, it would appear round only at *g*, when it was in the middle of that half of the globe which is towards our earth; for then we view the full extent of it in length and breadth: in every other place it turns away from us, and appears narrower, though of the same length, the farther it is from the middle; and on its coming on at *a*, and going off at *n*, it appears as small as a thread, the thin edge being then all that we see.

These spots have made us acquainted with a very important phenomenon, namely the *rotation* of the sun upon its axis. Amidst the changes which these spots are continually undergoing, regular motions may be detected, agreeing exactly with the motion of the surface of the sun, on the supposition that this luminary revolves round an axis almost perpendicular to the ecliptic in the same direction with its motion in its orbit round the earth. By a careful examination of the motion of these spots, it has been ascertained that the sun turns round its axis in about 25 days and a half, and that its equator is inclined to the ecliptic about 7°.5.

The spots on the sun's disk are almost always confined to a zone, extending about 30°.5 on each side of the equator. Sometimes, however, they have been observed at the distance of 39°.5 from the equator of the sun.

Bouguer demonstrated, by a number of curious experiments on the sun's light, that the intensity of the light is much greater toward the centre of the sun's disk than towards its circumference. Now, when a portion of the sun's surface is transported by the rotation of that luminary from the centre to the circumference of his disk, as it is seen under a smaller angle, the intensity of its light, instead of diminishing, ought to increase. Hence it follows, that part of the light which issues from the sun towards the circumference of his disk, must be somehow or other prevented from making its way to the earth. This cannot be accounted for, without supposing that the sun is surrounded by a dense atmosphere, which, being traversed obliquely by the rays from the circumference, intercepts more of them than of those from the centre which pass it perpendicularly.

68 Account of the phenomena by different observers.

The phenomena of the solar spots, as delivered by Scheiner and Hevelius, may be summed up in the following particulars. 1. Every spot which hath a nucleus, or considerably dark part, hath also an umbra, or fainter shade, surrounding it. 2. The boundary between the nucleus and umbra is always distinct and well defined. 3. The increase of a spot is gradual, the breadth of the nucleus and umbra dilating at the same time. 4. In like manner, the decrease of a spot is gradual, the breadth of the nucleus and umbra contracting at the same time. 5. The exterior boundary of the umbra never consists of sharp angles; but is always curvilinear, how irregular soever the outline of the nucleus may be. 6. The nucleus of a spot, whilst on the decrease, often changes its figure by the umbra encroaching irregularly upon it, insomuch that in a small space of time new encroachments are discernible, whereby the boundary between the nucleus and umbra is perpetually varying. 7. It often happens, by these encroachments, that the nucleus of a spot is divided into two or more nuclei. 8. The nuclei of the spots vanish sooner than the umbra. 9. Small umbræ are often seen without nuclei. 10. An umbra of any considerable size is seldom seen without a nucleus in the middle of it. 11. When a spot which consisted of a nucleus and umbra is about to disappear, if it is not suc-

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ceeded by a *facula*, or spot brighter than the rest of the disk, the place where it was is soon after not distinguishable from the rest.

In the Philosophical Transactions, vol. lxiv. Dr Wilson, professor of astronomy at Glasgow, hath given a dissertation on the nature of the solar spots, and mentions the following appearances. 1. When the spot is about to disappear on the western edge of the sun's limb, the eastern part of the umbra first contracts, then vanishes, the nucleus and western part of the umbra remaining; then the nucleus gradually contracts and vanishes, while the western part of the umbra remains. At last this disappears also; and if the spot remains long enough to become again visible, the eastern part of the umbra first becomes visible, then the nucleus; and when the spot approaches the middle of the disk, the nucleus appears environed by the umbra on all sides, as already mentioned. 2. When two spots lie very near to one another, the umbra is deficient on that side which lies next to the other spot: and this will be the case, though a large spot should be contiguous to one much smaller; the umbra of the large spot will be totally wanting on that side next the small one. If there are little spots on each side of the large one, the umbra does not totally vanish; but appears flattened or pressed in towards the nucleus on each side. When the little spots disappear, the umbra of the large one extends itself as usual. This circumstance, he observes, may sometimes prevent the disappearance of the umbra in the manner above mentioned; so that the western umbra may disappear before the nucleus, if a small spot happens to break out on that side.

In the same volume, p. 337. Mr Wollaston observes, that the appearances mentioned by Dr Wilson are not constant. He positively affirms, that the faculæ or bright spots on the sun are often converted into dark ones. "I have many times (says he) observed, near the eastern limb, a bright facula just come on, which has the next day shown itself as a spot, though I do not recollect to have seen such a facula near the western one after a spot's disappearance. Yet, I believe, both these circumstances have been observed by others; and perhaps not only near the limbs. The circumstance of the faculæ being converted into spots, I think I may be sure of. That there is generally (perhaps always) a mottled appearance over the face of the sun, when carefully attended to, I think I may be as certain. It is most visible towards the limbs, but I have undoubtedly seen it in the centre; yet I do not recollect to have observed this appearance, or indeed any spots, towards the poles. Once I saw, with a twelve inch reflector, a spot burst to pieces while I was looking at it. I could not expect such an event, and therefore cannot be certain of the exact particulars; but the appearance, as it struck me at the time, was like that of a piece of ice when dashed on a frozen pond, which breaks to pieces and slides in various directions." He also acquaints us, that the nuclei of the spots are not always in the middle of the umbræ; and gives the figure of one

69 Mr Dunn's account.

seen in November 13th 1773, which is a remarkable instance to the contrary. Mr Dunn, however, in his new Atlas of the Mundane System, gives some particulars very different from the above. "The face of the sun (says he) has frequently many large black spots, of various forms and dimensions, which move from east to west, and round the sun, according to some observations in 25 days, according to others in 26, and according to some in 27 days. The black or central part of each spot is in the middle of a great number of very small ones, which permit the light to pass between them. The small spots are scarce ever in contact with the central ones: but, what is most remarkable, when the whole spot is near the limb of the sun, the surrounding small ones form nearly a straight line, and the central part projects a little over it, like Saturn in his ring."

70 Herschel observations.

Dr Herschel, with a view of ascertaining more accurately the nature of the sun, made frequent observations upon it from the year 1779 to the year 1794. He imagines that the dark spots on the sun are mountains on its surface, which, considering the great attraction exerted by the sun upon bodies placed at its surface, and the slow revolution it has upon its axis, he thinks may be more than 300 miles high, and yet stand very firmly. He says, that in August 1792, he examined the sun with several powers from 90 to 500; and it evidently appeared that the dark spots are the opaque ground or body of the sun; and that the luminous part is an atmosphere, which, being interrupted or broken, gives us a view of the sun itself. Hence he concludes, that the sun has a very extensive atmosphere, which consists of elastic fluids that are more or less lucid and transparent; and of which the lucid ones furnish us with light. This atmosphere, he thinks, is not less than 1843, nor more than 2765 miles in height; and, he supposes, that the density of the luminous solar clouds need not be much more than that of our aurora borealis, in order to produce the effects with which we are acquainted. The sun then, if this hypothesis be admitted, is similar to the other globes of the solar system, with regard to its solidity—its atmosphere—its surface diversified with mountains and valleys—its rotation on its axis—and the fall of heavy bodies on its surface; it therefore appears to be a very eminent, large, and lucid planet, the primary one in our system, disseminating its light and heat to all the bodies with which it is connected.

Dr Herschel has lately given up the use of the old terms such as *spots*, *nuclei*, *penumbræ*, &c. and has introduced a number of new terms, which he considers as more precise. It will be necessary, before we proceed farther, to insert his explanation of these terms.

71 Explanation of his terms.

"The expressions," says he, "which I have used are *openings*, *shallows*, *ridges*, *nodules*, *corrugations*, *indentations*, and *pores*.

"*Openings* are those places where, by the accidental removal of the luminous clouds of the sun, its own solid body may be seen; and this not being lucid, the openings through which we see it may, by a common telescope, be mistaken for mere black spots, or their nuclei.

"*Shallows* are extensive and level depressions of the luminous solar clouds, generally surrounding the openings to a considerable distance. As they are less luminous than the rest of the sun, they seem to have some distant, though very imperfect resemblance to penumbræ; which might occasion their having been called so formerly.

"*Ridges* are bright elevations of luminous matter, extended in rows of an irregular arrangement.

"*Nodules* are also bright elevations of luminous matter,

ter, but confined to a small space. These nodules, and ridges, on account of their being brighter than the general surface of the sun, and also differing a little from it in colour, have been called faculæ, and luculi.

"*Corrugations*, I call that very particular and remarkable unevenness, ruggedness, or asperity, which is peculiar to the luminous solar clouds, and extends all over the surface of the globe of the sun. As the depressed parts of the corrugations are less luminous than the elevated ones, the disk of the sun has an appearance which may be called mottled.

Indentations are the depressed or low parts of the corrugations; they also extend over the whole surface of the luminous solar clouds.

Pores are very small holes or openings, about the middle of the indentations.

From the numerous observations of this philosopher he has drawn the following conclusions:—

72 Openings.

1. Openings are places where the luminous clouds of the sun are removed: large openings have generally shallows about them; but small openings are generally without shallows. They have generally ridges and nodules about them, and they have a tendency to run into each other. New openings often break out near other openings. Hence he supposes that the openings are occasioned by an elastic but not luminous gas, which comes up through the pores and incipient openings, and spreads itself on the luminous clouds, forcing them out of its way, and widening its passage. Openings sometimes differ in colour; they divide when decayed; sometimes they increase again; but when divided they usually decrease and vanish; sometimes they become large indentations, and sometimes they turn into pores.

73 Shallows.

2. Shallows are depressed below the general surface of the sun, and are places from which the luminous solar clouds of the upper regions are removed. Their thickness is visible; sometimes they exist without openings in them. Incipient shallows come from the openings, or branch out from shallows already formed, and go forward. He supposes that the shallows are occasioned by something coming out of the openings, which, by its propelling motion, drives away the luminous clouds from the place where it meets with the least resistance; or which, by its nature, dissolves them as it comes up to them. If it be an elastic gas, its levity must be such as to make it ascend through the inferior region of the solar clouds, and diffuse itself among the superior luminous matter.

74 Ridges.

3. Ridges are elevations above the general surface of the luminous clouds of the sun. One of them, which he measured, extended over an angular space of 2′ 45″.9, which is nearly 75,000 miles.

Ridges generally accompany openings: but they often also exist in places where there are no openings. They usually disperse very soon. He supposes, that the openings permit a transparent elastic fluid to come out, which disturbs the luminous matter on the top, so as to occasion ridges, and nodules; or, more precisely, that some elastic gas, acting below the luminous clouds, lifts them up, or increases them; and at last forces itself a passage through them, by throwing them aside.

75 Nodules.

4. Nodules are small, but highly elevated luminous places. He thinks that they may be ridges fore-shortened.

5. Corrugations consist of elevations and depressions. They extend all over the surface of the sun; they change their shape and situation; they increase, diminish, divide, and vanish quickly. Dispersed ridges and nodules form corrugations.

76 Pores.

6. The dark places of corrugations are indentations. Indentations are usually without openings, though in some places they contain small ones. They change to openings, and are of the same nature as shallows. They are low places, which often contain very small openings. They are of different sizes, and are extended all over the sun. With low magnifying powers they appear like points. The low places of indentations are *pores*. Pores increase sometimes, and become openings: they vanish quickly.

"It must be sufficiently evident," says Dr Herschel, "from what we have shown of the nature of openings, shallows, ridges, nodules, corrugations, indentations, and pores, that these phenomena could not appear, if the shining matter of the sun were a liquid; since, by the laws of hydrostatics, the openings, shallows, indentations, and pores, would instantly be filled up; nor could ridges and nodules preserve their elevation for a single moment. Whereas, many openings have been known to last for a whole revolution of the sun; and extensive elevations have remained supported for several days. Much less can it be an elastic fluid of an atmospheric nature: this would be still more ready to fill up the low places, and to expand itself to a level at the top. It remains, therefore, only for us to admit this shining matter to exist in the manner of empyreal, luminous, or phosphoric clouds, residing in the higher regions of the solar atmosphere."

77 Two regions of solar clouds.

From his observations, Dr Herschel concludes, that there are two different regions of solar clouds; that the inferior clouds are opaque, and probably not unlike those of our planet; while the superior are luminous, and emit a vast quantity of light: that the opaque inferior clouds probably suffer but little of the light of the self-luminous superior clouds to come to the body of the sun. "The shallows about large openings," he observes, "are generally of such a size, as hardly to permit any direct illumination from the superior olouds to pass over them into the openings; and the great height and closeness of the sides of small ones, though not often guarded by shallows, must also have nearly the same effect. By this it appears, that the planetary clouds are indeed a most effectual curtain, to keep the brightness of the superior regions from the body of the sun.

"Another advantage arising from the planetary clouds of the sun, is of no less importance to the whole solar system. Corrugations are everywhere dispersed over the sun; and their indentations may be called shallows in miniature. From this we may conclude, that the immense curtain of the planetary solar clouds is everywhere closely drawn; and, as our photometrical experiments have proved that these clouds reflect no less than 469 rays out of 1000, it is evident that they must add a most capital support to the splendour of the sun, by throwing back so great a share of the brightness

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brightness coming to them from the illumination of the whole superior regions."

These observations are sufficient to prove, that the sun has an atmosphere of great density, and extending to a great height. Like our atmosphere, it is obviously subject to agitations, similar to our winds; and it is also transparent. The following is Dr Herschel's theoretical explanation of the solar phenomena.

78 Theory of the solar phenomena.

"We have admitted," says he, "that a transparent elastic gas comes up through the openings, by forcing itself a passage through the planetary clouds. Our observations seemed naturally to lead to this supposition, or rather to prove it; for, in tracing the shallows to their origin, it has been shown, that they always begin from the openings, and go forwards. We have also seen, that in one case, a particular bias given to incipient shallows, lengthened a number of them out in one certain direction, which evidently denoted a propelling force acting the same way in them all. I am, however, well prepared to distinguish between facts observed, and the consequences that in reasoning upon them we may draw from them; and it will be easy to separate them, if that should hereafter be required.

If, however, it be now allowed, that the cause we have assigned may be the true one, it will then appear, that the operations which are carried on in the atmosphere of the sun are very simple and uniform.

"By the nature and construction of the sun, an elastic gas, which may be called empyreal, is constantly formed. This ascends everywhere, by a specific gravity less than that of the general solar atmospheric gas contained in the lower regions. When it goes up in moderate quantities, it makes itself small passages among the lower regions of clouds: these we have frequently observed, and have called them pores. We have shewn that they are liable to continual and quick changes, which must be a natural consequence of their fleeting generation.

"When this empyreal gas has reached the higher regions of the sun's atmosphere, it mixes with other gases, which, from their specific gravity, have their residence there, and occasions decompositions which produce the appearance of corrugations. It has been shown, that the elevated parts of the corrugations are small self-luminous nodules, or broken ridges; and I have used the name of self-luminous clouds, as a general expression for all phenomena of the sun, in what shape soever they may appear, that shine by their own light. These terms do not exactly convey the idea affixed to them; but those of meteors, coruscations, inflammations, luminous wisps, or others, which I might have selected, would have been liable to still greater objections. It is true, that when speaking of clouds, we generally conceive something too gross, and even too permanent, to permit us to apply that expression properly to luminous decompositions, which cannot float or swim in air, as we are used to see our planetary clouds do. But it should be remembered, that, on account of the great compression arising from the force of the gravity, all the elastic solar gases must be much condensed; and that, consequently, phenomena in the sun's atmosphere, which in ours would be mere transitory coruscations, such as those of the aurora borealis, will be so compressed as to become much more efficacious and permanent.

"The great light occasioned by the brilliant superior regions, must scatter itself on the tops of the inferior planetary clouds, and, on account of their great density, bring on a very vivid reflection. Between the interstices of the elevated parts of the corrugations, or self-luminous clouds, which, according to the observations that have been given, are not closely connected, the light reflected from the lower clouds will be plainly visible, and, being considerably less intense than the direct illumination from the upper regions, will occasion that faint appearance which we have called indentations.

"This mixture of the light reflected from the indentations, and that which is emitted directly from the higher parts of the corrugations, unless very attentively examined by a superior telescope, will only have the resemblance of a mottled surface.

"When a quantity of empyreal gas, more than what produces only pores in ascending, is formed, it will make itself small openings; or, meeting perhaps with some resistance in passing upwards, it may exert its action in the production of ridges and nodules.

"Lastly, If still further an uncommon quantity of this gas should be formed, it will burst through the planetary regions of clouds, and thus will produce great openings; then, spreading itself above them, it will occasion large shallows, and, mixing afterwards gradually with other superior gases, it will promote the increase, and assist in the maintenance, of the general luminous phenomena.

"If this account of the solar appearances should be well founded, we shall have no difficulty in ascertaining the actual state of the sun, with regard to its energy in giving light and heat to our globe; and nothing will now remain, but to decide the question which will naturally occur, whether there be actually any considerable difference in the quantity of light and heat emitted from the sun at different times." This question he decides in the affirmative, considering the great number of spots as a proof that the sun is emitting a great quantity of light and heat, and the want of spots as the contrary. The first is connected with a warm and good season; the second, on the contrary, produces a bad one *.

* Phil. Trans. 1801 part ii. p. 265.

Chap. II. *Of the Moon.*

Next to the sun, the most conspicuous of all the heavenly bodies is the moon. The changes which it undergoes are more striking and more frequent than those of the sun, and its apparent motions much more rapid. Hence they were attended to even before those of the sun were known; a fact which explains why the first inhabitants of the earth reckoned their time by the moon's motions, and of course followed the lunar instead of the solar year. In considering the moon, we shall follow the same plan that we observed with respect to the sun. We shall first give an account of her apparent motions; and, secondly, of her nature as far as it has been ascertained. These topics shall occupy the two following sections.

Sect.

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Apparent Motions of the Heavenly Bodies.

Sect. I. *Of the Apparent Motions of the Moon.*

79 Moon's motion in her orbit.

The moon, like the sun, has a peculiar motion from east to west. If we observe her any evening when she is situated very near any fixed star, we shall find her, in 24 hours, about 13° to the east of that star; and her distance continually increases, till at last, after a certain number of days, she returns again to the same star from the west, having performed a complete revolution in the heavens. By a continued series of observations it has been ascertained, that the moon makes a complete revolution in 27.32166118036 days, or 27 days 7 hours 43′ 11″ 31‴ 35⁗. Such at least was the duration of its revolution at the commencement of 1700. But it does not remain always the same. From a comparison between the observations of the ancients and those of the moderns, it appears, that the mean motion of the moon in her orbit is accelerating. This acceleration, but just sensible at present, will gradually become more and more obvious. It is a point of great importance to discover, whether it will always continue to increase, or whether, after arriving at a certain maximum, it will again diminish. Observations could be of no service for many ages in the resolution of this question; but the Newtonian theory has enabled astronomers to ascertain that the acceleration is periodical.

The moon's motion in her orbit is still more unequal than that of the sun. In one part of her orbit she moves faster, in another slower. By knowing the time of a complete revolution, we can easily calculate the mean motion for a day, or any given time; and this mean motion is called the mean anomaly. The true motion is called the true anomaly: the difference between the two is called the equation. Now the moon's equation sometimes amounts to 6° 18′ 32″.

Her apparent diameter varies with the velocity of her angular motion. When she moves fastest, her diameter is largest; it is smallest when her angular motion is slowest. When smallest, the apparent diameter is 0.489420°; when biggest, it is 0.558030°. Hence it follows, that the distance of the moon from the earth

80 Elliptical.

varies. By following the same mode of reasoning, which we have detailed in the last chapter, Kepler ascertained that the orbit of the moon is an ellipse, having the earth in one of its foci. Her radius vector describes equal areas in equal times; and her angular motion is inversely proportional to the square of her distance from the earth.

81 Its eccentricity.

The eccentricity of the elliptic orbit of the moon, has been ascertained to amount to 0.0550368, (the mean distance of the earth being represented by unity); or the greater axis is to the smaller, nearly as 100,000 to 99,848.

That point of the moon's orbit which is nearest the earth, is called the *perigee;* the opposite point is the *apogee*. The line which joins these opposite points, is called the line of the moon's *apsides*. It moves slowly eastward, completing a sidereal revolution in 3232.46643 days, or nearly 9 years.

82 Moon's irregularities.

The inclination of the moon's orbit is also variable: the greatest inequality is proportional to the cosine of twice the sun's angular distance from the ascending node, and amounts when a maximum to 0.14679°.

Even the elliptical orbit of the moon represents but imperfectly her real motion round the earth; for that luminary is subjected to a great number of irregularities, evidently connected with the positions of the sun, which considerably alter the figure of her orbit. The three following are the principal of these.

1. The greatest of all, and the one which was first ascertained, is called by astronomers the moon's *evection*. 83 The evection.
It is proportional to the sine of twice the mean angular distance of the moon from the sun, minus the mean angular distance of the moon from the perigee of its orbit. Its maximum amounts to 1.3410°. In the oppositions and conjunctions of the sun and moon it coincides with the equation of the centre, which it always diminishes. Hence the ancients, who determined that equation by means of the eclipses, found that equation smaller than it is in reality.

2. There is another inequality in the motion of the moon, which disappears during the conjunctions and oppositions of the sun and moon; and likewise when these bodies are 90° distant from each other. It is at its maximum when their mutual distance is about 45°, and then amounts to about 0.594°. Hence it has been concluded to be proportional to the sine of twice the mean angular distance of the moon from the sun. This inequality is called the *variation*. It disappears during the eclipses. 84 Variations.

3. The moon's motion is accelerated when that of the sun is retarded, and the contrary. This occasions an irregularity called the *annual equation*. It follows exactly the same law with that of the *equation of the centre* of the sun, only with a contrary sine. At its maximum it amounts to 0.18576°. During eclipses, it coincides with the equation of the sun. 85 Annual equation.

The moon's orbit is inclined to the ecliptic at an angle of 6.14692°. The points where it intersects the ecliptic are called the *nodes*. Their position is not fixed in the heavens. They have a *retrograde* motion, that is to say, a motion contrary to that of the sun. This motion may be easily traced by marking the successive stars which the moon passes when she crosses the ecliptic. They make a complete revolution of the heavens in 6793.3009 days. The *ascending* node is that in which the moon rises above the ecliptic towards the north pole, the *descending* node that in which she sinks below the equator towards the south pole. The motion of the nodes is subjected to several irregularities, the greatest of which is proportional to the sine of twice the angular distance of the sun from the ascending node of the lunar orbit. When at a maximum, it amounts to 1.62945°. The inclination of the orbit itself is variable. Its greatest inequality amounts to 0.14679°. It is proportional to the cosine of the same angle on which the irregularity in the motion of the nodes depends. 86 Revolution of her nodes.

The apparent diameter of the moon varies as well as that of the sun, and in a more remarkable manner. When smallest, it measures 29.5′; when largest, 34′. This must be owing to the distance of the moon from the earth being subject to variations.

The great distance of the sun from the earth renders it difficult to determine its parallax, on account of its minuteness. This is not the case with the moon. The distance of that luminary from the earth may be determined without much difficulty. 87 Moon's parallax.

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Apparent Motions of the Heavenly Bodies.

Let BAG (fig. 10.) be one half of the earth, AC its semidiameter, S the sun, *m* the moon, and EKOL a quarter of the circle described by the moon in revolving from the meridian to the meridian again. Let CRS be the rational horizon of an observer at A, extended to the sun in the heavens; and HAO, his sensible horizon extended to the moon's orbit. ALC is the angle under which the earth's semidiameter AC is seen from the moon at L; which is equal to the angle OAL, because the right lines AO and CL, which include both those angles, are parallel. ASC is the angle under which the earth's semidiameter AC is seen from the sun at S: and is equal to the angle OA*f*, because the lines AO and CRS are parallel. Now, it is found by observation, that the angle OAL is much greater than the angle OA*f*; but OAL is equal to ALC, and OA*f* is equal to ASC. Now as ASC is much less than ALC, it proves that the earth's semidiameter AC appears much greater as seen from the moon at L than from the sun at S; and therefore the earth is much farther from the sun than from the moon. The quantities of these angles may be determined by observation in the following manner.

Let a graduated instrument, as DAE (the larger the better), having a moveable index with sight-holes, be fixed in such a manner, that its plane surface may be parallel to the plane of the equator, and its edge AD in the meridian: so that when the moon is in the equinoctial, and on the meridian ADE, she may be seen through the sight-holes when the edge of the moveable index cuts the beginning of the divisions at o, on the graduated limb DE; and when she is so seen, let the precise time be noted. Now as the moon revolves about the earth from the meridian to the meridian again in about 24 hours 48 minutes, she will go a fourth part round it in a fourth part of that time, viz. in 6 hours 12 minutes as seen from C, that is, from the earth's centre or pole. But as seen from A, the observer's place on the earth's surface, the moon will seem to have gone a quarter round the earth when she comes to the sensible horizon at O; for the index through the sights of which she is then viewed will be at *d*, 90 degrees from D, where it was when she was seen at E. Now let the exact moment when the moon is seen at O (which will be when she is in or near the sensible horizon) be carefully noted (G) that it may be known in what time she has gone from E to O; which time subtracted from 6 hours 12 minutes (the time of her going from E to L) leaves the time of her going from O to L, and affords an easy method for finding the angle OAL (called the *moon's horizontal parallax*, which is equal to the angle ALC) by the following analogy: As the time of the moon's describing the arc EO is to 90 degrees, so is 6 hours 12 minutes to the degrees of the arc D*d*E, which measures the angle EAL; from which subtract 90 degrees, and there remains the angle OAL, equal to the angle ALC, under which the earth's semidiameter AC is seen from the moon. Now, since all the angles of a right-lined triangle are equal to 180 degrees, or to two right angles, and the sides of a triangle are always proportional to the sines of the opposite angles, say, by the Rule of Three, As the sine of the angle ALC at the moon L, is to its opposite side AC, the earth's semidiameter, which is known to be 3985 miles; so is radius, viz. the sine of 90 degrees, or of the right angle ACL, to its opposite side AL, which is the moon's distance at L from the observer's place at A on the earth's surface; or, so is the sine of the angle CAL to its opposite side CL, which is the moon's distance from the earth's centre, and comes out at a mean rate to be 240,000 miles. The angle CAL is equal to what OAL wants of 90 degrees.

88 Another method.

Other methods have been fallen upon for determining the moon's parallax; of which the following is recommended as the best, by Mr Ferguson, though hitherto it has not been put in practice. "Let two observers be placed under the same meridian, one in the northern hemisphere, and the other in the southern, at such a distance from each other, that the arc of the celestial meridian included between their two zeniths may be at least 80 or 90 degrees. Let each observer take the distance of the moon's centre from his zenith, by means of an exceeding good instrument, at the moment of her passing the meridian: and these two zenith distances of the moon together, and their excess above the distance between the two zeniths, will be the distance between the two apparent places of the moon. Then, as the sum of the natural sines of the two zenith distances of the moon is to radius, so is the distance between her two apparent places to her horizontal parallax: which being found, her distance from the earth's centre may be found by the analogy mentioned above.

Thus, in fig. 11. let VECQ be the earth, M the moon, and *Zbaz* an arc of the celestial meridian. Let V be Vienna, whose latitude EV is 48° 20′ north; and C the Cape of Good Hope, whose latitude EC is 34° 30′ south: both which latitudes we suppose to be accurately determined beforehand by the observers. As these two places are on the same meridian *n* VEC *s*, and in different hemispheres, the sum of their latitudes 82° 50′ is their distance from each other. Z is the zenith of Vienna, and *z* the zenith of the Cape of of Good Hope; which two zeniths are also 82° 50′ distant from each other, in the common celestial meridian Z*z*. To the observer at Vienna, the moon's centre will appear at *a* in the celestial meridian; and at the same instant, to the observer at the Cape, it will appear at *b*. Now suppose the moon's distance Z*a* from the zenith of Vienna to be 38° 1′ 53″, and her distance *zb* from the zenith of the Cape of Good Hope to be 46° 4′ 41″: the sum of these two zenith distances ($Za+zb$) is 84° 6′ 34″; from which subtract 82° 50′, the distance of Z*z* between the zeniths of these two places, and there will remain 1° 16′ 34″ for the arc *b a*, or distance between the two apparent places of the moon's eentre, as seen from V and from C. Then, supposing

(G) Here proper allowance must be made for the refraction, which being about 34 minutes of a degree in the horizon, will cause the moon's centre to appear 34 minutes above the horizon when her centre is really in it.

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supposing the tabular radius to be 10,000,000, the natural sine of 38° 1′ 53″ (the arc *Za*) is 6,160,816, and the natural sine of 46° 4′ 41″ (the arc *zb*) is 7,202,821: the sum of both these sines is 13,363,637. Say therefore, As 13,363,637 is to 10,000,000, so is 1° 16′ 34″ to 57′ 18″, which is the moon's horizontal parallax.

If the two places of observation be not exactly under the same meridian, their difference of longitude must be accurately taken, that proper allowance may be made for the moon's declination whilst she is passing from the meridian of the one to the meridian of the other.

89 Moon's size.

From the theory of the parallax we know, that at the distance of the moon from the earth the apparent size of the earth would be to that of the moon as 21,352 to 5823. Their respective diameters must be proportional to these numbers, or almost as 11 to 3. Hence the bulk of the moon is 49 times less than that of the earth.

90 Her phases explained.

The different appearances, or *phases*, of the moon constitute some of the most striking phenomena of the heavens. When she emerges from the rays of the sun in an evening, she appears after sunset as a small crescent just visible. The size of this crescent increases continually as she separates to a greater distance from the sun, and when she is exactly in opposition to that luminary, she appears under the form of a complete circle. This circle changes into a crescent as she approaches nearer that luminary, exactly in the same manner it had increased, till at last she disappears altogether, plunging into the sun's rays in the morning at sunrise. The crescent of the moon being always directed towards the sun, indicates obviously that she borrows her light from that luminary; while the law of the variation of her phases, almost proportional to the versed side of the angular distance of the moon from the sun, demonstrates that her figure is spherical. Hence it follows, that the moon is an opaque spherical body.

These different phases of the moon are renewed after every conjunction. They depend upon the excess of the synodical movement of the moon above that of the sun, an excess which is usually termed the synodical motion of the moon. The duration of the synodical revolution of the moon in the mean period between two conjunctions is 29.530588 days. It is to the tropical year nearly in the ratio of 19 to 235, that is to say, that 19 solar years consist of about 235 lunar months.

The points of the lunar orbit, in which the moon is either in conjunction or opposition to the sun are called *syzigies*. In the first point the moon is said to be *new*, in the second to be *full*. The *quadratures* are those points in which the moon is distant from the sun 90° or 270°. When in these points, the moon is said to be in her *first* and *third quarter*. One half only of the moon is then illuminated or seen from the earth. As a more particular account of these phases may be deemed necessary, we subjoin the following explanation, which will perhaps be better understood by the generality of readers.

91 Reflects the sun's light.

The moon is an opaque globe like the earth, and shines only by reflecting the light of the sun: therefore, whilst that half of her which is towards the sun is enlightened, the other half must be dark and invisible. Hence she disappears when she comes between us and the sun; because her dark side is then towards us. When she is gone a little way forward, we see a little of her enlightened side: which still increases to our view as she advances forward, until she comes to be opposite to the sun; and then her whole enlightened side is towards the earth, and she appears with a round illuminated orb, which we call the *full moon;* her dark side being then turned away from the earth. From the full she seems to decrease gradually as she goes through the other half of her course; showing us less and less of her enlightened side every day, till her next change or conjunction with the sun, and then she disappears as before.

The moon has scarce any difference of seasons; her axis being almost perpendicular to the ecliptic. What is very singular, one half of her has no darkness at all; the earth constantly affording it a strong light in the sun's absence; while the other half has a fortnight's darkness and a fortnight's light by turns.

92 Earth appears a moon to our moon.

Our earth is thought to be a moon to the moon; waxing and waning regularly, but appearing 13 times as big, and affording her 13 times as much light as she does us. When she changes to us, the earth appears full to her; and when she is in her first quarter to us, the earth is in its third quarter to her; and *vice versa*.

But from one half of the moon the earth is never seen at all: from the middle of the other half, it is always seen over head; turning round almost 30 times as quick as the moon does. From the circle which limits our view of the moon, only one half of the earth's side next her is seen; the other half being hid below the horizon of all places on that circle. To her the earth seems to be the biggest body in the universe; for it appears 13 times as big as she does to us.

As the earth turns round its axis, the several continents, seas, and islands, appear to the moon's inhabitants like so many spots of different forms and brightness, moving over its surface; but much fainter at some times than others, as our clouds cover them or leave them. By these spots the lunarians can determine the time of the earth's diurnal motion, just as we do the motion of the sun: and perhaps they measure their time by the motion of the earth's spots: for they cannot have a truer dial.

93 How the lunar inhabitants can measure their year.

The moon's axis is so nearly perpendicular to the ecliptic, that the sun never removes sensibly from her equator; and the obliquity of her orbit, which is next to nothing as seen from the sun, cannot cause the sun to decline sensibly from her equator. Yet her inhabitants are not destitute of means for ascertaining the length of their year, though their method and ours must differ. For we can know the length of our year by the return of our equinoxes; but the lunarians having always equal day and night, must have recourse to another method; and we may suppose, they measure their year by observing when either of the poles of our earth begins to be enlightened, and the other to disappear, which is always at our equinoxes; they being conveniently situated for observing great tracts of land about our earth's poles which are entirely unknown to us. Hence we may conclude, that the year is of the same absolute length both to the earth and moon, though

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very different as to the number of days; we having $365\frac{1}{4}$ natural days, and the lunarians only $12\frac{1}{19}$, every day and night in the moon being as long as $29\frac{1}{2}$ on the earth.

94 Longitude easily found.

The moon's inhabitants on the side next the earth may as easily find the longitude of their places as we can find the latitude of ours. For the earth keeping constantly, or very nearly so, over one meridian of the moon, the east or west distances of places from that meridian are as easily found as we can find our distance from the equator by the altitude of our celestial poles.

As the sun can only enlighten that half of the earth which is at any moment turned towards him, and, being withdrawn from the opposite half, leaves it in darkness, so he likewise doth to the moon; only with this difference, that as the earth is surrounded by an atmosphere, we have twilight after the sun sets; but if the moon has none of her own, nor is included in that of the earth, the lunar inhabitants have an immediate transition from the brightest sunshine to the blackest darkness. For, let *t r k s w* be the earth, and A, B, C, D, E, F, G, H, the moon in eight different parts of her orbit. As the earth turns round its axis from west to east, when any place comes to *t*, the twilight begins there, and when it revolves from thence to *r* the sun S rises; when the place comes to *s* the sun sets, and when it comes to *w* the twilight ends. But as the moon turns round her axis, which is only once a-month, the moment that any part of her surface comes to *r* (see the moon at G), the sun rises there without any previous warning by twilight; and when the same point comes to *s* the sun sets, and that point goes into darkness as black as at midnight.

Fig. 12.

95 Her phases explained.

The moon being an opaque spherical body (for her hills take off no more from her roundness than the inequalities on the surface of an orange take off from its roundness), we can only see that part of the enlightened half of her which is towards the earth. And therefore, when the moon is at A, in conjunction with the sun S, her dark half is towards the earth, and she disappears, as at *a*, there being no light on that half to render it visible. When she comes to her first octant at B, or has gone an eighth part of her orbit from her conjunction, a quarter of her enlightened side is towards the earth; and she appears horned, as at *b*. When she has gone a quarter of her orbit from between the earth and sun to C, she shows us one half of her enlightened side, as at *c*, and we say she is a quarter old. At D, she is in her second octant; and by showing us more of her enlightened side she appears gibbous, as at *d*. At E, her whole enlightened side is towards the earth; and therefore she appears round, as at *e*; when we say it is full moon. In her third octant at F, part of her dark side being towards the earth, she again appears gibbous, and is on the decrease, as at *f*. At G, we see just one half of her enlightened side; and she appears half decreased, or in her third quarter, as at *g*. At H, we only see a quarter of her enlightened side, being in her fourth octant; where she appears horned, as at *h*. And at A, having completed her course from the sun to the sun again, she disappears; and we say it is new moon. Thus, in going from A to E, the moon seems continually to increase; and in going from E to A, to decrease in the same proportion; having like phases at equal distances from A to E, but as seen from the sun S she is always full.

96 Never appears perfectly round.

The moon appears not perfectly round when she is full in the highest or lowest part of her orbit, because we have not a full view of her enlightened side at that time. When full in the highest part of her orbit, a small deficiency appears on her lower edge; and the contrary when full in the lowest part of her orbit.

It is plain by the figure, that when the moon changes to the earth, the earth appears full to the moon; and *vice versa*. For when the moon is at A, new to the earth, the whole enlightened side of the earth is towards the moon; and when the moon is at E, full to the earth, its dark side is towards her. Hence a new moon answers to a full earth, and a full moon to a new earth. The quarters are also reversed to each other.

97 Agreeable representation of her phases.

Between the third quarter and change, the moon is frequently visible in the forenoon, even when the sun shines; and then she affords us an opportunity of seeing a very agreeable appearance, wherever we find a globular stone above the level of the eye, as suppose on the top of a gate. For, if the sun shines on the stone, and we place ourselves so as the upper part of the stone may just seem to touch the point of the moon's lowermost horn, we shall then see the enlightened part of the stone exactly of the same shape with the moon; horned as she is, and inclined the same way to the horizon. The reason is plain; for the sun enlightens the stone the same way as he does the moon: and both being globes, when we put ourselves into the above situation, the moon and stone have the same position to our eyes; and therefore we must see as much of the illuminated part of the one as of the other.

98 Nonagesimal degree.

The position of the moon's cusps, or a right line touching the points of her horns, is very differently inclined to the horizon at different hours of the same day of her age. Sometimes she stands, as it were, upright on her lower horn, and then such a line is perpendicular to the horizon: when this happens, she is in what the astronomers call *the nonagesimal degree;* which is the highest point of the ecliptic above the horizon at that time, and is 90° from both sides of the horizon where it is then cut by the ecliptic. But this never happens when the moon is on the meridian, except when she is at the very beginning of Cancer or Capricorn.

99 Eclipses of the moon.

The explanation of the phases of the moon leads us to that of the eclipses; those phenomena which formerly were the subjects of dread and error, but which philosophers have converted to the purposes of utility and instruction. The moon can only become eclipsed by the interposition of an opaque body, which intercepts from it the light of the sun; and it is obvious that this opaque body is the earth, because the eclipses of the moon never happen except when the moon is in opposition, and consequently when the earth is interposed between her and the sun. The globe of the earth projects behind it relatively to the motion of the sun a conical shadow, whose axis is the straight line that joins the centres of the earth and sun, and which terminates at the point when the apparent diameters of these two bodies become equal. The diameter of these bodies seen from the centre of the moon in opposition

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sition, are nearly in the proportion of 3 for the sun and 11 for the earth. Therefore, the conical shadow of the earth is at least thrice as long as the distance between the earth and moon, and its breadth at the point where it is traversed by the moon more than double the diameter of that luminary.

The moon, therefore, would be eclipsed every time that it is in opposition, if the plane of its orbit coincided with the ecliptic. But in consequence of the mutual inclination of these two planes, the moon, when in opposition, is often elevated above the earth's conical shadow, or depressed below it; and never can pass through that shadow unless when it is near the nodes. If the whole of the moon's disk plunges into the shadow, the eclipse is said to be *total;* if only a part of the disk enter the shadow, the eclipse is said to be *partial.*

100 Period of the eclipses.

The mean duration of a revolution of the sun relatively to the nodes of the lunar orbit is 346.61963 days, and is to the duration of a synodical revolution of the moon nearly as 223 to 19. Consequently, after a period of 223 lunar months, the sun and moon return nearly to the same situation relatively to the order of the lunar orbit. Of course the eclipses must return in the same order after every 223 lunations. This gives us an easy method of predicting them. But the inequalities in the motions of the sun and moon occasion sensible differences; besides the return of the two luminaries to the same points relatively to the nodes not being rigorously true, the deviations occasioned by this want of exactness alter at last the order of the eclipses observed during one of these periods.

The following explanation of the lunar eclipses being more particular, may be acceptable to some of our readers.

That the moon can never be eclipsed but at the time of her being full, and the reason why she is not eclipsed at every full, has been shown already. In fig. 13. let S be the sun, E the earth, RR the earth's shadow, and B the moon in opposition to the sun: In this situation the earth intercepts the sun's light in its way to the moon; and when the moon touches the earth's shadow at *v*, she begins to be eclipsed on her eastern limb *x*, and continues eclipsed until her western limb *y* leaves the shadow at *w:* at B she is in the middle of the shadow, and consequently in the middle of the eclipse.

101 Why the moon is visible when eclipsed.

The moon, when totally eclipsed, is not invisible if she be above the horizon and the sky be clear; but appears generally of a dusky colour, like tarnished copper, which some have thought to be the moon's native light. But the true cause of her being visible is the scattered beams of the sun, bent into the earth's shadow by going through the atmosphere; which, being more or less dense near the earth than at considerable heights above it, refracts or bends the sun's rays more inward, the nearer they are passing by the earth's surface, than those rays which go through higher parts of the atmosphere, where it is less dense according to its height, until it be so thin or rare as to lose its refractive power. Let the circle *f*, *g*, *h*, *i*, concentric to the earth, include the atmosphere whose refractive power vanishes at the height *f* and *i;* so that the rays W *f w* and V *i v* go on straight without suffering the least refraction: but all those rays which enter the atmosphere between *f* and *k*, and between *i* and *l*, on opposite sides of the earth, are gradually more bent inward as they go through a greater portion of the atmosphere, until the rays W *k* and V *l* touching the earth at *m* and *n*, are bent so much as to meet at *q*, a little short of the moon; and therefore the dark shadow of the earth is contained in the space *m o p q n*, where none of the sun's rays can enter; all the rest, R, R, being mixed by the scattered rays which are refracted as above, is in some measure enlightened by them; and some of those rays falling on the moon, give her the colour of tarnished copper or of iron almost red hot. So that if the earth had no atmosphere, the moon would be as invisible in total eclipses as she is when new. If the moon were so near the earth as to go into its dark shadow, suppose about *p o*, she would be invisible during her stay in it; but visible before and after in the fainter shadow RR.

When the moon goes through the centre of the earth's shadow she is directly opposite to the sun; yet the moon has been often seen totally eclipsed in the horizon, when the sun was also visible in the opposite part of it; for the horizontal refraction being almost 34 minutes of a degree, and the diameter of the sun and moon being each at a mean state but 32 minutes, the refraction causes both luminaries to appear above the horizon when they are really below it.

When the moon is full at 12 degrees from either of her nodes, she just touches the earth's shadow, but enters not into it. In fig. 14. let GH be the ecliptic, *e f* the moon's orbit where she is 12 degrees from the node at her full, *c d* her orbit where she is 6 degrees from the node, *a b* her orbit where she is full in the node, AB the earth's shadow, and M the moon. When the moon describes the line *e f*, she just touches the shadow, but does not enter into it; when she describes the line *c d*, she is totally, though not centrally, immersed in the shadow; and when she describes the line *a b*, she passes by the node at M in the centre of the shadow, and takes the longest line possible, which is a diameter, through it: and such an eclipse being both total and central, is of the longest duration, namely, 3 h. 57 m. 6 sec. from the beginning to the end, if the moon be at her greatest distance from the earth; and 3 h. 37 m. 26. sec. if she be at her least distance. The reason of this difference is, that when the moon is farthest from the earth, she moves slowest; and when nearest to it, quickest.

The moon's diameter, as well as the sun's, is supposed to be divided into 12 equal parts, called *digits;* and so many of these parts as are darkened by the earth's shadow, so many digits is the moon eclipsed. All that the moon is eclipsed above 12 digits, shows how far the shadow of the earth is over the body of the moon, on that edge to which she is nearest at the middle of the eclipse.

102 Lunar eclipses difficultly observed.

It is difficult to observe exactly either the beginning or ending of a lunar eclipse, even with a good telescope, because the earth's shadow is so faint and ill-defined about the edges, that when the moon is either just touching or leaving it, the obscuration of her limb is scarce sensible; and therefore the nicest observers can hardly be certain to four or five seconds of time. But both

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both the beginning and ending of solar eclipses are visibly instantaneous: for the moment that the edge of the moon's disk touches the sun's, his roundness seems a little broke on that part: and the moment she leaves it, he appears perfectly round again.

103 Eclipses of the sun.

The eclipses of the sun only take place during the conjunctions of the sun and moon, or when the moon is placed between the sun and the earth. They are owing to the moon concealing the sun from the earth, or to the earth being plunged in the shadow of the moon. The moon is indeed much smaller than the sun; but it is so much nearer to the earth that its apparent diameter does not differ much from the diameter of that luminary: and, in consequence of the changes which take place in the apparent diameter of these bodies, it happens that sometimes the apparent diameter of the moon is greater than that of the sun. If we suppose the centres of the sun and moon in the same straight line with the eye of a spectator placed on the earth, he will see the sun eclipsed. If the apparent diameter of the moon happens to surpass that of the sun, the eclipse will be *total*: but if the moon's diameter be smallest, the observer will see a luminous ring, formed by that part of the sun's disk which exceeds that of the moon's, and the eclipse will in that case be *annular*. If the centre of the moon is not in the same straight line which joins the observer and the centre of the sun, the eclipse can only be *partial*, as the moon can only conceal a *part* of the sun's disk. Hence there must be a great variety in the appearance of the solar eclipses. We may add also to these causes of variety the elevation of the moon above the horizon, which changes its apparent diameter considerably. For it is well known, that the moon's diameter appears larger when she is near the horizon than when she is elevated far above it. Now, as the moon's height above the horizon varies according to the longitude of the observer, it follows, that the solar eclipses will not have the same appearance to the observers situated in different longitudes. One observer may see an eclipse which does not happen relatively to another. In this respect the solar differ from the lunar eclipses, which are the same to all the inhabitants of the earth.

104 Number of eclipses in a year.

In any year, the number of eclipses of both luminaries cannot be less than two, nor more than seven; the most usual number is four, and it is very rare to have more than six. For the sun passes by both the nodes but once a-year, unless he passes by one of them in the beginning of the year; and, if he does, he will pass by the same node again a little before the year be finished; because, as these points move $19\frac{1}{3}$ degrees backwards every year, the sun will come to either of them 173 days after the other. And when either node is within 17 degrees of the sun at the time of new moon, the sun will be eclipsed. At the subsequent opposition, the moon will be eclipsed in the other node, and come round to the next conjunction again ere the former node be 17 degrees past the sun, and will therefore eclipse him again. When three eclipses fall about either node, the like number generally falls about the opposite; as the sun comes to it in 173 days afterwards; and six lunations contain but four days more. Thus, there may be two eclipses of the sun and one of the moon about each of her nodes. But when the moon changes in either of the nodes, she cannot be near enough the other node at the next full to be eclipsed; and in six lunar months afterwards she will change nearer the other node; in these cases, there can be but two eclipses in a year, and they are both of the sun.

A longer period than the above mentioned, for comparing and examining eclipses which happen at long intervals of time, is 557 years, 21 days, 18 hours, 30 minutes, 11 seconds; in which time there are 6890 mean lunations; and the sun and node meet again so nearly as to be but 11 seconds distant; but then it is not the same eclipse that returns, as in the shorter period above mentioned.

105 Why more eclipses of the moon than of the sun are observed.

Eclipses of the sun are more frequent than of the moon, because the sun's ecliptic limits are greater than the moon's; yet we have more visible eclipses of the moon than of the sun, because eclipses of the moon are seen from all parts of that hemisphere of the earth which is next her, and are equally great to each of those parts: but the sun's eclipses are visible only to that small portion of the hemisphere next him whereon the moon's shadow falls.

The moon's orbit being elliptical, and the earth in one of its focuses, she is once at her least distance from the earth, and once at her greatest in every lunation.

106 Total and annular eclipses.

When the moon changes at her least distance from the earth, and so near the node that her dark shadow falls upon the earth, she appears big enough to cover the whole disk of the sun from that part on which her shallow falls; and the sun appears totally eclipsed there for some minutes: but, when the moon changes at her greatest distance from the earth, and so near the node that her dark shadow is directed towards the earth, her diameter subtends a less angle than the sun's; and therefore she cannot hide his whole disk from any part of the earth, nor does her shadow reach it at that time; and to the place over which the point of her shadow hangs, the eclipse is annular, the sun's edge appearing like a luminous ring all round the body of the moon.

When the change happens within 17 degrees of the node, and the moon at her mean distance from the earth, the point of her shadow just touches the earth and she eclipseth the sun totally to that small spot whereon her shadow falls; but the darkness is not of a moment's continuance.

The moon's apparent diameter, when largest, exceeds the sun's, when least, only 1 minute 38 seconds of a degree; and in the greatest eclipse of the sun that can happen at any time and place, the total darkness continues no longer than whilst the moon is going 1 minute 38 seconds from the sun in her orbit, which is about 3 minutes and 13 seconds of an hour.

107 Extent of the moon's shadow and penumbra.

The moon's dark shadow covers only a spot on the earth's surface about 180 English miles broad, when the moon's diameter appears largest, and the sun's least; and the total darkness can extend no farther than the dark shadow covers. Yet the moon's partial shadow or penumbra may then cover a circular space 4900 miles in diameter, within all which the sun is more or less eclipsed, as the places are less or more distant from the centre of the penumbra. When the moon changes exactly

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exactly in the node, the penumbra is circular on the earth at the middle of the general eclipse; because at that time it falls perpendicularly on the earth's surface; but at every other moment it falls obliquely, and will therefore be elliptical; and the more so, as the time is longer before or after the middle of the general eclipse; and then much greater portions of the earth's surface are involved in the penumbra.

108
Beginning, ending, &c. of a solar eclipse.

When the penumbra first touches the earth, the general eclipse begins; when it leaves the earth, the general eclipse ends: from the beginning to the end the sun appears eclipsed in some part of the earth or other. When the penumbra touches any place, the eclipse begins at that place, and ends when the penumbra leaves it. When the moon changes in the node, the penumbra goes over the centre of the earth's disk as seen from the moon; and consequently, by describing the longest line possible on the earth, continues the longest upon it; namely, at a mean rate, 5 hours, 50 minutes; more, if the moon be at her greatest distance from the earth, because she then moves slowest; less if she be at her least distance, because of her quicker motion.

Fig. 13.

To make several of the above and other phenomena plainer, let S be the sun, E the earth, M the moon, and AMP the moon's orbit. Draw the right line W *e* from the western side of the sun at W, touching the western side of the moon at *c*, and the earth at *e*: draw also the right line V *d*, from the eastern side of the sun at V, touching the eastern side of the moon at *d*, and the earth at *e*: the dark space *c e d* included between those lines is the moon's shadow, ending in a point at *e*, where it touches the earth; because in this case the moon is supposed to change at M in the middle between A the apogee, or farthest point of her orbit from the earth, and P the perigee, or nearest point to it. For, had the point P been at M, the moon had been nearer the earth: and her dark shadow at *e* would have covered a space upon it about 180 miles broad, and the sun would have been totally darkened, with some continuance: but had the point A been at M, the moon would have been farther from the earth, and her shadow would have ended in a point a little above *e*, and therefore the sun would have appeared like a luminous ring all around the moon. Draw the right lines WX *d h* and VX *c g*, touching the contrary sides of the sun and moon, and ending on the earth at *a* and *b*; draw also the right line SXM, from the centre of the sun's disk, through the moon's centre to the earth; and suppose the two former lines WX *d h* and VX *c g* to revolve on the line SXM as an axis, and their points *a* and *b* will describe the limits of the penumbra TT on the earth's surface, including the large space *a b a*; within which the sun appears more or less eclipsed, as the places are more or less distant from the verge of the penumbra *a b*.

Draw the right line *y* 12 across the sun's disk, perpendicular to SXM the axis of the penumbra; then divide the line *y* 12 into twelve equal parts, as in the figure, for the twelve digits or equal parts of the sun's diameter; and at equal distances from the centre of the penumbra at *e* (on the earth's surface YY) to its edge *a b*, draw twelve concentric circles, marked with the numeral figures 1 2 3 4, &c. and remember that the moon's motion in her orbit AMP is from west to east, as from *s* to *t*. Then,

To an observer on the earth at *b*, the eastern limb of the moon at *d* seems to touch the western limb of the sun at W, when the moon is at M; and the sun's eclipse begins at *b*, appearing as at A, fig. 15. at the left hand; but at the same moment of absolute time, to an observer at *a* in fig. 14. the western edge of the moon at *c* leaves the eastern edge of the sun at V, and the eclipse ends, as at the right hand C, fig. 15. At the very same instant, to all those who live on the circle marked 1 on the earth A, in fig. 14. the moon M cuts off or darkens a twelfth part of the sun S, and eclipses him one digit, as at 1 in fig. 15.: to those who live on the circle marked 2 in fig. 14. the moon cuts off two twelfth parts of the sun, as at 2 in fig. 15.: to those on the circle 3, three parts; and so on to the centre at 12 in fig. 14. where the sun is centrally eclipsed, as at B in the middle of fig. 15.; under which figure there is a scale of hours and minutes, to show at a mean state how long it is from the beginning to the end of a central eclipse of the sun on the parallel of London; and how many digits are eclipsed at any particular time from the beginning at A to the middle at B, or the end at C. Thus, in 16 minutes from the beginning, the sun is two digits eclipsed; in an hour and five minutes, eight digits; and in an hour and 37 minutes, 12 digits.

By fig. 14. it is plain, that the sun is totally or centrally eclipsed but to a small part of the earth at any time, because the dark conical shadow *e* of the moon M falls but on a small part of the earth; and that the partial eclipse is confined at that time to the space included by the circle *a b*, of which only one half can be projected in the figure, the other half being supposed to be hid by the convexity of the earth E; and likewise, that no part of the sun is eclipsed to the large space YY of the earth, because the moon is not between the sun and any of that part of the earth; and therefore to all that part the eclipse is invisible. The earth turns eastward on its axis, as from *g* to *h*, which is the same way that the moon's shadow moves; but the moon's motion is much swifter in her orbit from *s t*; and therefore, although eclipses of the sun are of no longer duration on account of the earth's motion on its axis than they would be if that motion was stopped, yet in four minutes of time at most, the moon's swifter motion carries her dark shadow quite over any place that its centre touches at the time of greatest obscuration. The motion of the shadow on the earth's disk is equal to the moon's motion from the sun, which is about $30\frac{1}{2}$ minutes of a degree every hour at a mean rate: but so much of the moon's orbit is equal to $30\frac{1}{2}$ degrees of a great circle on the earth; and therefore the moon's shadow goes $30\frac{1}{2}$ degrees, or 1830 geographical miles on the earth in an hour, or $30\frac{1}{2}$ miles in a minute, which is almost four times as swift as the motion of a cannon-ball.

As seen from the sun or moon, the earth's axis appears differently inclined every day of the year, on account of keeping its parallelism throughout its annual course. In fig. 16. let EDON be the earth at the two equinoxes and the two solstices, NS its axis, N the north pole, S the south pole, ÆQ the equator,

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T the tropic of Cancer, *t* the tropic of Capricorn, and ABC the circumference of the earth's enlightened disk as seen from the sun or new moon at these times. The earth's axis has the position NES at the vernal equinox, lying towards the right hand, as seen from the sun or new moon; its poles N and S being then in the circumference of the disk; and the equator and all its parallels seem to be straight lines, because their planes pass through the observer's eye looking down upon the earth from the sun or moon directly over E, where the ecliptic FG intersects the equator Æ. At the summer solstice the earth's axis has the position NDS; and that part of the ecliptic FG, in which the moon is then new, touches the tropic of Cancer T at D. The north pole N, at that time inclining $23\frac{1}{2}$ degrees towards the sun, falls so many degrees within the earth's enlightened disk, because the sun is then vertical to D $23\frac{1}{2}$ degrees north of the equator or ÆQ; and the equator, with all its parallels, seem elliptic curves bending downward, or towards the south pole, as seen from the sun; which pole, together with $23\frac{1}{2}$ degrees all round it, is hid behind the disk in the dark hemisphere of the earth. At the autumnal equinox, the earth's axis has the position NOS, lying to the left hand as seen from the sun or new moon, which are then vertical to O, where the ecliptic cuts the equator ÆQ. Both poles now lie in the circumference of the disk, the north pole just going to disappear behind it, and the south pole just entering into it; and the equator with all its parallels seem to be straight lines, because their planes pass through the observer's eye, as seen from the sun, and very nearly so as seen from the moon. At the winter solstice, the earth's axis has the position NNS, when its south pole S inclining $23\frac{1}{2}$ degrees towards the sun, falls $23\frac{1}{2}$ degrees within the enlightened disk, as seen from the sun or new moon, which are then vertical to the tropic of Capricorn *t*, $23\frac{1}{2}$ degrees south of the equator ÆQ; and the equator, with all its parallels, seem elliptic curves bending upward; the north pole being as far hid behind the disk in the dark hemisphere as the south pole is come into the light. The nearer that any time of the year is to the equinoxes or solstices, the more it partakes of the phenomena relating to them.

Thus it appears, that from the vernal equinox to the autumnal, the north pole is enlightened: and the equator and all its parallels appear elliptical as seen from the sun, more or less curved as the time is nearer to, or farther from, the summer solstice; and bending downwards, or towards the south pole; the reverse of which happens from the autumnal equinox to the vernal. A little consideration will be sufficient to convince the reader, that the earth's axis inclines towards the sun at the summer solstice; from the sun at the winter solstice; and sidewise to the sun at the equinoxes: but towards the right hand, as seen from the sun at the vernal equinox; and towards the left hand at the autumnal. From the winter to the summer solstice, the earth's axis inclines more or less to the right hand, as seen from the sun; and the contrary from the summer to the winter solstice.

The different positions of the earth's axis, as seen from the sun at different times of the year, affect solar eclipses greatly with regard to particular places: yea, so far as would make central eclipses which fall at one time of the year invisible if they fell at another, even though the moon should always change in the nodes, and at the same hour of the day; of which indefinitely various affections, we shall only give examples for the times of the equinoxes and solstices.

109 Eclipses affected by the position of the earth's axis.

In the same diagram, let FG be part of the ecliptic, and IK, *ik*, *ik*, *ik*, part of the moon's orbit; both seen edgewise, and therefore projected into right lines; and let the intersections NODE be one and the same node at the above times, when the earth has the forementioned different positions; and let the spaces included by the circles P*ppp* be the penumbra at these times, as its centre is passing over the centre of the earth's disk. At the winter solstice, when the earth's axis has the position NNS, the centre of the penumbra P touches the tropic of Capricorn *t* in N at the middle of the general eclipse; but no part of the penumbra P touches the tropic of Cancer T. At the summer solstice, when the earth's axis has the position NDS (*i* D *k* being then part of the moon's orbit whose node is at D), the penumbra *p* has its centre at D, on the tropic of Cancer T, at the middle of the general eclipse, and then no part of it touches the tropic of Capricorn *t*. At the autumnal equinox, the earth's axis has the position NOS (*i* O *k* being then part of the moon's orbit), and the penumbra equally includes part of both tropics T and *t*, at the middle of the general eclipse: at the vernal equinox it does the same, because the earth's axis has the position NES; but, in the former of these two last cases, the penumbra enters the earth at A, north of the tropic of Cancer T, and leaves it at *m* south of the tropic of Capricorn *t*, having gone over the earth obliquely southward, as its centre described the line AO *m*: whereas, in the latter case, the penumbra touches the earth at *n*, south of the equator ÆQ, and describing the line *n* E *q* (similar to the former line AO*m* in open space), goes obliquely northward over the earth, and leaves it at *q*, north of the equator.

In all these circumstances the moon has been supposed to change at noon in her descending node: Had she changed in her ascending node, the phenomena would have been as various the contrary way, with respect to the penumbra's going northward or southward over the earth. But because the moon changes at all hours, as often in one node as in the other, and at all distances from them both at different times as it happens, the variety of the phases of eclipses are almost innumerable, even at the same places; considering also how variously the same places are situated on the enlightened disk of the earth, with respect to the penumbra's motion, at the different hours when eclipses happen.

When the moon changes 17 degrees short of her descending node, the penumbra P 18 just touches the northern part of the earth's disk, near the north pole N; and as seen from that place, the moon appears to touch the sun, but hides no part of him from sight. Had the change been as far short of the ascending node, the penumbra would have touched the southern part of the disk near the south pole S. When the moon changes 12 degrees short of the descending node, more than a third part of the penumbra P 12 falls on the northern parts of the earth at the middle of the general eclipse: Had she changed as far past the same node,

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as much of the other side of the penumbra about P would have fallen on the southern parts of the earth; all the rest in the expansum, or open space. When the moon changes 6 degrees from the node, almost the whole penumbra P 6 falls on the earth at the middle of the general eclipse. And, lastly, when the moon changes in the node at N, the penumbra PN takes the longest course possible on the earth's disk: its centre falling on the middle thereof, at the middle of the general eclipse. The farther the moon changes from either node, within 17 degrees of it, the shorter is the penumbra's continuance on the earth, because it goes over a less portion of the disk, as is evident by the figure.

110
Duration of eclipses in different parts of the earth.

The nearer that the penumbra's centre is to the equator at the middle of the general eclipse, the longer is the duration of the eclipse at all those places where it is central; because, the nearer that any place is to the equator, the greater is the circle it describes by the earth's motion on its axis; and so, the place moving quicker, keeps longer in the penumbra, whose motion is the same way with that of the place, though faster, as has been already mentioned. Thus (see the earth at D and the penumbra at 12) whilst the point *b* in the polar circle *a b c d* is carried from *b* to *c* by the earth's diurnal motion, the point *d* on the tropic of Cancer T is carried a much greater length from *d* to D; and therefore, if the penumbra's centre goes one time over *c* and another time over D, the penumbra will be longer in passing over the moving place *d* than it was in passing over the moving place *b*. Consequently, central eclipses about the poles are of the shortest duration; and about the equator, of the longest.

In the middle of summer, the whole frigid zone, included by the polar circle *a b c d*, is enlightened: and if it then happens that the penumbra's centre goes over the north pole, the sun will be eclipsed much the same number of digits at *a* as at *c;* but whilst the penumbra moves eastward over *c*, it moves eastward over *a;* because, with respect to the penumbra, the motions of *a* and *c* are contrary: for *c* moves the same way with the penumbra towards *d*, but *a* moves the contrary way towards *b;* and therefore the eclipse will be of longer duration at *c* than at *a*. At *a* the eclipse begins on the sun's eastern limb, but at *c* on his western: at all places lying without the polar circles, the sun's eclipses begin on his western limb, or near it, and end on or near his eastern. At those places where the penumbra touches the earth, the eclipse begins with the rising sun, on the top of his western or uppermost edge; and at those places where the penumbra leaves the earth, the eclipse ends with the setting sun, on the top of his eastern edge, which is then the uppermost, just at its disappearing in the horizon.

About the new moon, that part of the lunar disk which is not illuminated by the sun is perceptible, owing to the feeble light reflected on it by the hemisphere of the earth that is illuminated.

SECT. II. *Of the Nature of the Moon.*

111
Moon's size.

WE have seen that the moon is about 39 times smaller than the earth. Her diameter is generally reckoned about 2180 miles. This is to the diameter of the earth nearly as 20 to 73; therefore, the surface of the moon is to that of the earth (being as the squares of their diameters) nearly as 1 to $14\frac{1}{3}$. And, admitting the moon's density to be to that of the earth as 5 to 4, their respective quantities of matter will be as 1 to 39 very nearly.

112
Light.

Bouguer has shown, by a set of curious experiments, that the light emitted by the full moon is 300,000 times less intense than that of the sun. Even when concentrated by the most powerful mirrors, it produces no effect on the thermometer.

113
Spots on her surface.

Many duskish spots may be seen upon the moon's disk, even with the naked eye; and through a telescope, their number is prodigiously increased: she also appears very plainly to be more protuberant in the middle than at the edges, or to have the figure of a globe and not a flat circle. When the moon is horned or gibbous, the one side appears very ragged and uneven, but the other always exactly defined and circular. The spots in the moon always keep their places exactly; never vanishing, or going from one side to the other, as those of the sun do. We sometimes see more or less of the northern and southern, and eastern and western part of the disk or face; but this is owing to what is called her libration, and will hereafter be explained. The astronomers Florentius, Langrenus, John Hevelius of Dantzic, Grimaldus, Ricciolus, Cassini, and M. de la Hire, have drawn the face of the moon as she is seen through telescopes magnifying between 200 and 300 times. Particular care has been taken to note all the shining parts in her surface; and, for the better distinguishing them, each has been marked with a proper name. Langrenus and Ricciolus have divided the lunar regions among the philosophers, astronomers, and other eminent men; but Hevelius and others, fearing lest the philosophers should quarrel about the division of their lands, have endeavoured to spoil them of their property, by giving the names belonging to different countries, islands, and seas on earth, to different parts of the moon's surface, without regard to situation or figure. The names adopted by Ricciolus, however, are those which are generally followed, as the names of *Hipparchus*, *Tycho*, *Copernicus*, &c. are more pleasing to astronomers than those of Africa, the Mediterranean sea, Sicily, and Mount Ætna. Fig. 17. is a tolerably exact representation of the full moon in her mean libration, with the numbers to the principal spots according to Ricciolus, Cassini, Mayer, &c. The asterisk refers to one of the volcanoes discovered by Dr Herschel, to be afterwards more particularly noticed. The names are as follow:

* Herschel's Volcano.
1 Grimaldus.
2 Galilæus.
3 Aristarchus.
4 Keplerus.
5 Gassendus.
6 Shikardus.
7 Harpalus.
8 Heraclides.
9 Lansbergius.
10 Reinoldus.
11 Copernicus.
12 Helicon.
13 Capuanus.
14 Bullialdus.
15 Eratosthenes.
16 Timocharis.
17 Plato.
18 Archimedes.
19 Insula Sinus Medii.
20 Pitatus.
21 Tycho.
22 Eudoxus.
23 Aristoteles.
24 Manilius.
25 Menelaus.
26 Hermes.
27 Possidonius.
28 Dionysius.
29 Plinius.
30 { Casharina Cyrillus. Theophilus.
31 Fracastorius.

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31 Fracastorius.
32 { Promontorium acutum. Censorinus.
33 Mesala.
34 Promontorium Somnii.
35 Proclus.
36 Cleomedes.
37 Snellius et Furnerius.
38 Petavius.
39 Langrenus.
40 Taruntius.
A Mare Humorum.
B Mare Nubium.
C Mare Imbrium.
D Mare Nectaris.
E Mare Tranquillitatis.
F Mare Serenitatis.
G Mare Fœcunditatis.
H Mare Crisium.

114 Great inequalities on the surface of the Moon.

That there are prodigious inequalities on her surface, is proved by looking at her through a telescope, at any other time than when she is full; for then there is no regular line bounding light and darkness: but the confines of these parts appear as it were toothed and cut with innumerable notches and breaks: and even in the dark part, near the borders of the lucid surface, there are seen some small spaces enlightened by the sun's beams. Upon the fourth day after new moon, there may be perceived some shining points like rocks or small islands within the dark body of the moon; but not far from the confines of light and darkness there are observed other little spaces which join to the enlightened surface, but run out into the dark side, which by degrees change their figure, till at last they come wholly within the illuminated face, and have no dark parts round them at all. Afterwards many more shining spaces are observed to arise by degrees, and to appear within the dark side of the moon, which before they drew near to the confines of light and darkness were invisible, being without any light, and totally immersed in the shadow. The contrary is observed in the decreasing phases, where the lucid spaces which joined the illuminated surface by degrees recede from it, and, after they are quite separated from the confines of light and darkness, remain for some time visible, till at last they also disappear. Now it is impossible that this should be the case, unless these shining points were higher than the rest of the surface, so that the light of the sun may reach them.

115 Method of measuring the lunar mountains. Fig. 20.

Not content with perceiving the bare existence of these lunar mountains, astronomers have endeavoured to measure their height in the following manner. Let EGD be the hemisphere of the moon illuminated by the sun, ECD the diameter of the circle bounding light and darkness, and A the top of a hill within the dark part when it first begins to be illuminated. Observe with a telescope the proportion of the right line AE, or the distance of the point A from the lucid surface to the diameter of the moon ED; and because in this case the ray of light ES touches the globe of the moon, AEC will be a right angle by 16th prop. of Euclid's third book; and, therefore, in the triangle AEC having the two sides AE and EC, we can find out the third side AC; from which subducting BC or EC, there will remain AB the height of the mountain. Ricciolus affirms, that upon the fourth day after new moon he has observed the top of the hill called *St Catharine's* to be illuminated, and that it was distant from the confines of the lucid surface about a sixteenth part of the moon's diameter. Therefore, if CF=8, A E will be 1, and $AC^2=CE^2+AE^2$ by prop. 47. of Euclid's first book. Now, the square of CE being 64, and the square of AE being 1, the square of AC will be 65, whose square root is 8,062, which expresses the length of AC. From which deducting BC=8, there will remain AC=0,062. So that CB or CE is therefore to AB as 8 is to 0,062, that is, as 8000 is to 62. If the diameter of the moon therefore was known, the height of this mountain would also be known. This demonstration is taken from Dr Keill, who supposes the semidiameter of the moon to be 1182 miles; according to which, the mountain must be somewhat more than nine miles of perpendicular height: but astronomers having now determined the moon's semidiameter to be only 1090 miles, the height of the mountain will be nearly 8½ miles.

116 Height of the lunar mountains overrated.

In the former edition of this work, we could not help making some remarks on the improbability that the mountains of the moon, a planet so much inferior in size to the earth, should exceed in such vast proportion the highest of our mountains, which are computed at little more than one-third of the height just mentioned. Our remark is now confirmed by the observations of Dr Herschel. After explaining the method used by Galileo, Hevelius, &c. for measuring the lunar mountains, he tells us, that the former takes the distance of the top of a lunar mountain from the line that divides the illuminated part of the disk from that which is in the shade to be equal to one-twentieth of the moon's diameter; but Hevelius makes it only one twenty-sixth. When we calculate the height of such a mountain, therefore, it will be found, according to Galileo, almost 5¼ miles; and according to Hevelius 3¼ miles, admitting the moon's diameter to be 2180 miles. Mr Ferguson, however, says (Astronomy Explained, § 252.), that some of her mountains, by comparing their height with her diameter, are found to be three times higher than the highest hills on earth: and Keill, in his Astronomical Lectures, has calculated the height of St Catharine's hill, according to the observations of Ricciolus, and finds it nine miles.

117 Dr Herschel's observations on them.

Having premised these accounts, Dr Herschel explains his method of taking the height of a lunar mountain from observations made when the moon was not in her quadrature, as the method laid down by Hevelius answers only to that particular case; for in all others the projection must appear shorter than it really is. "Let SLM, says he, or *s l m*, (fig. 96.) be a line drawn from the sun to the mountain, touching the moon at L or *l*, and the mountain at M or *m*. Then, to an observer at E, or *e*, the lines LM, *l m*, will not appear of the same length, though the mountain should be of an equal height; for LM will be projected into *o n*, and *l m* into ON. But these are the quantities that are taken by the micrometer when we observe a mountain to project from the line of illumination. From the observed quantity *o n*, when the moon is not in her quadrature, to find LM, we have the following analogy. The triangles *o* OL, *r* ML, are similar; therefore L *o* : LO : : L *r* : LM, or $\frac{LO+o\,n}{L\,o}$=LM: but LO is the radius of the moon, and L *r* or *o n* is the observed distance of the mountain's projection; and L *o* is the sine of the angle ROL = *o* LS; which we may take to be the distance of the sun from the moon without any material error, and which therefore we may find at any given time from the ephemeris."

The telescope used in these observations was a Newtonian

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Newtonian reflector of six feet eight inches focal length, to which a micrometer was adapted, consisting of two parallel hairs, one of which was moveable by means of a fine screw. The value of the parts shown by the index was determined by a trigonometrical observation of a known object at a known distance, and was verified by several trials. The power was always 222, excepting where another is expressly mentioned; and this was also determined by experiment, which frequently differs from theory on account of some small errors in the data, hardly to be avoided. The moon having sufficient light, an aperture of no more than four inches was made use of; and, says Dr Herschel, "I believe, that for distinctness of vision, this instrument is perhaps equal to any that ever was made."

With this instrument he observed a prominence, which he calls a *rock*, situated near the *Lacus Niger* of Hevelius, and found that it projected 41.56″. To reduce this into miles, put R for the semidiameter of the moon in seconds, as given by the nautical almanack at the time of observation, and Q for the observed quantity, also in seconds and centesimals; then it will be in general, $R : 1090 :: Q : \frac{1090Q}{R} = on$ in miles.

Thus it is found, that 41.56″ is 46.79 miles. The distance of the sun from the moon at that time was, by the nautical almanack, about $93° 57\frac{1}{2}'$; the sine of which to the radius 1 is .9985, &c. and $\frac{on}{Lo}$ in this case is LM=46.85 miles. Then, by Hevelius's method, the perpendicular height of the rock is found to be about one mile. At the same time, a great many rocks, situated about the middle of the disk, projected from 25.92″ to 26.56″; which gives *o n* about 29.3 miles: so that these rocks are all less than half a mile high.

These observations were made on the 13th of November 1779. On the 13th of January 1780, examining the mountains of the moon, he found that there was not one of them fairly placed on level ground, which is very necessary for an exact measurement of the projection: for if there should be a declivity on the moon before the mountains, or a tract of hills placed so as to cast a shadow upon that part before them which would otherwise be illuminated, the projection would appear too large; and, on the contrary, should there be a rising ground before them, it would appear too little.

Proceeding in this cautious manner, Dr Herschel measured the height of many of the lunar prominences, and draws at last the following conclusions.—"From these observations I believe it is evident, that the height of the lunar mountains in general is greatly overrated; and that, when we have excepted a few, the generality do not exceed half a mile in their perpendicular elevation. It is not so easy to find any certain mountain exactly in the same situation it has been measured in before; therefore some little difference must be expected in these measures. Hitherto I have not had an opportunity of particularly observing the three mountains mentioned by Hevelius; nor that which Ricciolus found to project a sixteenth part of the moon's diameter. If Keill had calculated the height of this last-mentioned hill according to the theorem I had given, he would have found (supposing the observation to have been made, as he says, on the fourth day after new moon) that its perpendicular height could not well be less than between 11 and 12 miles. I shall not fail to take the first opportunity of observing these four, and every other mountain of any eminence; and if other persons, who are furnished with good telescopes and micrometers, would take the quantity of the projection of the lunar mountains, I make no doubt but that we would be nearly as well acquainted with their heights, as we are with the elevation of our own.

118 Caution to be observed in using Dollond's telescopes.

One caution I would beg leave to mention to those who may use the excellent $3\frac{1}{2}$ feet refractors of Mr Dollond. The admirable quantity of light, which on most occasions is so desirable, will probably give the measure of the projection somewhat larger than the true, if not guarded against by proper limitations placed before the object-glass. I have taken no notice of any allowance to be made for the refraction a ray of light must suffer in passing through the atmosphere of the moon, when it illuminates the top of the mountain, whereby its apparent height will be lessened, as we are too little acquainted with that atmosphere to take it into consideration. It is also to be observed, that this would equally affect the conclusions of Hevelius, and therefore the difference in our inferences would still remain the same."

In the continuation of his observations, Dr Herschel informs us that he had measured the height of one of the mountains that had been measured by Hevelius. "Antitaurus (says he), the mountain measured by Hevelius, was badly situated: because Mount Moschus and its neighbouring hills cast a deep shadow, which may be mistaken for the natural convexity of the moon. A good, full, but just measure, 25.105″; in miles, 29.27: therefore LM 31.7 miles, and the perpendicular height not quite half a mile. As great exactness was desired in this observation, it was repeated with very nearly the same result. Several other mountains were measured by the same method; and all his observations concurred in making the height of the lunar mountains much less than what former astronomers had done. Mount Lipulus was found to be near two-thirds of a mile; one of the Apennine mountains, between Lacus Thrasimenus and Pontus Euxinus, measured a mile and a quarter; Mons Armenia, near Taurus, two-thirds of a mile; Mons Leucoptera three quarters of a mile. Mons Sacer projected 45.625″; 'but (says he) I am almost certain that there are two very considerable cavities, or places where the ground descends below the level of the convexity, just before these mountains; so that these measures must of course be a good deal too large; but supposing them to be just, it follows, that *o n* is 50.193 miles, LM=64 miles, and the perpendicular height above one mile and three-fourths.'

119 Volcanoes discovered in the moon.

As the moon has on its surface mountains and valleys in common with the earth, some modern astronomers have discovered a still greater similarity, viz. that some of these are really volcanoes, emitting fire as those on earth do. An appearance of this kind was discovered some years ago by Don Ulloa in an eclipse of the sun. It was a small bright spot like a star near the margin of the moon, and which he at that time supposed to have been a hole with the sun's light shining

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ing through it. Succeeding observations, however, have induced astronomers to attribute appearances of this kind to the eruption of volcanic fire; and Dr Herschel has particularly observed several eruptions of the lunar volcanoes, the last of which he gives an account of in the Phil. Trans. for 1787. "April 19. 10 h. 36 m. sidereal time. I perceive (says he) three volcanoes in different places of the dark part of the new moon. Two of them are either already nearly extinct, or otherwise in a state of going to break out; which perhaps may be decided next lunation. The third shows an actual eruption of fire or luminous matter. I measured the distance of the crater from the northern limb of the moon, and found it 3′ 57.3″; its light is much brighter than the nucleus of the comet which M. Mechain discovered at Paris the 10th of this month.

"April 20. 10 h. 2 m. sidereal time. The volcano burns with greater violence than last night. Its diameter cannot be less than 3 sec. by comparing it with that of the Georgian planet: as Jupiter was near at hand, I turned the telescope to his third satellite, and estimated the diameter of the burning part of the volcano to be equal to at least twice that of the satellite; whence we may compute that the shining or burning matter must be above three miles in diameter. It is of an irregular round figure, and very sharply defined on the edges. The other two volcanoes are much farther towards the centre of the moon, and resemble large, pretty faint nebulæ, that are gradually much brighter in the middle; but no well defined luminous spot can be discerned in them. These three spots are plainly to be distinguished from the rest of the marks upon the moon; for the reflection of the sun's rays from the earth is, in its present situation, sufficiently bright, with a ten feet reflector, to show the moon's spots, even the darkest of them; nor did I perceive any similar phenomena last lunation, though I then viewed the same places with the same instrument.

"The appearance of what I have called the *actual fire*, or eruption of a volcano, exactly resembled a small piece of burning charcoal when it is covered by a very thin coat of white ashes, which frequently adhere to it when it has been some time ignited; and it had a degree of brightness about as strong as that with which such a coal would be seen to glow in faint daylight. All the adjacent parts of the volcanic mountain seemed to be faintly illuminated by the eruption, and were gradually more obscure as they lay at a greater distance from the crater. This eruption resembled much that which I saw on the 4th of May in the year 1783, but differed considerably in magnitude and brightness; for the volcano of the year 1783, though much brighter than that which is now burning, was not nearly so large in the dimensions of its eruption: the former seen in the telescope resembled a star of the fourth magnitude as it appears to the naked eye; this, on the contrary, shows a visible disk of luminous matter very different from the sparkling brightness of star light."

120 Conjectures concerning her substance.

Concerning the nature of the moon's substance there have been many conjectures formed. Some have imagined, that, besides the light reflected from the sun, the moon hath also some obscure light of her own, by which she would be visible without being illuminated by the sunbeams. In proof of this it is urged, that during the time of even total eclipses the moon is still visible, appearing of a dull red colour, as if obscured by a great deal of smoke. In reply to this it hath been advanced, that this is not always the case; the moon sometimes disappearing totally in the time of an eclipse, so as not to be discernible by the best glasses, while little stars of the fifth and sixth magnitudes were distinctly seen as usual. This phenomenon was observed by Kepler twice, in the years 1580 and 1583; and by Hevelius in 1620. Ricciolus and other Jesuits at Bologna, and many people throughout Holland, observed the same on April 14. 1642: yet at Venice and Vienna she was all the time conspicuous. In the year 1703, Dec. 23. there was another total obscuration. At Arles, she appeared of a yellowish brown; at Avignon, ruddy and transparent, as if the sun had shone through her; at Marseilles, one part was reddish and the other very dusky; and at length, though in a clear sky, she totally disappeared. The general reason for her appearance at all during the time of eclipses shall be given afterwards: but as for these particular phenomena, they have not yet, as far as we know, been satisfactorily accounted for.

Different conjectures have also been formed concerning the spots on the moon's surface. Some philosophers have been so taken with the beauty of the brightest places observed in her disk, that they have imagined them to be rocks of diamonds; and others have compared them to pearls and precious stones. Dr Keill and the greatest part of astronomers now are of opinion, that these are only the tops of mountains, which by reason of their elevation are more capable of reflecting the sun's light than others which are lower. The duskish spots, he says, cannot be seas, nor any thing of a liquid substance; because, when examined by the telescope, they appear to consist of an infinity of caverns and empty pits, whose shadows fall within them, which can never be the case with seas, or any liquid substance: but, even within these spots, brighter places are also to be observed; which, according to his hypothesis, ought to be the points of rocks standing up within the cavities. Dr Long, however, is of opinion, that several of the dark spots on the moon are really water. May not the lunar seas and lakes (says he) have islands in them, wherein there may be pits and caverns? And if some of these dark parts be brighter than others, may not that be owing to the seas and lakes being of different depths, and to their having rocks in some places and flats in others?

It has also been urged, that if all the dark spots observed on the moon's surface were really the shadows of mountains, or of the sides of deep pits, they could not possibly be so permanent as they are found to be; but would vary according to the position of the moon with regard to the sun, as we find shadows on earth are varied according as the earth is turned towards or from the sun. Accordingly it is pretended, that variable spots are actually discovered on the moon's disk, and that the direction of these is always opposite to the sun. Hence they are found among those parts which are soonest illuminated in the increasing moon, and in the decreasing moon lose their light sooner than the intermediate ones; running round, and appearing sometimes longer, and sometimes shorter. The permanent

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manent dark spots, therefore, it is said, must be some matter which is not fitted for reflecting the rays of the sun so much as the bright parts do: and this property, we know by experience, belongs to water rather than land; whence these philosophers conclude, that the moon, as well as our earth, is made up of land and seas.

121 Whether the moon has any atmosphere.

It has been a matter of dispute whether the moon has any atmosphere or not. The following arguments have been urged by those who take the negative side.

1. The moon constantly appears with the same brightness when there are no clouds in our atmosphere; which could not be the case if she were surrounded with an atmosphere like ours, so variable in its density, and so frequently obscured by clouds and vapours. 2. In an appulse of the moon to a star, when she comes so near it that part of her atmosphere is interposed between our eye and the star, refraction would cause the latter to seem to change its place, so that the moon would appear to touch it later than by her own motion she would do. 3. Some philosophers are of opinion, that because there are no seas or lakes in the moon, there is therefore no atmosphere, as there is no water to be raised up in vapours.

All these arguments, however, have been answered by other astronomers in the following manner. 1. It is denied that the moon appears always with the same brightness, even when our atmosphere appears equally clear. Hevelius relates, that he has several times found in skies perfectly clear, when even stars of the sixth and seventh magnitude were visible, that at the same altitude of the moon, and the same elongation from the earth, and with one and the same telescope, the moon and its maculæ do not appear equally lucid, clear, and conspicuous at all times; but are much brighter and more distinct at some times than at others. From the circumstances of this observation, say they, it is evident that the reason of this phenomenon is neither in our air, in the tube, in the moon, nor in the spectator's eye; but must be looked for in something existing about the moon. An additional argument is drawn from the different appearances of the moon already mentioned in total eclipses, which are supposed to be owing to the different constitutions of the lunar atmosphere.

122 Why the light is not refracted by the moon's atmosphere.

To the second argument Dr Long replies, that Sir Isaac Newton has shown (*Princip.* prop. 37. cor. 5.), that the weight of any body upon the moon is but a third part of what the weight of the same would be upon the earth; now the expansion of the air is reciprocally as the weight that compresses it: the air, therefore, surrounding the moon, being pressed together, by a weight, or being attracted towards the centre of the moon by a force equal only to one-third of that which attracts our air towards the centre of the earth, it thence follows, that the lunar atmosphere is only one-third as dense as that of the earth, which is too little to produce any sensible refraction of the stars light. Other astronomers have contended that such refraction was sometimes very apparent. M. Cassini says that he frequently observed Saturn, Jupiter, and the fixed stars, to have their circular figure changed into an elliptical one, when they approached either to the moon's dark or illuminated limb; though they own, that in other occultations no such change could be observed. With regard to the fixed stars, indeed, it has been urged, that granting the moon to have an atmosphere of the same nature and quantity as ours, no such effect as a gradual diminution of light ought to take place; at least, that we could by no means be capable of perceiving it. Our atmosphere is found to be so rare at the height of 44 miles as to be incapable of refracting the rays of light. This height is the 180th part of the earth's diameter; but since clouds are never observed higher than four miles, we must conclude that the vaporous or obscure part is only one 1980th. The mean apparent diameter of the moon is 31′ 29″, or 1889 seconds: therefore the obscure parts of her atmosphere, when viewed from the earth, must subtend an angle of less than one second; which space is passed over by the moon in less than two seconds of time. It can therefore hardly be expected that observation should generally determine whether the supposed obscuration takes place or not.

The third argument is necessarily inconclusive, because we know not whether there is any water in the moon or not; nor though this could be demonstrated, would it follow that the lunar atmosphere answers no other purpose than the raising of water into vapours There is, however, a strong argument in favour of the existence of a lunar atmosphere, taken from the appearance of a luminous ring round the moon in the time of solar eclipses. In the eclipse of May 1. 1706, Captain Stanyan, from Bern in Switzerland, writes, that "the sun was totally darkened there for the space of four minutes and a half: that a fixed star and planet appeared very bright: that his getting out of the eclipse was preceded by a blood-red streak of light from his left limb, which continued not longer than six or seven seconds of time; then part of the sun's disk appeared all on a sudden, brighter than Venus was ever seen in the night; and in that very instant gave light and shadow to things as strong as moon light uses to do." The publisher of this account observes that the red streak of light preceding the emersion of the sun's body, is a proof that the moon has an atmosphere; and its short continuance of five or six seconds shows that its height is not more than the five or six hundredth part of her diameter.

123 Luminous ring observed about the moon in total eclipses.

Fatio, who observed the same eclipse at Geneva, tells us, that "there was seen during the whole time of the total immersion, a whiteness which seemed to break out from behind the moon, and to encompass her on all sides equally: this whiteness was not well defined on its outward side, and the breadth of it was not a twelfth part of the diameter of the moon. The planet appeared very black, and her disk very well defined within the whiteness which encompassed it about, and was of the same colour as that of a white crown or halo, of about four or five degrees in diameter, which accompanied it, and had the moon for its centre. A little after the sun had begun to appear again, the whiteness, and the crown which had encompassed the moon, did entirely vanish." "I must add (says Dr Long), that this description is a little perplexed, either through the fault of the author or of the translator; for I suppose Fatio wrote in French: however, it plainly appears by it that the moon's atmosphere was visible, surrounded by a light of larger extent, which

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I think must be that luminous appearance (the zodiacal light) mentioned from Cassini." Flamstead, who published this account, takes notice, that, according to these observations, the altitude of the moon's atmosphere cannot be well supposed less than 180 geographical miles; and that probably this atmosphere was never discovered before the eclipse, by reason of the smallness of the refraction, and the want of proper observations.

An account of the same eclipse, as it appeared at Zurich, is given by Dr Scheuchzer, in the following words: "We had an eclipse of the sun, which was both total and annular; total, because the whole sun was covered by the moon; annular, not what is properly so called, but by refraction: for there appeared round the moon a bright shining, which was owing to the rays of the sun refracted through the atmosphere of the moon."

Dom. Cassini, from a number of accounts sent him from different parts, says, that in all those places where it was total, during the time of total darkness, there was seen round the moon a crown or broad circle of pale light, the breadth whereof was about a 12th part of the moon's diameter: that at Montpelier, where the observers were particularly attentive to see if they could distinguish the zodiacal light already mentioned, they took notice of a paler light of a larger extent, which surrounded the crown of light before mentioned, and spread itself on each side of it, to the distance of four degrees. He then mentions Kepler's opinion, that the crown of light which appears round the moon during the total darkness in an eclipse of the sun is caused by some celestial matter surrounding the moon, of sufficient density to receive the rays of the sun and send them to us; and that the moon may have an atmosphere similar to that of our earth, which may refract

124 the sun's light.

Dr Halley's account of a solar eclipse in 1715.

A total eclipse of the sun was observed on the 22d of April O. S. in the year 1715, by Dr Halley at London, and by M. Louville of the Academy of Sciences at Paris. Dr Halley relates, that "when the first part of the sun remained on his east side, it grew very faint, and was easily supportable to the naked eye even through the telescope, for above a minute of time before the total darkness; whereas, on the contrary, the eye could not endure the splendour of the emerging beams through the telescope even from the first moment. To this, two causes perhaps concurred: the one, that the pupil of the eye did necessarily dilate itself during the darkness, which before had been much contracted by looking on the sun: the other that the eastern parts of the moon, having been heated with a day near as long as 30 of ours, must of necessity have that part of its atmosphere replete with vapours raised by the so long continued action of the sun; and, by consequence, it was more dense near the moon's surface, and more capable of obstructing the sun's beams; whereas at the same time the western edge of the moon had suffered as long a night, during which there might fall in dews all the vapours that were raised in the preceding long day; and for that reason, that that part of its atmosphere might be seen much more pure and transparent.

"About two minutes before the total immersion, the remaining part of the sun was reduced to a very fine horn, whose extremities seemed to lose their acuteness, and to become round like stars; and for the space of about a quarter of a minute a small piece of the southern horn of the eclipse seemed to be cut off from the rest by a good interval, and appeared like an oblong star rounded at both ends; which appearance would proceed from no other cause but the inequalities of the moon's surface; there being some elevated parts thereof near the moon's southern pole, by whose interposition part of that exceedingly fine filament of light was intercepted. A few seconds before the sun was totally hid, there discovered itself round the moon a luminous ring, about a digit, or perhaps a tenth part of the moon's diameter in breadth. It was of a pale whiteness, or rather of a pearl colour, seeming to me a little tinged with the colour of the iris, and to be concentric with the moon; whence I concluded it the moon's atmosphere. But the great height of it, far exceeding that of our earth's atmosphere, and the observations of some who found the breadth of the ring to increase on the west side of the moon as the emersion approached, together with the contrary sentiments of those whose judgments I shall always revere, make me less confident, especially in a matter to which I gave not all the attention requisite. 125

Flashes of light appear to dart from behind the moon.

"Whatever it was, the ring appeared much brighter and whiter near the body of the moon than at a distance from it; and its outward circumference, which was ill defined, seemed terminated only by the extreme rarity of the matter of which it was composed, and in all respects resembled the appearance of an enlightened atmosphere seen from far: but whether it belonged to the sun or moon, I shall not pretend to determine. During the whole time of the total eclipse, I kept my telescope constantly fixed on the moon, in order to observe what might occur in this uncommon appearance; and I saw perpetual flashes or coruscations of light, which seemed for a moment to dart out from behind the moon, now here, now there, on all sides, but more especially on the western side, a little before the emersion; and about two or three seconds before it, on the same western side, where the sun was just coming out, a long and very narrow streak of dusky but strong red light seemed to colour the dark edge of the moon, though nothing like it had been seen immediately after the immersion. But this instantly vanished after the appearance of the sun, as did also the aforesaid luminous ring." 126

Mr Louville's observations.

Mr Louville relates, that a luminous ring of a silver colour appeared round the moon as soon as the sun was entirely covered by her disk, and disappeared the moment he recovered his light; and this ring was brightest near the moon, and grew gradually fainter towards its outer circumference, where it was, however, defined; that it was not equally bright all over, but had several breaks in it: but he makes no doubt of its being occasioned by the moon's atmosphere, and thinks that the breaks in it were occasioned by the mountains of the moon; he says also, that this ring had the moon, and not the sun, for its centre, during the whole time of its appearance. Another proof brought by him of the moon having an atmosphere is, that, towards the end of the total darkness, there was seen on that side of the moon on which the sun was going to appear, a piece of a circle, of a lively red, which might be

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be owing to the red rays that are least refrangible being transmitted through the moon's atmosphere in the greatest quantity: and that he might be assured this redness did not proceed from the glasses of his telescope, he took care to bring the red part into the middle of his glasses.

127 Lightning supposed to be frequent in the moon.

He lays great stress on the streaks of light which he saw dart instantaneously from different places of the moon during the time of total darkness, but chiefly near the eastern edge of the disk: these he takes to be lightning, such as a spectator would see flashing from the dark hemisphere of the earth, if he were placed upon the moon, and saw the earth come between himself and the sun. "Now (says Dr Long) it is highly probable, that if a man had, at any time, a view of that half of the earth where it is night, he would see lightning in some part of it or other." Louville farther observes, that the most mountainous countries are most liable to tempests; and that mountains being more frequent in the moon, and *higher, than on earth**, thunder and lightning must be more frequent there than with us; and that the eastern side of the moon would be most subject to thunder and lightning, those parts having been heated by the sun for half the month immediately preceding. It must here be observed, that Halley, in mentioning these flashes, says they seemed to come from behind the moon; and Louville, though he says they came sometimes from one part and sometimes from another, owns, that he himself only saw them near the eastern part of the disk; and that, not knowing at that time what it was that he saw, he did not take notice whether the same appearance was to be seen on other parts of the moon or not. He tells us, however, of an English astronomer, who presented the Royal Society with a draught of what he saw in the moon at the time of this eclipse; from which Louville seems to conclude, that lightnings had been observed by that astronomer near the centre of the moon's disk. "Now (says Mr Long) thunder and lightning would be a demonstration of the moon having an atmosphere similar to ours, wherein vapours and exhalations may be supported, and furnish materials for clouds, storms, and tempests. But the strongest proof brought by Louville of the moon having an atmosphere is this, that as soon as the eclipse began, those parts of the sun which were going to be hid by the moon grew sensibly palish as the former came near them, suffering beforehand a kind of imperfect eclipse or diminution of light; this would be owing to nothing else but the atmosphere of the moon, the eastern part whereof going before her reached the sun before the moon did.

* See N° 114. *et seq.*

128 Great height of the lunar atmosphere accounted for.

As to the great height of the lunar atmosphere, which from the breadth of the luminous ring, being about a whole digit, would upon a calculation come out 180 miles, above three times as high as the atmosphere of the earth, Louville thinks that no objection; since if the moon were surrounded with an atmosphere of the same nature with that which encompasses the earth, the gravitation thereof towards the moon would be but one third of that of our atmosphere towards the earth; and consequently its expansion would make the height of it three times as great from the moon as is the height of our atmosphere from the earth."

The same luminous ring has been observed in other total eclipses, and even in such as are annular, though without the luminous streaks or flashes of lightning above-mentioned; it is even taken notice of by Plutarch: however, some members of the academy at Paris have endeavoured to account for both these phenomena without having recourse to a lunar atmosphere; and for this purpose they made the following experiments:

129 These phenomena otherwise accounted for.

The image of the sun coming through a small hole into a darkened room, was received upon a circle of wood or metal of a diameter a good deal larger than that of the sun's image; then the shadow of this opaque circle was cast upon white paper, and there appeared round it, on the paper, a luminous circle such as that which surrounds the moon. The like experiment being made with a globe of wood and with another of stone not polished, the shadows of both these cast upon paper were surrounded with a palish light, most vivid near the shadows, and gradually more diluted at a distance from them. They observe also, that the ring round the moon was seen in the eclipse of 1706 by Wurzelbaur, who cast her shadow upon white paper. The same appearance was observed on holding an opaque globe in the sun, so as to cover his whole body from the eye; for, looking at it through a smoked glass, in order to prevent the eye from being hurt by the glare of light it would otherwise be exposed to, the globe appeared with a light resembling that round the moon in a total eclipse of the sun.

Thus they solve the phenomenon of the ring seen round the moon by the inflection, or *diffraction* as they call it, of the solar rays passing near an opaque substance. As for the small streaks of light above-mentioned, and which are supposed to be lightning, they explain these by an hypothesis concerning the cavities of the moon themselves; which they consider as concave mirrors reflecting the light of the sun nearly to the same point; and as these are continually changing their situation with great velocity by the moon's motion from the sun, the light which any one of them sends to our eye is seen but for a moment. This, however, will not account for the flashes, if any such there are, seen near the centre of the disk, though it does, in no very satisfactory manner, account for those at the edges.

130 Occultations of the fixed stars by the moon.

It has already been observed, that the occultations of the fixed stars and planets by the moon, in general happen without any kind of refraction of their light by the lunar atmosphere. The contrary, however, has sometimes been observed, and the stars have been seen manifestly to change their shape and colour on going behind the moon's disk. An instance of this happened on the 28th of June N. S. in the year 1715, when an occultation of Venus by the moon happened in the day-time. Some astronomers in France observing this with a telescope, saw Venus change colour for about a minute before she was hid by the moon; and the same change of colour was observed immediately after her emersion from behind the disk. At both times the edge of the disk of Venus that was nearest the moon appeared reddish, and that which was most distant of a bluish colour. These appearances, however, which might have been taken for proofs of a lunar atmosphere, were supposed to be owing to the observers having directed the axis of their telescopes towards the moon. This would necessarily cause any planet or star near the edge of the moon's disk to be seen through those parts of the glasses which are near their circum-

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ference, and consequently to appear coloured. This was evidently the case from other observations of an occultation of Jupiter by the moon the same year, when no such appearance of refraction could be perceived while he was kept in the middle of the telescope. Maraldi also informs us, that he had observed before this two other occultations of Venus and one of Jupiter; and was always attentive to see whether those planets changed their figure or colour either upon the approach of the moon to cover them, or at their first coming again into sight; but never could perceive any such thing. Nor could he, in a great number of occultations of the fixed stars, perceive the smallest apparent change in any of them, excepting once that a fixed star seemed to increase its distance a little from the moon as it was going to be covered by her; but this, he suspected, might be owing to his telescope being directed so as to have the star seen too far from the middle of its aperture. He concludes, therefore, that the moon has no atmosphere: and he remarks, that at Montpelier, perhaps because the air is clearer there than at London, the luminous ring round the moon appeared much larger than at London; that it was very white near the moon, and gradually decreasing in brightness, formed round her a circular area of about eight degrees in diameter. If, says he, this light was caused by the atmosphere of the moon, of what a prodigious extent must that atmosphere be?

131 Moon has no sensible atmosphere.

We have related all these opinions at full length, in order to put our readers in possession of the arguments that have been advanced upon this subject; but it is now generally admitted, and indeed, scarcely can be denied, that the atmosphere of the moon, if it really has any, is almost entirely insensible.

132 Turns round her axis.

From the spots upon the moon's disk it has been ascertained, that the same hemisphere of that luminary is always directed towards the earth. Hence it follows that she turns round her axis once during every revolution round the earth.

133 Libration of the moon.

Exact observations have ascertained that slight varieties take place respecting the appearances of the moon's disk. The spots are observed alternately to approach towards and recede from the edge of the moon. Those that are very near the edge appear and disappear alternately, making periodical oscillations, which are distinguished by the name of the *libration of the moon.* To form a precise idea of the nature of this libration, we must consider that the disk of the moon, seen from the centre of the earth, is terminated by the circumference of a great circle of the moon, perpendicular to a line drawn from the earth's centre to that of the moon. The lunar hemisphere is projected upon the plane of this circle turned towards the earth, and its appearances are due to the movements of rotation of that body relative to its radius vector. If the moon did not revolve round her axis, this radius vector would describe a great circle on the moon's surface, all the points of which would present themselves successively to us. But the moon, revolving in the same time that this radius vector describes the great circle, always keeps the same point of the circle nearly upon the radius, and of course the same hemisphere turned towards the earth. The inequalities of her motion produce the slight variations in her appearance: for the rotation of the moon does not partake sensibly of these irregularities. Hence it varies somewhat relatively to the radius vector, which accordingly cuts successively different points of the surface. Of course the globe of the moon makes oscillations relatively to that radius corresponding to the inequalities of her motions, which alternately conceal from our view and discover to us some parts of her surface.

Farther: the axis of rotation of the moon is not exactly perpendicular to the plane of her orbit. If we suppose the position of this axis fixed, during a revolution of the moon it inclines more or less to the radius vector, so that the angle formed by these two lines is acute during one part of her revolution, and obtuse during another part of it. Hence the poles of rotation are alternately visible from the earth, and those parts of her surface that are near these poles.

Besides all this, the observer is not placed at the centre of the earth, but at its surface. It is the radius drawn from his eye to the centre of the moon, which determines the middle point of her visible hemisphere. But in consequence of the lunar parallax, it is obvious that this radius must cut the surface of the moon in points sensibly different according to the height of that luminary above the horizon. All these causes concur to produce the *libration* of the moon, a phenomenon which is merely optical, and not connected with her rotation, which relatively to us is perfectly equable, or at least if it be subjected to any irregularities, they are too small to be observed.

This is not the case with the variations in the plane of the moon's equator. While endeavouring to determine its position by the lunar spots, Cassini was led to this remarkable conclusion, which includes the whole astronomical theory of the real libration of that luminary. Conceive a plane passing through the centre of the moon perpendicular to her axis of rotation, and of course coinciding with the plane of her equator; conceive a second plane, parallel to the ecliptic, to pass through the same centre; and also a third plane, which is the mean plane of the lunar orbit: these three planes have a common intersection; the second, placed between the two others, forms with the first an angle of 1°.503, and with the third an angle of 5°.14692; therefore the intersections of the lunar equator with the ecliptic coincide always with the mean nodes of the lunar orbit, and like them have a retrograde motion, which is completed in the period of 6793.3009 days. During that interval the two poles of the equator and lunar orbit describe small circles parallel to the ecliptic, enclosing between them the pole of the ecliptic, so that these three poles are constantly upon a great circle of the heavenly sphere. 134 Theory of it.

Chap. III. *Of the Planets.*

Amidst the infinite variety of stars which occupy a place in the sphere of the heavens, and which occupy nearly the same relative position with respect to each other, there are eight which may be observed to move in a very complicated manner, but following certain precise laws, for they always commence the same motions again after every period. The motions of these

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these stars, called planets, constitute one of the principal objects of astronomy. These planets are called

1. Mercury.
2. Venus.
3. Mars.
4. Ceres.
5. Pallas.
6. Jupiter.
7. Saturn.
8. Herschel.

Mercury and Venus never separate from the sun farther than certain limits; the rest separate to all the possible angular distances. The movements of all these bodies are included in a zone of the heavenly sphere called the *zodiac*. This zone is divided into two equal parts by the ecliptic. Its breadth was formerly considered as only about 16°; but it must be much increased if the orbits of Ceres and Pallas, the two newly discovered planets, are to be comprehended in it. It will be proper to consider the motions and appearances of each of these planets. This will be the subject of the following sections.

SECT. I. *Of Mercury.*

Mercury is a small star, but emits a very bright white light: though, by reason of his always keeping near the sun, he is seldom to be seen; and when he does make his appearance, his motion towards the sun is so swift, that he can only be discerned for a short time. He appears a little after sunset, and again a little before sunrise.

135 His apparent motion. Mercury never goes to a greater distance from the sun than about 27°.5; so that he is never longer in setting after the sun than an hour and 50 minutes; nor does he ever rise sooner than 1 hour and 50 minutes before that luminary. Very frequently, he goes so near the sun as to be lost altogether in his rays. When he begins to make his appearance in the evening after sunset, he can scarcely at first be distinguished in the rays of the twilight. But the planet disengages itself more and more, and is seen at a greater distance from the sun every successive evening; and having got to the distance of about 22°.5, it begins to return again. During this interval, the motion of Mercury referred to the stars is direct; but when it approaches within 18° of the sun it appears for some time stationary; and then its motion begins to be retrograde. The planet continues to approach the sun, and at last plunges into his rays in the evening, and disappears. Soon after, it may be perceived in the morning, before sunrise, separating farther and farther from the sun, his motion being retrograde, as before he disappeared. At the distance of 18° it becomes stationary, and assumes a direct motion, continuing, however, to separate till it comes to 22.5° of distance; then it returns again to the sun, plunges into his rays, and appears soon after in the evening, after sunset, to repeat the same career. The angular distance from the sun, which the planet reaches on both sides of that luminary, varies from 16° to nearly 28°.

The duration of a complete oscillation, or the interval of time that elapses before the planet returns again to the point from which it set out, varies also from 100 to 130 days. The mean arc of his retrogradation is about $13\frac{1}{3}$°; its mean duration 23 days. But the quantity differs greatly in different retrogradations. In general, the laws of the movements of Mercury are very complicated; he does not move exactly in the plane of the ecliptic; sometimes he deviates from it more than 5°.

Some considerable time must have elapsed before astronomers suspected that the stars which were seen approaching the sun in the evening and in the morning were one and the same. The circumstance, however, of the one never being seen at the same time with the other would gradually lead them to the right conclusion.

The apparent diameter of Mercury varies as well as that of the sun and moon, and this variation is obviously connected with his position relatively to the sun, and with the direction of his movement. The diameter is at its minimum when the planet plunges into the solar rays in the morning, or when it disengages itself from them: it is at its maximum when the planet plunges into the solar rays in the evening, or when it disengages itself from them in the evening; that is to say, when the planet passes the sun in its retrograde motion, its diameter is the greatest possible; when it passes the sun in its direct motion, it is the smallest possible;—and the mean length of the apparent diameter of Mercury is 11″. 136 Diameter.

Sometimes, when the planet disappears during its retrograde motion, that is to say, when it plunges into the sun's rays in the evening, it may be seen crossing the sun under the form of a black spot, which describes a chord along the disk of the sun. This black spot is recognised to be the planet by its position, its apparent diameter, and its retrograde motion. These *transits* of Mercury, as they are termed, are real annular eclipses of the sun: they demonstrate that the planet is an opaque body, and that it borrows its light from the sun. When examined by means of telescopes magnifying about 200 or 300 times, he appears equally luminous throughout his whole surface, without the least dark spot. But he exhibits the same difference of phases with the moon, being sometimes horned, sometimes gibbous, and sometimes shining almost with a round face, though not entirely full, because his enlightened side is never turned directly towards us; but at all times perfectly well defined without any ragged edge, and perfectly bright. Like the moon, the crescent is always turned towards the sun. These different phases throw considerable light on the orbit of Mercury. 137 Nature.

SECT. II. *Of Venus.*

Venus, the most beautiful star in the heavens, known by the names of the *morning* and *evening star*, likewise keeps near the sun, though she recedes from him almost double the distance of Mercury. She is never seen in the eastern quarter of the heavens when the sun is in the western; but always seems to attend him in the evening, or to give notice of his approach in the morning.

The planet Venus presents the same phenomena with Mercury; but her different phases are much more sensible, her oscillations wider, and of longer duration. Her greatest distance from the sun varies from 45° to nearly 48°, and the mean duration of a complete oscillation is 584 days.

Venus has been sometimes seen moving across the sun's disk in the form of a round black spot, with an apparent diameter of about 59″. A few days after this has been observed, Venus is seen in the morning, 138 Her apparent motions.

 west

Apparent Motions of the Heavenly Bodies.

west of the sun, in the form of a fine crescent, with the convexity turned toward the sun. She moves gradually westward with a retarded motion, and the crescent becomes more full. In about ten weeks she has moved 46° west of the sun, and is now a semicircle, and her diameter is 26″. She is now stationary. She then moves eastward with a motion gradually accelerated, and overtakes the sun about $9\frac{1}{7}$ months after having been seen on his disk. Some time after, she is seen in the evening, east of the sun, round, but very small. She moves eastward, and increases in diameter, but loses of her roundness, till she gets about 46° east of the sun, when she is again a semicircle. She now moves westwards, increasing in diameter, but becoming a crescent like the waning moon; and, at last, after a period of nearly 584 days, comes again into conjunction with the sun with an apparent diameter of 59″.

The mean arc of her retrogradation is about 16°, and its mean duration is 42 days. She does not move exactly in the plane of the ecliptic, but deviates from it several degrees. Like Mercury, she sometimes crosses the sun's disk. The duration of these transits, as observed from different parts of the earth's surface, are very different: this is owing to the parallax of Venus, in consequence of which different observers refer to different parts of the sun's disk, and see her describe different chords on that disk. In the transit which happened in 1769, the difference of its duration, as observed at Otaheite and at Wardhuys in Lapland, amounted to 23 m. 10 sec. This difference gives us the parallax of Venus, and of course her distance from the earth during a conjunction. The knowledge of this parallax enables us, by a method to be afterwards described, to ascertain that of the sun, and consequently to discover its distance from the earth.

The great variations of the apparent diameter of Venus demonstrates that her distance from the earth is exceedingly variable. It is largest when the planet passes over the surface of the sun. Her mean apparent diameter is 58″.

139 Revolution round her axis.

From the movement of certain spots upon the surface of Venus, it has been concluded that she revolves round her axis once in 24 hours; but this requires to be corrected by future observations. It is extremely difficult to perceive or examine these spots in our climate. The subject merits the attention of astronomers farther to the south, in more favourable circumstances. The following detail will show the uncertainty which has prevailed among astronomers respecting these spots.

140 Spots when first discovered on the disk of Venus.

Dr Long informs us, that the earliest account he had met with of any spots seen by means of the telescope on the disk of Venus was in a collection of letters printed at Paris in 1665, in one of which Mr Auzout relates his having received advice from Poland that Mr Burratini had, by means of large telescopes, seen spots upon the planet Venus similar to those upon the moon.

141 Cassini's observations.

In 1667, Cassini, in a letter to Mr Petit, mentions his having for a long time carefully observed Venus through an excellent telescope made by Campani, in order to know whether that planet revolved on its axis or not, as he had before found Jupiter and Mars to do. But though he then observed some spots upon her, he says, that even when the air was quiet and clear, they appeared faint, irregular, and not well defined; so that it was difficult to have such a distinct view of any of them as to be certain that it was the same spot which was seen again in any subsequent observation; and this difficulty was increased, in the first place, when Venus was in her inferior semicircle; because at that time she must be viewed through the thick vapours near the horizon; though otherwise it was most proper, on account of her being then nearest to us. In the second place, if we would observe her at some height above those vapours, it could only be for a short time; and thirdly, when she is low in her inferior circle, and at that time nearest the earth, the enlightened part of her is too small to discover any motion in it. He was therefore of opinion, that he should succeed better in his observations when the planet was about its mean distance from us, showing about one half of her enlightened hemisphere; at which time also he could observe her for a much longer time above the gross atmospherical vapours. His first appearance of success was October 14. 1666, at three quarters past five in the evening; when he saw a bright spot (fig. 37.), but could not then view that spot long enough to draw any inference concerning the planet's motion. He had no farther success till the 20th of April the following year; when, about a quarter of an hour before sunrise, he began again to perceive on the disk of Venus, now about half enlightened, a bright part near the section, distant from the southern horn a little more than a fourth part of the diameter of the disk, and near the eastern edge. He took notice also of a darkish oblong spot nearer to the northern than the southern horn: at sunrise the bright part was advanced farther from the southern horn than when he first observed it; 142

142 Why the spots seem to move from south to north.

but though he was pleased to find that he had now a convincing proof of the planet's motion, he was surprised that the spots moved from south to north in the lower part of the disk, and from north to south in the upper part; a kind of motion of which we have no example except in the librations of the moon. This, however, was occasioned by the situation of the planet's axis. Cassini expected to have found the rotation of Venus similar to that of Jupiter and Mars, both of which have their axis perpendicular to their respective orbits, and turn round according to the order of the signs; so that in each of them the motion of the inferior half of their respective globe, or that part next the sun, is from east to west; in the superior half from west to east; but in Venus, whose axis is inclined 75 degrees towards her orbit, the coincidence is so near, that one half of her disk appears to move from south to north, the other from north to south.

On the 21st of April, at sunrise, the bright part was a good way off the section, and about a fourth part of the diameter distant from the southern horn. 143

143 Particular account of the appearances of the spots at different times.

When the sun was eight degrees six minutes high, it seemed to be got beyond the centre, and was cut through by the section. At the time the sun was seven degrees high, the section cut it in the middle, which showed its motion to have some inclination towards the centre.

May 9. a little before sunrise, the bright spot was seen near the centre, a little to the northward, with two obscure ones situated between the section and the circumference, at a distance from each other, equal to that

that of each of them from the nearest angular point or horn of the planet. The weather being at that time clear, he observed for an hour and half a quarter the motion of the bright spot, which seemed to be exactly from south to north, without any sensible declination to east or west. A variation was at the same time perceived in the darkish spot, too great to be ascribed to any optical cause. The bright spot was also seen on the 10 and 13th days of May before sunrise between the northern horn and the centre, and the same irregular change of darkish spots was taken notice of; but as the planet removed to a greater distance from the earth, it became more difficult to observe these appearances. The above phenomena are represented as they occurred, in fig. 19. to 25.

144 Cassini's conclusions concerning the revolution of Venus on her axis.

But though, from the appearances just now related, M. Cassini was of opinion that Venus revolved on her axis, he was by no means so positive in this matter as with regard to Mars and Jupiter. "The spots on these (says he) I could attentively observe for a whole night, when the planets were in opposition to the sun: I could see them return to the same situation, and consider their motion during some hours, and judge whether they were the same spots or not, and what time they took in turning round: but it was not the same with the spots of Venus; for they can be observed only for so short a time, that it is much more difficult to know with certainty when they return into the same situation. I can, however, supposing that the bright spot which I observed on Venus, and particularly this year, was the same, say that she finishes her motion, whether of rotation or libration, in less than a day; so that, in 23 days nearly, the spot comes into the same situation on nearly the same hour of the day, though not without some irregularity. Now (supposing the bright spot observed to be always the same) whether this motion is an entire turning round, or only a libration, is what I dare not positively affirm."

145 Difficulties attending these observations.

In 1669, M. Cassini again observed Venus through a telescope, but could not then perceive any spots upon her surface; the reason of which Du Hamel conjectures to have been the fluctuation of the vapours near the horizon, which prevented them from being visible. However, we hear nothing more of any spots being seen on her disk till the year 1726; when, on the 9th of February, Bianchini, with some of Campani's telescopes of 90 and 100 Roman palms, began to observe the planet at the altitude of 40° above the horizon, and continued his observation till, by the motion of several spots, he determined the position of her axis to be inclined as above mentioned, that the north pole pointed at a circle of latitude drawn through the 20th degree of Aquarius, elevated 15° or 20° above the orbit of Venus. He delineated also the figures of several spots which he supposed to be seas, and complimented the king of Portugal and some other great men by calling them by their names. Though none of Bianchini's observations were continued long enough to know whether the spots, at the end of the period assigned for the rotation of the planet, would have been in a different situation from what they were at the beginning of it; yet, from observations of two and of four days, he concluded the motion of the spots to be at the rate of 15° per day; at which advance the planet must turn round either once in 24 days or in 23 hours; but without farther observation it could not be determined which of the two was the period of revolution: for if an observer should at a particular hour, suppose seven in the evening, mark exactly the place of a spot, and at the same hour next evening find the spot advanced 15°, he would not be able to determine whether the spot had advanced only 15°, or had gone once quite round with the addition of 15° more in part of another rotation. Mr Bianchini, however, supposes Venus to revolve in 24 days eight hours; the principal proof adduced for which is an observation of three spots, ABC, being situated as in fig. 26. when they were viewed by himself, and several persons of distinction, for about an hour, during which they could not perceive any change of place. The planet being then hid behind the Barbarini palace, they could not have another view of her till three hours after, when the spots still appeared unmoved. "Now (says Mr Bianchini) if her rotation were so swift as to go round in 23 hours, in this second view, three hours after the former, the spots must have advanced near 50 degrees; so that the spot C would have been gone off at R, the spot B would have succeeded into the place of C, the spot A into the place of B, and there would have been no more but two spots, A and B, to have been seen."

146 Bianchini's observations.

147 Doubts concerning the time she takes in revolving round her axis.

148 Dispute between Cassini and Bianchini.

Cassini, the son, in a memoir for 1732, denies the conclusion of Bianchini to be certain. He says, that during the three hours interval, the spot C might be gone off the disk, and the spot B got into the place thereof, where, being near the edge, it would appear less than in the middle. That A, succeeding into the place of B, would appear larger than it had done near the edge, and that another spot might come into the place of A; and there were other spots besides these three on the globe of the planet, as appears by the figures of Bianchini himself, particularly one which would naturally come in the place of A. That if the rotation of Venus be supposed to be in 23 hours, it will agree with Bianchini's observations, as well as with those of his father; but that, on the other supposition, the latter must be entirely rejected as erroneous: and he concludes with telling us, that Venus had frequently been observed in the most favourable times by Mr Maraldi and himself with excellent telescopes of 80 and 100 feet focus, without their being able to see any distinct spot upon her disk. "Perhaps (says Dr Long) those seen by Bianchini had disappeared, or the air in France was not clear enough; which last might be the reason why his father could never see those spots in France which he had observed in Italy, even when he made use of the longest telescopes." Neither of these astronomers take notice of any indentings in the curve which divides the illuminated part from the dark in the disk of Venus, though in some views of that planet by Fontana and Ricciolus, the curve is indented; and it has from thence been concluded, that the surface of the planet is mountainous like that of the moon. This had also been supposed by Burratini, already mentioned; and a late writer has observed, that, "when the air is in a good state for observation, mountains like those of the moon may be observed with a very powerful telescope."

149 Cassini discovers her satellite.

Cassini, besides the discovery of the spots on the disk of Venus, by which he was enabled to ascertain her revolution

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volution on an axis, had also a view of her satellite or moon, of which he gives the following account.—"A. D. 1686, August 28th, at 15 minutes after four in the morning, looking at Venus with a telescope of 34 feet, I saw, at the distance of one-third of her diameter eastward, a luminous appearance, of a shape not well defined, that seemed to have the same phase with Venus, which was then gibbous on the western side. The diameter of this phenomenon was nearly equal to a fourth part of the diameter of Venus. I observed it attentively for a quarter of an hour, and having left off looking at it for four or five minutes, I saw it no more; but daylight was then advanced. I had seen a like phenomenon which resembled the phase of Venus, Jan. 25th, A. D. 1672, from 52 minutes after six in the morning to two minutes after seven, when the brightness of the twilight made it disappear. Venus was then horned; and this phenomenon, the diameter whereof was nearly a fourth part of the diameter of Venus, was of the same shape. It was distant from the southern horn of Venus, a diameter of the planet, on the western side. In these two observations, I was in doubt whether it was not a satellite of Venus of such a consistence as not to be very well fitted to reflect the light of the sun; and which, in magnitude, bore nearly the same proportion to Venus as the moon does to the earth, being at the same distance from the sun and the earth as Venus was, the phases whereof it resembled. Notwithstanding all the pains I took in looking for it after these two observations, and at divers other times, in order to complete so considerable a discovery, I was never able to see it. I therefore suspended my judgment of this phenomenon. If it should return often, there will be these two epochas, which, compared with other observations, may be of use to find out the periodical time of its return, if it can be reduced to any rule."

150 Discovered also by Mr Short.

A similar observation was made by Mr Short on the 23d of October 1740, about sunrise. He used at this time a reflecting telescope of about 16.5 inches, which magnified between 50 and 60 times, with which he perceived a small star at about 10′ distance from Venus, as measured by the micrometer; and, putting on a magnifying power of 240 times, he found the star put on the same appearance with the planet herself. Its diameter was somewhat less than a third of that of the primary, but its light was less vivid, though exceedingly sharp and well defined. The same appearance continued with a magnifying power of 140 times. A line, passing through the centre of Venus and it, made an angle of 18 or 20 degrees with the equator: he saw it several times that morning for about the space of an hour, after which he lost sight of it, and could never find it again.

From this time the satellite of Venus, though very frequently looked for by astronomers, could never be perceived, which made it generally believed that Cassini and Mr Short had been mistaken; but as the transits of the planet over the sun in 1761 and 1769 seemed to promise a greater certainty of finding it, the satellite was very carefully looked for by almost every one who had an opportunity of seeing the transit, but generally without success. Mr Baudouin at Paris had provided a telescope of 25 feet, in order to observe the passage of the planet over the sun, and to look for its satellite; but he did not succeed either at that time or in the months of April and May following. Mr Montaigne, however, one of the members of the Society of Limoges, had better success. On the 3d of May 1761, he perceived, about half an hour after nine at night, at the distance of 20′ from Venus, a small crescent, with the horns pointing the same way as those of the planet; the diameter of the former being about one-fourth of that of the latter; and a line drawn from Venus to the satellite making an angle with the vertical of about 20° towards the south. But though he repeated this observation several times, some doubt remained whether it was not a small star. Next day he saw the same star at the same hour, distant from Venus about half a minute or a minute more than before, and making with the vertical an angle of 10° below on the north side; so that the satellite seemed to have described an arc of about 30°, whereof Venus was the centre, and the radius 20′. The two following nights were hazy, so that Venus could only be seen; but on the 7th of May, at the same hour as before, he saw the satellite again above Venus, and on the north side, at the distance of 25′ or 26′ upon a line which made an angle of about 45° with the vertical towards the right hand. The light of the satellite was always very weak, but it had the same phases with its primary, whether viewed together with it in the field of his telescope or by itself. The telescope was nine feet long, and magnified an object between 40 and 50 times, but had no micrometer; so that the distances above mentioned are only from estimation.

151 Seen by Mr Montaigne at the transit in 1761.

Fig. 27. represents the three observations of Mr Montaigne. V is the planet Venus; ZN the vertical. EC, a parallel to the ecliptic, making them an angle with the vertical of 45°; the numbers, 3, 4, 7, mark the situations of the satellite on the respective days. From the figure it appears that the points 3 and 7 would have been diametrically opposite, had the satellite gone 15° more round the point V at the last observation; so that in four days it went through 155°. Then, as 155° is to four days or 96 hours, so is 360 to a fourth number, which gives 9 days 7 hours for the whole length of the synodical revolution. Hence Mr Baudouin concluded that the distance of this satellite was about 60 of the semidiameters of Venus from its surface; that its orbit cut the ecliptic nearly at right angles; had its ascending node in 22° of Virgo; and was in its greatest northern digression on the 7th at nine at night; and he supposed that at the transit of the primary the satellite would be seen accompanying it. By a subsequent observation, however, on the 11th of May, he corrected his calculation of the periodical time of the satellite, which he now enlarged to 12 days; in consequence of which he found that it would not pass over the disk of the sun along with its primary, but go at the distance of above 20′ from his southern limb; though if the time of its revolution should be 15 hours longer than 12 days, it might then pass over the sun after Venus was gone off. He imagined the reason why this satellite was so difficult to be observed might be, that one part of its globe was crusted over with spots, or otherwise unfit to reflect the light of the sun. By comparing the periodical time of this satellite with that of our moon, he computed the quantity of matter in Venus to be nearly equal

152 Why this satellite is so difficult to be seen.

equal to that in our earth; in which case it must have considerable influence in changing the obliquity of the ecliptic, the latitudes and longitudes of stars, &c.

It is now known that this supposed satellite of Cassini was merely an optical deception.

153 Observations concerning the atmosphere of Venus.

In the Philosophical Transactions for 1761, Mr Hirst gives an account of his having observed an atmosphere round the planet Venus. The observations were made at Fort St George; and looking attentively at that part of the sun's disk where he expected the planet would enter, he plainly perceived a faint shade or penumbra; on which he called out to his two assistants, "'Tis a coming!" and two or three seconds after, the first external contact took place, in the moment whereof all the three agreed; but he could not see the penumbra after the egress; and of the other two gentlemen, one had gone home, and the other had lost the planet out of the field of his telescope. Mr Dunn at Chelsea saw a penumbra, or small diminution of light, that grew darker and darker for about five seconds before the internal contact preceding the egress; from whence he determines that Venus is surrounded with an atmosphere of about 50 geographical miles high. His observations, he tells us, were made mith an excellent six-feet Newtonian reflector, with a magnifying power of 110, and of 220 times; he had a clear dark glass next his eye, and the sun's limb appeared well defined; but a very narrow waterish penumbra appeared round Venus. The darkest part of the planet's phasis was at the distance of about a sixth part of her diameter from its edge; from which an imperfect light increased to the centre, and illuminated round about.

In the northern parts of Europe this penumbra could not be seen. Mr Wargentin, who communicated several observations of the first external contact, says, that he could not mark the time exactly, because of the undulation of the limb of the sun; but thought it very remarkable that, at the egress, the limb of Venus that was gone off the sun showed itself with a faint light during almost the whole time of emersion. Mr Bergman, who was then at the observatory at Upsal, begins his account at the time when three-fourths of the disk of the planet was entered upon that of the sun; and he says, that the part which was not come upon the sun was visible though dark, and surrounded by a crescent of faint light, as in fig. 28.: but this appearance was much more remarkable at the egress; for as soon as any part of the planet was got off the sun, that part was visible with a like crescent, but brighter, fig. 29. As more of the planetary disk went off that of the sun, however, that part of the crescent which was farthest from the sun grew fainter, and vanished, until at last only the horns could be seen, as in fig. 30. The total ingress was not instantaneous; but, as two drops of water, when about to part, form a ligament between them; so there was a dark swelling stretched out between Venus and the sun, as in fig. 31.; and when this ligament broke, the planet appeared to have got about an eighth part of her diameter from the nearest limb of the sun, fig. 32.: he saw the like appearance at going off, but not so distinct. fig. 33. Mr Chappe likewise took notice, that the part of Venus which was not upon the sun was visible during part of the time of ingress and egress; that it was farther surrounded by a small luminous ring of a deep yellow near the place that appeared in the form of a crescent, which was much brighter at the going off than coming upon the sun; and that, during the whole time the disk of Venus was upon the sun, he saw nothing of it. The time of total ingress was instantaneous like a flash of lightning; but at the egress the limb of the sun began to be obscured three seconds before the interior contact. Some of the French astronomers attributed this luminous ring round Venus to the inflection of the sun's rays, as they also do the light seen round the moon in solar eclipses; but Mr Chappe supposes it to have been owing to the sun enlightening more than one half of the planetary globe, though he owns this cause not to be altogether sufficient. Mr Fouchy, who observed the transit at La Muette in France, perceived, during the whole time, a kind of ring round Venus, brighter than the rest of the sun, which became fainter the farther it went from the planet, but appeared more vivid in proportion as the sun was clearer. Mr Ferner, who observed at the same place, confirms the testimony of Mr Fouchy. "During the whole time (says he) of my observing with the telescope, and the blue and green glasses, I perceived a light round about Venus, which followed her like a luminous atmosphere, more or less lively according as the air was more or less clear. Its extent altered in the same manner; nor was it well terminated, throwing out, as it were, some feeble rays on all sides."

154 Dr Long's opinion on these observations.

"I am not clear (says Dr Long) as to the meaning of the luminous circle here mentioned; whether, when the whole planet was upon the sun, they saw a ring of light round it, distinct from the light of the sun; or whether they mean only the light which surrounded that part of Venus that was not upon the sun." Mr Chappe takes this and other accounts of the observations made in France in this latter sense; and though he sometimes called the luminous part of the crescent that surrounded the part of the planet not upon the sun a ring, he explains himself that he did so, because at the coming upon the sun he perceived it at one side of the planet, and on the opposite side on its going off: for which reason he supposed that it surrounded it on all sides. See fig. 34, 35.

Sect. III. *Of Mars.*

The two planets which we have just described, appear to accompany the sun like satellites, and their mean motion round the earth is the same with that luminary. The remaining planets go to all the possible angular distances from the sun. But their motions have obviously a connection with the sun's position.

Mars is of a red fiery colour, and always gives a much duller light than Venus, though sometimes he equals her in size. He is not subject to the same limitation in his motions as Mercury or Venus; but appears sometimes very near the sun, and sometimes at a great distance from him; sometimes rising when the sun sets, or setting when he rises. Of this planet it is remarkable, that when he approaches any of the fixed stars, which all the planets frequently do, these stars change their colour, grow dim, and often become totally invisible, though at some little distance from the body of the planet: but Dr Herschel thinks this has been exaggerated by former astronomers.

Mars

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Mars appears to move from west to east round the earth. The mean duration of his sidereal revolution is 686.979579 days. His motion is very unequal. When we begin to perceive this planet in the morning when he begins to separate from the sun, his motion is direct and the most rapid possible. This rapidity diminishes gradually, and the motion ceases altogether when the planet is about 137° distant from the sun; then his motion becomes retrograde, and increases in rapidity till he comes into opposition with the sun. It then gradually diminishes again, and becomes nothing when Mars approaches within 137° of the sun. Then the motion becomes direct after having been retrograde for 73 days, during which interval the planet described an arch of about 16°. Continuing to approach the sun, the planet at last is lost in the evening in the rays of that luminary. All these different phenomena are renewed after every opposition of Mars; but there are considerable differences both in the extent and duration of his retrogradations.

Mars does not move exactly in the plane of the ecliptic, but deviates from it several degrees. His apparent diameter varies exceedingly. His mean apparent diameter is 27″, and it increases so much, that when the planet is in opposition, the apparent diameter is 81″. Then the parallax of Mars becomes sensible, and about double that of the sun.

The disk of Mars changes its form relatively to its position with regard to the sun, and becomes oval. Its phases show that it derives its light from that luminary. The spots observed on its surface have informed astronomers that it moves round its axis from west to east in 1.02733 days, and its axis is inclined to the ecliptic at an angle of about 59.7°.

155 Spots when first seen on Mars.

They were first observed in 1666 by Cassini at Bologna with a telescope of Campani about 16½ feet long; and continuing to observe them for a month, he found they came into the same situation in 24 hours and 40 minutes. The planet was observed by some astronomers at Rome with longer telescopes made by Eustachio Divini; but they assigned to it a rotation in 13 hours only. This, however, was afterwards shown by Mr Cassini to have been a mistake, and to have arisen from their not distinguishing the opposite sides of the planet, which it seems have spots pretty much alike. He made further observations on the spots of this planet in 1670; from whence he drew an additional confirmation of the time the planet took to revolve. The spots were again observed in subsequent oppositions; particularly for several days in 1704 by Maraldi, who took notice that they were not always well defined, and that they not only changed their shape frequently in the space between two oppositions, but even in the space of a month. Some of them, however, continued of the same form long enough to ascertain the time of the planet's revolution. Among these there appeared this year an oblong spot, resembling one of the belts of Jupiter when broken. It did not reach quite round the body of the planet; but had, not far from the middle of it, a small protuberance towards the north, so well defined that he was thereby enabled to settle the period of its revolution at 24 hours 39 minutes; only one minute less than what Cassini had determined it to be. See fig. 45.

The near approach of Mars to the earth in 1719, gave a much better opportunity of viewing him than had been obtained before; as he was then within 2½° of his perihelion, and at the same time in opposition to the sun. His apparent magnitude and brightness were thus so much increased, that he was by the vulgar taken for a new star. His appearance at that time, as seen by Maraldi through a telescope of 34 feet long, is represented in fig. 37. There was then a long belt that reached half way round, to the end of which another shorter belt was joined, forming an obtuse angle with the former, as in fig. 38. This angular point was observed on the 19th and 20th of August, at 11 hours 15 minutes, a little east of the middle of the disk; and 37 days after, on the 25th and 26th of September, returned to the same situation. This interval, divided by 36, the number of revolutions contained in it, gives 24 hours 40 minutes for the period of one revolution; which was verified by another spot of a triangular shape, one angle whereof was towards the north pole, and the base towards the south, which on the 5th and 6th of August appeared as in fig. 39. and after 72 revolutions returned to the same situation on the 16th and 17th of October. The appearances of Mars, as delineated by Mr Hook, when viewed through a 36 feet telescope are represented in fig. 40. He appeared through this instrument as big as the full moon. Some of the belts of this planet are said to be parallel to his equator; but that seen by Maraldi was very much inclined to it.

156 Bright spots about the poles of Mars.

Besides these dark spots former astronomers took notice that a segment of his globe about the south pole exceeded the rest of his disk so much in brightness, that it appeared beyond them as if it were the segment of a larger globe. Maraldi informs us, that this bright spot had been taken notice of for 60 years, and was more permanent than the other spots on the planet. One part of it is brighter than the rest, and the least bright part is subject to great changes, and has sometimes disappeared.

A similar brightness about the north pole of Mars was also sometimes observed; and these observations are now confirmed by Herschel, who has viewed the planet with much better instruments, and much higher magnifying powers, than any other astronomer ever was in possession of. His observations were made with a view to determine the figure of the planet, the position of his axis, &c. A very particular account of them is given in the 74th volume of the Philosophical Transactions, but which our limits will not allow us to insert. Fig. 41. to 64. show the particular appearances of Mars, as viewed on the days there marked. The magnifying powers he used were sometimes as high as 932; and with this the south polar spot was found to be in diameter 41‴. Fig. 65. shows the connection of the other figures marked 56, 57, 58, 59, 60, 61, 62, which complete the whole equatorial succession of spots on the disk of the planet. The centre of the circle marked 57 is placed on the circumference of the inner circle, by making its distance from the circle marked 59 answer to the interval of time between the two observations, properly calculated and reduced to sidereal measure. The same is done with regard to the circles marked 58, 59, &c. and it will be found by placing any one of these connected circles in such a manner as to have its contents in a similar situation with the figures

157 Dr Herschel's account of these spots.

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gures in the single representation, which bears the same number, that there is a sufficient resemblance between them; though some allowance must undoubtedly be made for the distortions occasioned by this kind of projection.

158 Causes of the appearance and disappearance of these spots.

With regard to the bright spots themselves, Dr Herschel informs us, that the poles of the planets are not exactly in the middle of them, though nearly so. "From the appearance and disappearance (says he) of the bright north polar spot in the year 1781, we collect that the circle of its motion was at some considerable distance from the pole. By calculation, its latitude must have been about 76° or 77° north; for I find that, to the inhabitants of Mars, the declination of the sun, June 25th, 12h. 15m. of our time was about 9° 56′ south; and the spot must have been so far removed from the north pole as to fall a few degrees within the enlightened part of the disk to become visible to us. The south pole of Mars could not be many degrees from the centre of the large bright southern spot of the year 1781; though this spot was of such a magnitude as to cover all the polar regions farther than the 70th or 65th degree; and in that part which was on the meridian, July 3d, at 10 h. 54 minutes, perhaps a little farther.

"From the appearances of the south polar spot in 1781, we may conclude that its centre was nearly polar. We find it continued visible all the time Mars revolved on his axis; and to present us generally with a pretty equal share of the luminous appearance, a spot which covered from 45° to 60° of a great circle on the globe of the planet, could not have any considerable polar distance.

159 Of the exact position of the poles of Mars.

From the observations and calculations made concerning the poles of Mars, we may conclude that his north pole must be directed towards some point of the heavens, between $9^s\ 24^\circ\ 35'$ and $0^s\ 7^\circ\ 15'$; because the change of the situation of the pole from left to right, which happened in the time the planet passed from one place to the other, is a plain indication of its having gone through the node of its axis. Next, we may also conclude, that the node must be considerably nearer the latter point of the ecliptic than the former; for whatever be the inclination of the axis, it will be seen under equal angles at equal distances from the node. But by a trigonometrical process of solving a few triangles, we soon discovered both the inclination of the axis, and the place where it intersects the ecliptic at rectangles (which, for want of a better term, I have perhaps improperly called its *node*). Accordingly I find by calculation, that the node is in 17° 47′ of Pisces, the north pole of Mars being directed towards that part of the heavens; and that the inclination of the axis to the ecliptic is 59° 40′. By further calculations we find that the pole of Mars on the 17th of April 1777, was then actually 81° 27′ inclined to the ecliptic, and pointed towards the left as seen from the sun.

"The inclination and situation of the node of the axis of Mars, with respect to the ecliptic, being found, may be thus reduced to the orbit of the planet himself. Let EC (fig. 66.) be a part of the ecliptic, OM part of the orbit of Mars, PEO a line drawn from P, the celestial pole of Mars, through E, that point which has been determined to be the place of the node of the axis of Mars in the ecliptic, and continued to O, where it intersects his orbit. Now, if, according to M. de la Lande, we put the node of the orbit of Mars for 1783 in $1^s\ 17^\circ\ 58'$, we have from the place of the node of the axis, that is, $11^s\ 17^\circ\ 47'$ to the place of the node of the orbit, an arch EN of 60° 11′. In the triangle NEO, right-angled at E, there is also given the angle ENO, according to the same author, 1° 51′, which is the inclination of the orbit of Mars to the ecliptic. Hence we find the angle EON 89° 5′, and the side ON 60° 12′. Again, when Mars is in the node of its orbit N, we have by calculation the angle PNE=63° 7′; to which adding the angle ENO=1° 51′, we have PNO=64° 58′: from which two angles, PON and PNO, with the distance ON, we obtain the inclination of the axis of Mars, and place of its node with respect to its own orbit; the inclination being 61° 18′, and the place of the node of the axis 58° 31′ preceding the intersection of the ecliptic with the orbit of Mars, or in our 19° 28′ of Pisces."

160 Of the seasons in Mars.

Our author next proceeds to show how the seasons in this planet may be calculated, &c. Which conjectures, though they belong properly to the next section, yet are so much connected with what has gone before, that we shall insert here what he says upon the subject.

"Being thus acquainted with what the inhabitants of Mars will call the obliquity of their ecliptic, and the situation of their equinoctial and solstitial points, we are furnished with the means of calculating the seasons on that planet, and may account, in a manner which I think highly probable, for the remarkable appearance about its polar regions.

"But first, it may not be improper to give an instance how to resolve any query concerning the Martial seasons. Thus, let it be required to compute the declination of the sun on Mars, June 25. 1781, at midnight of our time. If ♈, ♉, ♊, ♋, &c. (fig. 67), represent the ecliptic of Mars, and ♈, ♋, ♎, ♑ the ecliptic of out planet, A *a*, *b* B the mutual intersection of the Martial and terrestrial ecliptics; then there is given the heliocentric longitude of Mars, ♈ $m=9^s\ 10^\circ\ 30'$; then taking away six signs, and ♎ *h* or ♈ $a=1^s\ 17^\circ\ 58'$, there remains $b\,m=1^s\ 22^\circ\ 32'$. From this arch, with the given inclination 1° 51′ of the orbits to each other, we have cosine of inclination to radius, as tangent of $b\,m$ to tangent of $BM=1^s\ 22^\circ\ 33'$. And taking away B ♈$=1^s\ 1^\circ\ 29'$, which is the complement to ♑ B (or ♋ A, already shown to be $1^s\ 28^\circ\ 31'$), there will remain ♈ $M=0^s\ 21^\circ\ 4'$, the place of Mars in its own orbit; that is, on the time above mentioned, the sun's longitude on Mars will be $6^s\ 21^\circ\ 4'$; and the obliquity of the Martial ecliptic, 28° 42′, being also given, we find, by the usual method, the sun's declination 9° 56′ south.

161 Considerable resemblance betwixt the earth and Mars.

"The analogy between Mars and the earth is perhaps by far the greatest in the whole solar system. Their diurnal motion is nearly the same; the obliquity of their respective ecliptics not very different: of all the superior planets, the distance of Mars from the sun is by far the nearest alike to that of the earth; nor will the length of the Martial year appear very different

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different from what we enjoy, when compared to the surprising duration of the years of Jupiter, Saturn, and the Georgium Sidus. If we then find that the globe we inhabit has its polar region frozen and covered with mountains of ice and snow that only partly melt when alternately exposed to the sun, I may well be permitted to surmise, that the same causes may probably have the same effect on the globe of Mars; that the bright polar spots are owing to the vivid reflection of light from frozen regions; and that the reduction of those spots is to be ascribed to their being exposed to the sun. In the year 1781, the south polar spot was extremely large, which we might well expect, as that pole had but lately been involved in a whole twelvemonth's darkness and absence of the sun; but in 1783, I found it considerably smaller than before, and it decreased continually from the 20th of May till about the middle of September, when it seemed to be at a stand. During this last period the south pole had already been above eight months enjoying the benefit of summer, and still continued to receive the sun-beams, though, towards the latter end, in such an oblique direction as to be but little benefited by them. On the other hand, in the year 1781, the north polar spot, which had then been its twelvemonth in the sunshine, and was but lately returning into darkness, appeared small, though undoubtedly increasing in size. Its not being visible in the year 1783, is no objection to these phenomena, being owing to the position of the axis, by which it was removed out of sight.

162 White spots about the poles of Mars, supposed to be occasioned by snow.

163 Of the spheroidical form of Mars.

"That a planetary globe, such as Mars, turning on an axis, should be of a spheroidical form, will easily find admittance, when two familiar instances in Jupiter and the earth, as well as the known laws of gravitation and the centrifugal force of rotatory bodies, lead the way to the reception of such doctrines. So far from creating difficulties, or doubts, it will rather appear singular, that the spheroidical form of this planet has not already been noticed by former astronomers; and yet, reflecting on the general appearance of Mars, we soon find, that opportunities of making observations on its real form cannot be very frequent: for when it is near enough to view it to an advantage, we see it generally gibbous, and its appositions are so scarce, and of so short a duration, that in more than two years time, we have not above three or four weeks for such observations. Besides, astronomers being generally accustomed to see this planet distorted, the spheroidical form might easily be overlooked.

164 Difference between the equatorial and polar diameter of Mars.

"September 25. 1783. At 9 h. 50 m. the equatorial diameter of Mars measured 21″ 53‴; the polar diameter 21″ 15‴ *full measure;* that is, certainly not too small. This difference of the diameters was shown, on the 28th of the same month, to Mr Wilson of Glasgow, who saw it perfectly well, so as to be convinced that it was not owing to any defect or distortion occasioned by the lens; and because I wished him to be satisfied of the reality of the appearance, I reminded him of several precautions; such as causing the planet to pass directly through the centre of the field of view, and judging of its figure when it was most distinct and best defined, &c. Next day the difference between the two diameters was shown to Dr Blagden and Mr Aubert. The former not only saw it immediately, but thought the flattening almost as much as that of Jupiter. Mr Aubert also saw it very plainly, so as to entertain no manner of doubt about the appearance.

"September 30th, 10h. 52m. the equatorial diameter was 22″ 9‴, with a magnifying power of 278. By a second measure it was 22″ 31‴, full large; the polar diameter, very exact, was 21″ 26‴. On the first of October, at 10h. 50m. the equatorial diameter measured 103 by the micrometer; and the polar 98; the value of the divisions in seconds and thirds not being well determined, on account of some changes lately made in the focal length of the object metals of the telescope. On the 13th, the equatorial diameter was exactly 22″ 35‴: the polar diameter 21″ 35‴." In a great number of succeeding observations, the same appearance occurred; but on account of the quick changes in the appearance of this planet, Dr Herschel thought proper to settle the proportion betwixt the equatorial and polar diameters from those which were made on the very day of the apposition, and which were also to be preferred on account of their being repeated with a very high power, and in a fine clear air, with two different instruments of an excellent quality. From these he determined the proportions to be as 103 to 98, or 1355 to 1272.

165 Of the atmosphere of Mars.

It has been commonly related by astronomers, that the atmosphere of this planet is possessed of such strong refractive powers, as to render the small fixed stars near which it passes invisible. Dr Smith relates an observation of Cassini, where a star in the water of Aquarius at the distance of six minutes from the disk of Mars, became so faint before its occultation, that it could not be seen by the naked eye, nor with a three-feet telescope. This would indicate an atmosphere of a very extraordinary size and density: but the following observations of Dr Herschel seem to show that it is of much smaller dimensions. "1783, Oct. 26th. There are two small stars preceding Mars, of different sizes; with 460 they appear both dusky red, and are pretty unequal; with 218 they appear considerably unequal. The distance from Mars of the nearest, which is also the largest, with 227 measured 3′ 26″ 20‴. Some time after, the same evening, the distance was 3′ 8″ 55‴, Mars being retrograde. Both of them were seen very distinctly. They were viewed with a new 20 feet reflector, and appeared very bright. October 27th, the small star is not quite so bright in proportion to the large one as it was last night, being a good deal nearer to Mars, which is now on the side of the small star; but when the planet was drawn aside, or out of view, it appeared as plainly as usual. The distance of the small star was 2′ 5″ 25‴. The largest of the two stars (adds he), on which the above observations were made, cannot exceed the 12th, and the smallest the 13th or 14th magnitude; and I have no reason to suppose that they were any otherwise affected by the approach of Mars, than what the brightness of its superior light may account for. From other phenomena it appears, however, that this planet is not without a considerable atmosphere; for besides the permanent spots on its surface, I have often noticed occasional changes of partial bright belts, and also once a darkish one in a pretty high latitude; and these alterations we can hardly ascribe to any other cause than the variable disposition of clouds and vapours floating in the atmosphere of the planet."

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Sect. IV. *Of Jupiter.*

Jupiter is the brightest of all the planets except Venus. He moves from west to east in a period of 4332.602208 days, exhibiting irregularities similar to those of Mars. Before he comes into opposition, and when distant from the sun about 115°, his motion becomes retrograde, and increases in swiftness till he comes into opposition. The motion then becomes gradually slower, and becomes direct when the planet advances within 115° of the sun. The duration of the retrograde motion is about 121 days, and the arch of retrogradation described is about 10°. But there is a considerable difference both in the amount and in the duration of this retrograde motion.

166 Belts of Jupiter when first discovered.

Jupiter has the same general appearance with Mars, only that the belts on his surface are much larger and more permanent. Their general appearance, as described by Dr Long, is represented fig. 68—71.; but they are not to be seen but by an excellent telescope. They are said to have been first discovered by Fontana and two other Italians; but Cassini was the first who gave a good account of them. Their number is very variable, as sometimes only one, and at others no fewer than eight, may be perceived. They are generally parallel to one another, but not always so; and their breadth is likewise variable, one belt having been observed to grow narrow, while another in its neighbourhood has increased in breadth, as if the one had flowed into the other: and in this case Dr Long observes, that a part of an oblique belt lay between them, as if to form a communication for this purpose. The time of their continuance is very uncertain, sometimes remaining unchanged for three months; at others, new belts

167 Spots sometimes appear in them.

have been formed in an hour or two. In some of these belts large black spots have appeared, which moved swiftly over the disk from east to west, and returned in a short time to the same place; from whence the rotation of this planet about its axis has been determined. On the 9th of May 1664, Dr Hook, with a good 12 feet telescope, observed a small spot in the biggest of the three obscure belts of Jupiter; and observing it from time to time, found that in two hours it had moved from east to west about half the visible diameter of the planet. In 1665, Cassini observed a spot near the largest belt of Jupiter which is most frequently seen. It appeared round, and moved with the greatest velocity when in the middle, but appeared narrower, and moved slower, the nearer it was to the circumference. "These circumstances (says Dr Long) showed that the spot adhered to the body of Jupiter, and was carried round upon it. It continued thereon till the year following; long enough to determine the periodical time of Jupiter's rotation upon his axis

168 Account of one of these spots.

to be 9 h. 56 m." This principal, or ancient spot as it is called, is the largest, and of the longest continuance of any hitherto known, and has appeared and vanished no fewer than eight times between the years 1665 and 1708; from the year last mentioned it was invisible till 1713. The longest time of its continuing to be visible was three years; and the longest time of its disappearing was from 1708 to 1713: it seems to have some connection with the principal southern belt; for the spot has never been seen when that disappeared, though that belt has often been visible without that spot. Besides this ancient spot, Cassini, in the year 1669, saw one of less stability that did not continue of the same shape or dimensions, but broke into several small ones, whereof the revolution was but 9 h. 51 m.; and two other spots that revolved in 9 h. 52½ m. The figure of Jupiter is evidently an oblate spheroid, the longest diameter of his disk being to the shortest as 13 to 12. His rotation is from west to east, like that of the sun, and the plane of his equator is

169 No difference of seasons in Jupiter.

very nearly coincident with that of his orbit; so that there can scarcely be any difference of seasons in that planet. His rotation has been observed to be somewhat quicker in his aphelion than his perihelion. The axis of rotation is nearly perpendicular to the plane of the ecliptic, and the planet makes one revolution in 0.41377 day, or about 9 h. 35′ and 37″. The changes in the appearance of these spots, and the difference in the time of their rotation, make it probable that they do not adhere to Jupiter, but are clouds transported by the winds with different velocities in an atmosphere subject to violent agitations.

The apparent diameter of this planet is a maximum during his opposition to the sun, it is then equal to about 46″; when in conjunction it is smaller, being only about 31″: his mean apparent diameter is equal to 36″.

170 Is attended by four moons.

Four little stars are observed around Jupiter, which constantly accompany him. Their relative situation is continually changing. They oscillate on both sides of the planet, and their relative rank is determined by the length of these oscillations. That one in which the oscillation is shortest is called the *first satellite*, and so on. These satellites are analogous to our moon. See fig. 18. and 186. They are all supposed to move in ellipses; though the eccentricities of all of them are too small to be measured, excepting that of the fourth; and even this amounts to no more than 0.007 of its mean distance from the primary. The orbits of these planets were thought by Galileo to be in the same plane with that of their primary: but Mr Cassini has found that their orbits make a small angle with it; and, as he did not find any difference in the place of their nodes, he concluded that they were all in the same place, and that their ascending nodes were in the middle of Aquarius. After observing them for more than 36 years, he found their greatest latitude, or deviation from the

171 Distances and periodical times of Jupiter's moons.

plane of Jupiter's orbit, to be 2° 55′. The first of these satellites revolves at the distance of 5.697 of Jupiter's semidiameters, or 1′ 51″ as measured by proper instruments; its periodical time is 1 d. 18 h. 27′ 34″. The next satellite revolves at the distance of 9.017 semidiameters, or 2′ 56″, in 3 d. 13 h. 13′ 43″; the third at the distance of 14.384 semidiameters, or 4′ 42″, in 7 d. 3 h. 42′ 36″; and the fourth at the distance of 25.266, or 8′ 16″, in 16 d. 16 h. 32′ 09″.

Since the time of Cassini it has been found that the nodes of Jupiter's satellites are not in the same place; and from the different points of view in which we have an opportunity of observing them from the earth, we see them sometimes apparently moving in straight lines, and at other times in elliptic curves. All of them, by reason of their immense distance, seem to keep near their primary, and their apparent motion is a kind of oscillation like that of a pendulum, going alternately

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ly from their greatest distance on one side to the greatest distance on the other, sometimes in a straight line, and sometimes in an elliptic curve. When a satellite is in its superior semicircle, or that half of its orbit which is more distant from the earth than Jupiter is, its motion appears to us direct, according to the order of the signs; but in its inferior semicircle, when it is nearer to us than Jupiter, its motion appears retrograde; and both these motions seem quicker the nearer the satellites are to the centre of the primary, slower the more distant they are, and at the greatest distance of all they appear for a short time to be stationary.

172 Occultations and eclipses of Jupiter's satellites.

From this account of the system of Jupiter and his satellites, it is evident, that occultations of them must frequently happen by their going behind their primary, or by coming in betwixt us and it. The former takes place when they proceed towards the middle of their upper semicircle; the latter, when they pass through the same part of their inferior semicircle. Occultations of the former kind happen to the first and second satellite; at every revolution, the third very rarely escapes an occultation, but the fourth more frequently by reason of its greater distance. It is seldom that a satellite can be discovered upon the disk of Jupiter, even by the best telescopes, excepting at its first entrance, when by reason of its being more directly illuminated by the rays of the sun than the planet itself, it appears like a lucid spot upon it.

173 The satellites sometimes appear as dark spots.

Sometimes, however, a satellite in passing over the disk, appears like a dark spot, and is easily to be distinguished. This is supposed to be owing to spots on the body of these secondary planets; and it is remarkable, that the same satellite has been known to pass over the disk at one time as a dark spot, and at another so luminous that it could not be distinguished from Jupiter himself, except at its coming on and going off. To account for this, we must say, that either the spots are subject to change; or if they be permanent like those of our moon, that the satellites at different times turn different parts of their globes towards us.

174 Why they vary in their light and apparent magnitude.

Possibly both these causes may contribute to produce the phenomena just mentioned. For these reasons also both the light and apparent magnitude of the satellites are variable; for the fewer spots there are upon that side which is turned towards us, the brighter it will appear; and as the bright side only can be seen, a satellite must appear larger the more of its bright side it turns towards the earth, and the less so the more it happens to be covered with spots. The fourth satellite, though generally the smallest, sometimes appears bigger than any of the rest: the third sometimes seems least, though usually the largest; nay, a satellite may be so covered with spots as to appear less than its shadow passing over the disk of the primary, though we are certain that the shadow must be smaller than the body which casts it. To a spectator placed on the surface of Jupiter, each of these satellites would put on the phases of the moon; but as the distance of any of them from Jupiter is but small when compared with the distance of that planet from the sun, the satellites are therefore illuminated by the sun very nearly in the same manner with the primary itself; hence they appear to us always round, having constantly the greatest part of their enlightened half turned towards the earth: and indeed they are so small, that were they to put on the phases of the moon, these phases could scarce be discerned through the best telescopes.

175 Their shadows sometimes visible on the disk of Jupiter.

When the satellites pass through their inferior semicircles, they may cast a shadow upon their primary, and thus cause an eclipse of the sun to his inhabitants if there are any; and in some situations this shadow may be observed going before or following the satellite.

176 Three of Jupiter's moons eclipsed in every revolution.

On the other hand, in passing through their superior semicircles, the satellites may be eclipsed in the same manner as our moon by passing through the shadow of Jupiter: and this is actually the case with the first, second, and third of these bodies; but the fourth, by reason of the largeness of its orbit, passes sometimes above or below the shadow, as is the case with our moon.

177 At what time the eclipses, occultations, &c. of Jupiter's satellites are visible.

The beginnings and endings of these eclipses are easily seen by a telescope when the earth is in a proper situation with regard to Jupiter and the sun; but when this or any other planet is in conjunction with the sun, the superior brightness of that luminary renders both it and the satellites invisible. From the time of its first appearing after a conjunction until near the apposition, only the immersions of the satellites into his shadow, or the beginnings of the eclipses, are visible; at the apposition, only the occultations of the satellites, by going behind or coming before their primary, are observable; and from the apposition to the conjunction, only the emersions, or end of the eclipses, are to be seen. This is exactly true in the first satellite, of which we can never see an immersion with its immediately subsequent emersion: and it is but rarely that they can be both seen in the second; as in order to their being so, that satellite must be near one of its limits, at the same time that the planet is near his perihelion and quadrature with the sun. With regard to the third, when Jupiter is more than 46 degrees from conjunction with, or apposition to, the sun, both its immersions and immediately subsequent emersions are visible; as they likewise are in the fourth, when the distance of Jupiter from conjunction or apposition is 24 degrees.

When Jupiter is in quadrature with the sun, the earth is farthest out of the line that passes through the centres of the sun and Jupiter, and therefore the shadow of the planet is then most exposed to our view: but even then the body of the planet will hide from us one side of that part of the shadow which is nearest to it, through which the first satellite passes; which is the reason that though we see the entrance of that satellite into the shadow, or its coming out from thence, as the earth is situated on the east or west side thereof, we cannot see them both; whereas the other satellites going through the shadow at a greater distance from Jupiter, their ingress and egress are both visible.

Sect. V. *Of Saturn.*

Saturn is likewise a very conspicuous planet, though not so brilliant as Jupiter. The period of his sidereal revolution round the earth, is 10759.077213 days. He moves from west to east nearly in the plane of the ecliptic, and exhibits irregularities similar to those of Jupiter and Mars. He becomes retrograde both before and after his opposition, when at the distance of about 109° from the sun. His retrograde motion continues about 139 days, and during its continuance he describes an

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an arc of about 6°. His diameter is a maximum at his opposition, and his mean apparent diameter is 18″.

178 Telescopic appearance of Saturn.

Saturn, when viewed through a good telescope, makes a more remarkable appearance than any of the other planets. Galileo first discovered his uncommon shape, which he thought to be like two small globes, one on each side of a large one; and he published his discovery in a Latin sentence: the meaning of which was, that he had seen him appear with three bodies; though, in order to keep the discovery a secret, the letters were transposed. Having viewed him for two years, he was surprised to see him become quite round without these appendages, and then after some time to

179 His ring first discovered by Huygens.

assume them as before. These adjoining globes were what are now called the *ansæ* of his ring, the true shape of which was first discovered by Huygens about 40 years after Galileo, first with a telescope of 12 feet, and then with one of 23 feet, which magnified objects 100 times. From the discoveries made by him and other astronomers, it appears that this planet is surrounded by a broad thin ring, the edge of which reflects little or none of the sun's light to us, but the planes of the ring reflect the light in the same manner that the planet itself does; and if we suppose the diameter of Saturn to be divided into three equal parts, the diameter of the ring is about seven of these parts. The ring is detached from the body of Saturn in such a manner, that the distance between the innermost part of the ring and the body is equal to its breadth. If we had a view of the planet and his ring, with our eyes, perpendicular to one of the planes of the latter, we should see them as in fig. 72.: but our eye is never so much elevated above either plane as to have the visual ray stand at right angles to it, nor indeed is it ever elevated more than about 30 degrees above it; so that the ring, being commonly viewed at an oblique angle, appears of an oval form, and through very good telescopes double, as represented fig. 73. and 74. Both the outward and inward rim is projected into an ellipsis, more or less oblong according to the different degrees of obliquity with which it is viewed. Sometimes our eye is in the plane of the ring, and then it becomes invisible; either because the outward edge is not fitted to reflect the sun's light, or more probably because it is too thin to be seen at such a distance. As the plane of this ring keeps always parallel to itself, that is, its situation in one part of the orbit is always parallel to that in any other part, it disappears twice in every revolution of the planet, that is, about once in 15 years; and he sometimes appears quite round for nine months together. At other times, the distance betwixt the body of the planet and the ring is very perceptible; insomuch that Mr Whiston tells us of Dr Clarke's father having seen a star through the opening, and supposed him to have been the only person who ever saw a sight so rare, as the opening, though certainly very large, appears very small to us. When Saturn appears round, if our eye be in the plane of the ring, it will appear as a dark line across the middle of the planet's disk; and if our eye be elevated above the plane of the ring, a shadowy belt will be visible, caused by the shadow of the ring as well as by the interposition of part of it betwixt the eye and the planet. The shadow of the ring is broadest when the sun is most elevated, but its obscure parts appear broadest when our eye is most elevated above the plane of it. When it appears double, the ring next the body of the planet appears brightest; when the ring appears of an elliptical form, the parts about the ends of the largest axis are called the *ansæ*, as has been already mentioned. These, a little before and after the disappearing of the ring, are of unequal magnitude: the largest ansa is longer visible before the planet's round phase, and appears again sooner, than the

180 Ring of Saturn probably has a revolution on its axis.

other. On the first of October 1714, the largest ansa was on the east side, and on the 12th on the west side of the disk of the planet, which makes it probable that the ring has a rotation round an axis. Herschel has demonstrated, that it revolves in its own plane in 10 hours 32′ 15.4″. The observations of this philosopher have added greatly to our knowledge of Saturn's ring. According to him there is one single, dark, considerably broad line, belt, or zone, which he has constantly found on the north side of the ring. As this dark belt is subject to no change whatever, it is probably owing to some permanent construction of the surface of the ring: this construction cannot be owing to the shadow of a chain of mountains, since it is visible all round on the ring; for there could be no shade at the ends of the ring: a similar argument will apply against the opinion of very extended caverns. It is pretty evident that this dark zone is contained between two concentric circles; for all the phenomena correspond with the projection of such a zone. The nature of the ring Dr Herschel thinks no less solid than that of Saturn itself, and it is observed to cast a strong shadow upon the planet. The light of the ring is also generally brighter than that of the planet; for the ring appears sufficiently bright when the telescope affords scarcely light enough for Saturn. The doctor concludes that the edge of the ring is not flat, but spherical or speroidical. The dimensions of the ring, or of the two rings with the space between them, Dr Herschel gives as below:

	Miles.
Inner diameter of smaller ring	146345
Outside diam. of ditto	184393
Inner diam. of larger ring	190248
Outside diam. of ditto	204883
Breadth of the inner ring	20000
Breadth of the outer ring	7200
Breadth of the vacant space, or dark zone	2839

There have been various conjectures relative to the nature of this ring. Some persons have imagined that the diameter of the planet Saturn was once equal to the present diameter of the outer ring, and that it was hollow; the present body being contained within the former surface, in like manner as a kernel is contained within its shell: they suppose that, in consequence of some concussion, or other cause, the outer shell all fell down to the inner body, and left only the ring at the greater distance from the centre, as we now perceive it. This conjecture is in some measure corroborated by the consideration, that both the planet and its ring perform their rotations about the same common axis, and in very nearly the same time. But from the observations of Dr Herschel, he thus concludes: "It does not appear to me that there is sufficient ground for admitting the ring of Saturn to be of a very changeable nature, and I guess that its phenomena will hereafter be so fully explained, as to reconcile

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reconcile all observations. In the meanwhile we must withhold a final judgment of its construction, till we can have more observations. Its division, however, into two very unequal parts, can admit of no doubt."

The diameters of Saturn are not equal: that which is perpendicular to the plane of his ring appears less by one-eleventh than the diameter situated in that plane. If we compare this form with that of Jupiter, we have reason to conclude that Saturn turns rapidly round his shorter axis, and that the ring moves in the plane of his equator. Herschel has confirmed this opinion by actual observation. He has ascertained the duration of a revolution of Saturn round his axis to amount to 0.428 day. Huygens observed five belts upon this planet nearly parallel to the equator.

181 His seven satellites.

Saturn is still better attended than Jupiter (see fig. 18. and 186.); having, besides the ring above-mentioned, no fewer than seven moons continually circulating round him. The first, at the distance of 2.097 semidiameters of his ring, and 4.893 of the planet itself, performs its revolution in 1 d. 21 h. 18′ 57″; the second, at 2.686 semidiameters of the ring, and 6.268 of Saturn, revolves in 2 d. 17 h. 41′ 22″; the third, at the distance of 8.754 semidiameters of Saturn, and 3.752 of the ring, in 4 d. 12 h. 25′ 12″; the fourth, called the *Huygenian satellite*, at 8.698 semidiameters of the ring, and 20.295 of Saturn, revolves in 15 d. 22 h. 41′ 12″; while the fifth, placed at the vast distance of 59.154 semidiameters of Saturn, or 25.348 of his ring, does not perform its revolution in less than 79 d. 7 h. 47′ 00″. The orbits of all these satellites, except the fifth, are nearly in the same plane, which makes an angle with the plane of Saturn's orbit of about 31°; and by reason of their being inclined at such large angles, they cannot pass either across their primary or behind it with respect to the earth, except when very near their nodes; so that eclipses of them happen much more seldom than of the satellites of Jupiter. There is, however, an account in the Philos. Transact. of an occultation of the fourth satellite behind the body of Saturn; and there is a curious account by Cassini in the Memoirs of the Royal Academy for 1692, of a fixed star being covered by the fourth satellite, so that

182 Fifth satellite sometimes disappears, and why.

for 13 minutes they appeared both as one star. By reason of their extreme smallness, these satellites cannot be seen unless the air be very clear; and Dom. Cassini for several years observed the fifth satellite to grow less and less as it went through the eastern part of its orbit until it became quite invisible; while in the western part it gradually became more and more bright until it arrived at its greatest splendour.—"This phenomenon (says Dr Long) cannot be better accounted for than by supposing one half of the surface of this satellite to be unfit to reflect the light of the sun in sufficient quantity to make it visible, and that it turns round its axis nearly in the same time as it revolves round its primary; and that, by means of this rotation, and keeping always the same face toward Saturn, we upon the earth may, during one half of its periodical time, be able to see successively more and more of its bright side, and during the other half of its period have more and more of the spotted or dark side turned towards us. In the year 1705, this satellite unexpectedly became visible in all parts of its orbit through the very same telescopes that were before often made use of to view it in the eastern part without success: this shows the spots upon this satellite, like those upon Jupiter and some other of the primary planets, are not permanent, but subject to change."

The two other satellites were discovered by Dr Herschel in 1787 and 1788. They are nearer to Saturn than any of the other five. But in order to prevent confusion, they have been called the 6th and 7th satellites. The fifth satellite has been observed by Dr Herschel to turn once round its axis, exactly in the time in which it revolves round Saturn. In this respect it resembles our moon.

Sect. VI. *Of Herschel.*

The planets hitherto described have been known from the remotest antiquity; but the planet Herschel, called also the Georgium Sidus, and Uranus, escaped the attention of the ancient astronomers. Flamstead, Mayer, and Le Mounier had observed it as a small star; but in 1781 Dr Herschel discovered its motion, and ascertained it to be a planet. Like Mars, Jupiter, and Saturn, it moves from west to east round the sun. The duration of its sidereal revolution is 30689 days. Its motion, which is nearly in the plane of the ecliptic, begins to be retrograde before and after the opposition, when the planet is 103.5° from the sun; its retrograde motion continues for about 151 days; and the arc of retrogradation amounts to 3.6°. If we judge of the distance of this planet by the slowness of its motions, it ought to be at the very confines of the planetary system.

183 Its satellites.

The apparent magnitude of this planet is so small that it can seldom be seen with the naked eye. It is accompanied by six satellites: two of them, which were discovered by Dr Herschel in 1787, revolve about that planet in periods of 8 d. 17 h. 1 m. 19. sec. and 13 d. 11 h. 5 m. 1½ sec. respectively, the angular distances from the primary being 33″ and 44⅔″: their orbits are nearly perpendicular to the plane of the ecliptic. The history of the discovery of the other four, with such elements as could then be ascertained, are given in the Philosophical Transactions for 1798, Part I. The precise periods of these additional satellites cannot be ascertained without a greater number of observations than had been made when Dr Herschel sent the account of their discovery to the Royal Society; but he gave the following estimates as the most probable which could be formed by means of the data then determined. Admitting the distance of the anterior satellite to be 25″.5, its periodical revolution will be 5 d. 21 h. 25 m. If the intermediate satellite be placed at an equal distance between the two old satellites, or at 38″.57, its period will be 10 d. 23 h. 4 m. The nearest exterior satellite is about double the distance of the farthest old one; its periodical time will therefore be about 38 d. 1 h. 49 m. The most distant satellite is full four times as far from the planet as the old second satellite: it will therefore take at least 107 d. 16 h. 40 m. to complete one revolution. All these satellites perform their revolutions in their orbits contrary to the order of the signs; that is, their real motion is retrograde.

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Sect. VII. *Of Ceres and Pallas.*

These two planets, lately discovered by Piazzi and Olbers, two foreign astronomers, ought to have followed Mars in the order of description, as their orbits are placed between those of Mars and Jupiter; but as they have been observed only for a very short time, we judged it more proper to reserve the account of them till we came to the words Ceres and Pallas, when the elements of their orbits will in all probability be determined with more precision than at present. They are invisible to the naked eye; and Dr Herschel has ascertained that their size is extremely small. For that reason, together with the great obliquity of their orbits, he has proposed to distinguish them from the planets, and to call them *asteroids*.

Chap. IV. *Of the Comets.*

The planets are not the only moving bodies visible in the heavens. There are others which appear at uncertain intervals, and with a very different aspect from the planets. These are very numerous, and no fewer than 450 are supposed to belong to our solar system. They are called *Comets*, from their having a long tail, somewhat resembling the appearance of hair. This, however, is not always the case; for some comets have appeared which were as well defined, and as round as planets: but in general they have a luminous matter diffused around them, or projecting out from them, which to appearance very much resembles the Aurora Borealis. When these appear, they come in a direct line towards the sun, as if they were going to fall into his body; and after having disappeared for some time in consequence of their proximity to that luminary, they fly off again on the other side as fast as they came, projecting a tail much greater and brighter in their recess from him than when they advanced towards him; but, getting daily at a farther distance from us in the heavens, they continually lose of their splendour, and at last totally disappear. Their apparent magnitude is very different; sometimes they appear only of the bigness of the fixed stars; at other times they will equal the diameter of Venus, and sometimes even of the sun or moon. So, in 1652, Hevelius observed a comet which seemed not inferior to the moon in size, though it had not so bright a splendour, but appeared with a pale and dim light, and had a dismal aspect. These bodies will also sometimes lose their splendour suddenly, while their apparent bulk remains unaltered. With respect to their apparent motions, they have all the inequalities of the planets; sometimes seeming to go forwards, sometimes backwards, and sometimes to be stationary.

The comets, viewed through a telescope, have a very different appearance from any of the planets. The nucleus, or star, seems much more dim. Sturmius tells us, that observing the comet of 1680 with a telescope, it appeared like a coal dimly glowing; or a rude mass of matter illuminated with a dusky fumid light, less sensible at the extremes than in the middle; and not at all like a star, which appears with a round disk and a vivid light.

Hevelius observed of the comet in 1661, that its body was of a yellowish colour, bright and conspicuous, but without any glittering light. In the middle was a dense ruddy nucleus, almost equal to Jupiter, encompassed with a much fainter thinner matter.—February 5th. The nucleus was somewhat bigger and brighter, of a gold colour, but its light more dusky than the rest of the stars; it appeared also divided into a number of parts.—Feb. 6th. The nuclei still appeared, though less than before. One of them on the left side of the lower part of the disk appeared to be much denser and brighter than the rest; its body round, and representing a little lucid star; the nuclei still encompassed with another kind of matter.—Feb. 10th. The nuclei more obscure and confused, but brighter at top than at bottom.—Feb. 13th. The head diminished much both in brightness and in magnitude.—March 2d. Its roundness a little impaired, and the edges lacerated.—March 28th. Its matter much dispersed; and no distinct nucleus at all appearing.

Wiegelius, who saw through a telescope the comet of 1664, the moon, and a little cloud illuminated by the sun, at the same time, observed that the moon appeared of a continued luminous surface, but the comet very different, being perfectly like the little cloud enlightened by the sun's beams.

184

Atmospheres and phases of comets.

The comets, too, are to appearance surrounded with atmospheres of a prodigious size, often rising ten times higher than the nucleus. They have often likewise different phases, like the moon.

185

Dr Long's account of them.

"The head of a comet (says Dr Long) to the eye, unassisted by glasses, appears sometimes like a cloudy star; sometimes shines with a dull light like that of the planet Saturn: some comets have been said to equal, some to exceed, stars of the first magnitude; some to have surpassed Jupiter, and even Venus; and to have cast a shadow as Venus sometimes does.

"The head of a comet, seen through a good telescope, appears to consist of a solid globe, and an atmosphere that surrounds it. The solid part is frequently called the *nucleus;* which through a telescope is easily distinguished from the atmosphere or hairy appearance.

"A comet is generally attended with a blaze or tail, whereby it is distinguished from a star or planet; as it is also by its motion. Sometimes the tail only of a comet has been visible at a place where the head has been all the while under the horizon; such an appearance is called a *beam*.

186

Appearances of the comet of 1618.

"The nucleus of the comet of 1618 is said, a few days after coming into view, to have broken into three or four parts of irregular figures. One observer compares them to so many burning coals; and says they changed their situation while he was looking at them, as when a person stirs a fire; and a few days after were broken into a great number of smaller pieces. Another account of the same is, that on the 1st and 4th of December, the nucleus appeared to be a round, solid, and luminous body, of a dusky lead colour, larger than any star of the first magnitude. On the 8th of the same month it was broken into three or four parts of irregular figures; and on the 20th was changed into a cluster of small stars.

187

Phenomena of their tails.

"As the tail of a comet is owing to the heat of the sun, it grows larger as the comet approaches near to, and

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and shortens as it recedes from, that luminary. If the tail of a comet were to continue of the same length, it would appear longer or shorter according to the different views of the spectator; for if his eye be in a line drawn through the middle of the tail lengthwise, or nearly so, the tail will not be distinguished from the rest of the atmosphere, but the whole will appear round; if the eye be a little out of that line, the tail will appear short as in fig. 75.; and it is called a *bearded comet*, when the tail hangs down towards the horizon, as in that figure. If the tail of a comet be viewed sidewise, the whole length of it is seen. It is obvious to remark, that the nearer the eye is to the tail, the greater will be the apparent length thereof.

"The tails of comets often appear bent, as in fig. 76. and 77. owing to the resistance of the æther; which, though extremely small, may have a sensible effect on so thin a vapour as the tails consist of. This bending is seen only when the earth is not in the plane of the orbit of the comet continued. When that plane passes through the eye of the spectator, the tail appears straight, as in fig. 78, 79.

"Longomontanus mentions a comet, that, in 1618, Dec. 10th, had a tail above 100 degrees in length; which shows that it must then have been very near the earth. The tail of a comet will at the same time appear of different lengths in different places, according as the air in one place is clearer than in another. It need not be mentioned, that in the same place, the difference in the eyes of the spectators will be the cause of their disagreeing in their estimate of the length of the tail of a comet.

188 Difference between the observations of Hevelius and Hooke.

"Hevelius is very particular in telling us, that he observed the comet of 1665 to cast a shadow upon the tail; for in the middle thereof there appeared a dark line. It is somewhat surprising, that Hooke should be positive in affirming, on the contrary, that the place where the shadow of the comet should have been, if there had been any shadow, was brighter than any other part of the tail. He was of opinion that comets have some light of their own: His observations were made in a hurry; he owns they were short and transitory. Hevelius's were made with so much care, that there is more reason to depend upon them. Dom. Cassini observed, in the tail of the comet of 1680, a darkness in the middle; and the like was taken notice of by a curious observer in that of 1744.

189 Account of the comet of 1680.

"There are three comets, viz. of 1680, 1744, and 1759, that deserve to have a farther account given of them. The comet of 1680 was remarkable for its near approach to the sun; so near, that in its perihelion it was not above a sixth part of the diameter of that luminary from the surface thereof. Fig. 77. taken from Newton's Principia, represents so much of the trajectory of this comet as it passed through while it was visible to the inhabitants of our earth, in going from and returning to its perihelion. It shows also the tail, as it appeared on the days mentioned in the figure. The tail, like that of other comets, increased in length and brightness as it came nearer to the sun; and grew shorter and fainter as it went farther from him and from the earth, till that and the comet were too far off to be any longer visible.

190 Of that of 1744.

"The comet of 1744 was first seen at Lausanne in Switzerland, Dec. 13. 1743, N. S. From that time it increased in brightness and magnitude as it was coming nearer to the sun. The diameter of it, when at the distance of the sun from us, measured about one minute; which brings it out equal to three times the diameter of the earth. It came so near Mercury, that, if its attraction had been proportionable to its magnitude, it was thought probable it would have disturbed the motion of that planet. Mr Betts of Oxford, however, from some observations made there, and at Lord Macclesfield's observatory at Sherburn, found, that when the comet was at its least distance from Mercury, and almost twice as near the sun as that planet was, it was still distant from him a fifth part of the distance of the sun from the earth; and could therefore have no effect upon the planet's motions. He judged the comet to be at least equal in magnitude to the earth. He says, that in the evening of Jan. 23d, this comet appeared exceedingly distinct and bright, and the diameter of its nucleus nearly equal to that of Jupiter. Its tail extended above 26 degrees from its body; and was in length, supposing the sun's parallax 10″, no less than 23 millions of miles. Dr Bevis, in the month of May 1744, made four observations of Mercury, and found the places of that planet, calculated from correct tables, differed so little from the places observed, as to show that the comet had no influence upon Mercury's motion.

"The nucleus, which had before been always round, on the 10th of February appeared oblong in the direction of the tail, and seemed divided into two parts, by a black stroke in the middle. One of the parts had a sort of beard brighter than the tail; this beard was surrounded by two unequal dark strokes, that separated the beard from the hair of the comet. The odd phenomena disappeared the next day, and nothing was seen but irregular obscure spaces like smoke in the middle of the tail; and the head resumed its natural form. February 15th, the tail was divided into two branches; the eastern part about seven or eight degrees long, the western 24. On the 23d, the tail began to be bent; it shewed no tail till it was as near to the sun as the orbit of Mars; the tail grew longer as it approached nearer the sun; and at its greatest length was computed to equal a third part of the distance of the earth from the sun. Fig. 76. is a view of this comet, taken by an observer at Cambridge. I remember that, in viewing it, I thought the tail seemed to sparkle, or vibrate luminous particles. Hevelius mentions the like in other comets; and that their tails lengthen and shorten while we are viewing. This is probably owing to the motion of our air.

191 Of the comet of 1759.

"The comet of 1759 did not make any considerable appearance by reason of the unfavourable situation of the earth all the time its tail might otherwise have been conspicuous; the comet being then too near the sun to be seen by us; but deserves our particular consideration, as it was the first that ever had its return foretold."

Hevelius gives pictures of comets of various shapes; as they are described by historians to have been like a sword, a buckler, a tun, &c. These are drawn by fancy only, from the description in words. He gives, however, also pictures of some comets, engraved by his

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his own hand from the views he had of them through a very long and excellent telescope. In these we find changes in the nucleus and the atmosphere of the same comet. The nucleus of the comet of 1661, which in one observation appeared as one round body, as it is represented in fig. 87. in subsequent views seemed to consist of several smaller ones separated from one another, as in fig. 86. The atmosphere surrounding the nucleus, at different times, varied in the extent thereof; as did also the tail in length and breadth. The nuclei of other comets, as has already been observed, have sometimes phases like the moon. Those of 1744 and 1769 had both this kind of appearance.

Chap. V. *Of the Fixed Stars.*

192 Number of fixed stars increased by telescopes. The parallax of the stars is insensible. When viewed through the best telescopes, they appear not at all magnified, but rather diminished in bulk; by reason as is thought by some, that the telescope takes off that twinkling appearance they make to the naked eye; but by others, more probably, that the telescope tube excludes a quantity of the rays of light, which are not only emitted from the particular stars themselves, but by many thousands more, which falling upon our eyelids and the aerial particles about us, are reflected into our eyes so strongly as to excite vibrations, not only on those points of the retina where the images of the stars are formed, but also in other points at the same distance round about. This, without the telescope, makes us imagine the stars to be much bigger than when we see them only by a few rays coming directly from them, so as to enter our eyes without being intermixed with others. The smallness of their apparent diameter is proved by the suddenness with which they disappear on their occultations by the moon. The time which they take does not amount to one second, which shows their apparent diameter not to exceed 4″. The vivacity of their light, compared with their small diameter, leads us to suppose them at a much greater distance than the planets, and to consider them as luminous bodies like our sun, instead of borrowing their light from that luminary like the planets.

193 Different magnitudes of the stars. The stars, on account of their apparently various magnitudes, have been distributed into several classes or orders. Those which appear largest are called *stars of the first magnitude*; the next to them in lustre, *stars of the second magnitude*; and so on to the *sixth*, which are the smallest that are visible to the naked eye. This distribution having been made long before the invention of telescopes, the stars which cannot be seen without the assistance of these instruments are distinguished by the name of *telescopic stars*.

194 Telescopic stars. The ancients divided the starry sphere into particular constellations, or systems of stars, according as they lay near one another, so as to occupy those spaces which the figures of different sorts of animals or things would take up, if they were there delineated. **195 Unformed stars.** And those stars which could not be brought into any particular constellation were called *unformed stars*.

196 Uses of their division into constellations. This division of the stars into different constellations, or asterisms, serves to distinguish them from one another, so that any particular star may be readily found in the heavens by means of a celestial globe; on which the constellations are so delineated, as to put the most remarkable stars into such parts of the figures as are most easily distinguished. The number of the ancient constellations is 48, and upon our present globes about 70. On Senex's globes are inserted Bayer's letters; the first in the Greek alphabet being put to the biggest star in each constellation, the second to the next, and so on: by which means, every star is as easily found as if a name were given to it. Thus, if the star γ in the constellation of the Ram be mentioned, every astronomer knows as well what star is meant as if it were pointed out to him in the heavens. See fig. 205, 206, where the stars are represented with the figures of the animals fiom whence the constellations are marked.

197 Division of the heavens. These is also a division of the heavens into three parts. 1. The zodiac (ζωδιακος), from ζωδιον, *zodion*, "an animal," because most of the constellations in it, which are 12 in number, have the names of animals: Fig. 26, 29.
As *Aries* the ram, *Taurus* the bull, *Gemini* the twins, *Cancer* the crab, *Leo* the lion, *Virgo* the virgin, *Libra* the balance, *Scorpio* the scorpion, *Sagittarius* the archer, *Capricornus* the goat, *Aquarius* the water-bearer, and *Pisces* the fishes. The zodiac goes quite round the heavens: it is about 16 degrees broad, so that it takes in the orbits of all the planets, and likewise the orbit of the moon. Along the middle of this zone or belt is the ecliptic, or circle which the earth describes annually as seen from the sun, and which the sun appears to describe as seen from the earth. 2. All that region of the heavens which is on the north side of the zodiac, containing 21 constellations. And, 3. That on the south side, containing 15.

198 Zodiac how divided. The ancients divided the zodiac into the above 12 constellations or signs in the following manner: They took a vessel with a small hole in the bottom, and, having filled it with water, suffered the same to distil drop by drop into another vessel set beneath to receive it; beginning at the moment when some star arose, and continuing till it rose the next following night. The water falling down into the receiver they divided into 12 equal parts; and having two other small vessels in readiness, each of them fit to contain one part, they again poured all the water into the upper vessel; and, observing the rising of some star in the zodiac, they at the same time suffered the water to drop into one of the small vessels; and as soon as it was full, they shifted it, and set an empty one in its place. When each vessel was full, they took notice what star of the zodiac rose; and though this could not be done in one night, yet in many they observed the rising of 12 stars or points, by which they divided the zodiac into 12 parts.

The names of the constellations, and the number of stars observed in each of them by different astronomers, are as follows.

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199 Catalogue of the constellations.

The Ancient Constellations.

		Ptolemy.	Tycho.	Hevelius.	Flamstead.
Ursa minor	The Little Bear	8	7	12	24
Ursa major	The Great Bear	35	29	73	87
Draco	The Dragon	31	32	40	80
Cepheus	Cepheus	13	4	51	35
Bootes, *Arctophilax*		23	18	52	54
Corona Borealis	The Northern Crown	8	8	8	21
Hercules, *Engonasin*	Hercules kneeling	29	28	45	113
Lyra	The Harp	10	11	17	21
Cygnus, *Gallina*	The Swan	10	18	47	81
Cassiopeia	The Lady in her chair	13	26	37	55
Perseus	Perseus	29	29	46	59
Auriga	The Waggoner	14	9	40	66
Serpentarius, *Ophiuchus*	Serpentarius	29	15	40	74
Serpens	The Serpent	18	13	22	64
Sagitta	The Arrow	5	5	5	18
Aquila, *Vultur*	The Eagle	15	12	23	71
Antinous	Antinous		3	19	
Delphinus	The Dolphin	10	10	14	18
Equulus, *Equi sectio*	The Horse's Head	4	4	6	10
Pegasus, *Equus*	The Flying Horse	20	19	38	89
Andromeda	Andromeda	23	23	47	66
Triangulum	The Triangle	4	4	12	16
Aries	The Ram	18	21	27	66
Taurus	The Bull	44	43	51	141
Gemini	The Twins	25	25	38	85
Cancer	The Crab	23	15	29	83
Leo	The Lion	35	30	49	95
Coma Berenices	Berenice's Hair		14	21	43
Virgo	The Virgin	32	33	50	110
Libra, *Chelæ*	The Scales	17	10	20	51
Scorpio	The Scorpion	24	10	20	44
Sagittarius	The Archer	31	14	22	69
Capricornus	The Goat	28	28	29	51
Aquarius	The Water-bearer	45	41	47	108
Pisces	The Fishes	38	36	39	113
Cetus	The Whale	22	21	45	97
Orion	Orion	38	42	62	78
Eridanus, *Fluvius*	Eridanus, *the River*	34	10	27	84
Lepus	The Hare	12	13	16	19
Canis major	The Great Dog	29	13	21	31
Canis minor	The Little Dog	2	2	13	14
Argo Navis	The Ship	45	3	4	64
Hydra	The Hydra	27	19	31	60
Crater	The Cup	7	3	10	31
Corvus	The Crow	7	4	-	9
Centaurus	The Centaur	37	-	-	35
Lupus	The Wolf	19	-	-	24
Ara	The Altar	7	-	-	9
Corona Australis	The Southern Crown	13	-	-	12
Piscis Australis	The Southern Fish	18	-	-	24

The New Southern Constellations.

Columba Noachi	Noah's Dove	10	Apis, *Musca*	The Bee or Fly	4
Robur Carolinum	The Royal Oak	12	Chamæleon	The Chameleon	10
Grus	The Crane	13	Triangulum Australe	The South Triangle	5
Phœnix	The Phenix	13	Piscis volans, *Passer*	The Flying Fish	8
Indus	The Indian	12	Dorado, *Xiphias*	The Sword Fish	6
Pavo	The Peacock	14	Toucan	The American Goose	9
Apus, *Avis Indica*	The Bird of Paradise	11	Hydrus	The Water Snake	10

Hevelius's

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Hevelius's Constellations made out of the unformed Stars.

		Hevel.	Flamst.
Lynx	The Lynx	19	44
Leo minor	The Little Lion	–	53
Asterion & Chara	The Greyhounds	23	25
Cerberus	Cerberus	4	–
Vulpecula & Anser	The Fox and Goose	27	35
Scutum Sobieski	Sobieski's Shield	7	–
Lacerta	The Lizard	10	16
Camelopardalus	The Camelopard	32	58
Monoceros	The Unicorn	19	31
Sextans	The Sextant	11	41

Several stars observed by the ancients are now no more to be seen, but are destroyed; and new ones have appeared which were unknown to the ancients. Some of them have also disappeared for some time, and again become visible.

We are also assured from the observations of astronomers, that some stars have been observed which never were seen before, and for a certain time they have distinguished themselves by their superlative lustre; but afterwards decreasing, they vanished by degrees, and were no more to be seen. One of these stars being first seen and observed by Hipparchus, the chief of the ancient astronomers, set him upon composing a catalogue of the fixed stars, that by it posterity might learn whether any of the stars perish, and others are produced afresh.

After several ages, another new star appeared to Tycho Brahe and the astronomers who were cotemporary with him: which put him on the same design with Hipparchus, namely, the making a catalogue of the fixed stars. Of this, and other stars which have appeared since that time, we have the following history by Dr Halley: "The first new star in the chair of Cassiopeia, was not seen by Cornelius Gemma on the 8th of November 1572, who says, he that night considered that part of the heaven in a very serene sky, and saw it not: but that the next night, November 9. it appeared with a splendour surpassing all the fixed stars, and scarce less bright than Venus. This was not seen by Tycho Brahe before the 11th of the same month: but from thence he assures us that it gradually decreased and died away, so as in March 1574, after sixteen months, to be no longer visible; and at this day no signs of it remain. The place thereof in the sphere of fixed stars, by the accurate observations of the same Tycho, was $0^s\ 9^\circ\ 17'$ *a* 1ma * ♈is, with $53^\circ\ 45'$ north latitude.

200 Dr Halley's history of new stars.

"Such another star was seen and observed by the scholars of Kepler, to begin to appear on Sept. 30. *st. vet.* anno 1604, which was not to be seen the day before: but it broke out at once with a lustre surpassing that of Jupiter; and like the former, it died away gradually, and in much about the same time disappeared totally, there remaining no footsteps thereof in January $160\frac{5}{6}$. This was near the ecliptic, following the right leg of Serpentarius; and by the observations of Kepler and others, was in $7^s\ 20^\circ\ 00'$ *a* 1ma * ♈, with north latitude $1^\circ\ 56'$. These two seem to be of a distinct species from the rest, and nothing like them has appeared since.

"But between them, viz. in the year 1596, we have the first account of the wonderful star in Collo Ceti, seen by David Fabricius on the third of August *st. vet.* as bright as a star of the 3d magnitude, which has been since found to appear and disappear periodically; its period being precisely enough seven revolutions in six years, though it returns not always with the same lustre. Nor is it ever totally extinguished, but may at all times be seen with a six feet tube. This was singular in its kind, till that in Collo Cygni was discovered. It precedes the first star of Aries $1^\circ\ 40'$, with $15^\circ\ 57'$ south latitude.

"Another new star was first discovered by William Jansonius in the year 1600, *in pectore*, or rather *in eductione*, Colli Cygni, which exceeded not the third magnitude. This having continued some years, became at length so small, as to be thought by some to have disappeared entirely; but in the years 1657, 1658, and 1659, it again rose to the third magnitude; though soon after it decayed by degrees to the fifth or sixth magnitude, and at this day is to be seen as such in $9^s\ 18^\circ\ 38'$ *a* 1ma * ♈, with $55^\circ\ 29'$ north latitude.

"A fifth new star was first seen by Hevelius in the year 1670, on July 15. *st. vet.* as a star of the third magnitude, but by the beginning of October was scarce to be perceived by the naked eye. In April following it was again as bright as before, or rather greater than of the third magnitude, yet wholly disappeared about the middle of August. The next year, in March 1672, it was seen again, but not exceeding the sixth magnitude: since when, it has been no further visible, though we have frequently sought for its return; its place is $9^s\ 3^\circ\ 17'$ *a* 1ma * ♈, and has lat. north $47^\circ\ 28'$.

"The sixth and last is that discovered by Mr G. Kirch in the year 1686, and its period determined to be of $404\frac{1}{2}$ days; and though it rarely exceeds the fifth magnitude, yet it is very regular in its returns, as we found in the year 1714. Since then we have watched, as the absence of the moon and clearness of the weather would permit, to catch the first beginning of its appearance in a six feet tube, that, bearing a very great aperture, discovers most minute stars. And on June 15. last, it was first perceived like one of the very least telescopical stars; but in the rest of that month and July, it gradually increased, so as to become in August visible to the naked eye: and so continued till the month of September. After that, it again died away by degrees: and on the 8th of December, at night, was scarcely discernible by the tube; and, as near as could be guessed, equal to what it was at its first appearance on June 25th: so that this year it has been seen in all near six months, which is but little less than half its period; and the middle, and consequently the greatest brightness, falls about the 10th of September."

201 Mr Montanere's account of changes amongst the fixed stars.

Concerning the changes which happen among the fixed stars, Mr Montanere, professor of mathematics at Bononia, gave the following account, in a letter to the Royal Society, dated April 30th 1670. "There are now wanting in the heavens two stars of the second magnitude in the stern of the ship Argo, and its yard; Bayerus marked them with the letters β and χ. I and others observed them in the year 1664, upon the occasion of the comet that appeared that year: when they disappeared first, I know not: only I am sure that in the year 1668, upon the 10th of April, there was not the least glimpse of them to be seen; and yet the rest

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rest about them, even of the third and fourth magnitudes, remained the same. I have observed many more changes among the fixed stars, even to the number of a hundred, though none of them are so great as those I have showed."

The late improvements in astronomy, and particularly those in the construction of telescopes, have now given astronomers an opportunity of observing the changes which take place among the stars with much greater accuracy than could be formerly done. In a paper in the 76th volume of the Philosophical Transactions, Mr Edward Pigot gives a dissertation on the stars suspected by the astronomers of last century to be changeable. For the greater accuracy in the investigation of his subject, he divides them into two classes; one containing those which are undoubtedly changeable, and the other those which are only suspected to be so. The former contains a list of 12 stars, from the first to the fourth magnitude; including the new one which appeared in Cassiopeia in 1572, and that in Serpentarius in 1604: the other contains the names of 38 stars of all magnitudes, from the first to the seventh. He is of opinion, that the celebrated new star in Cassiopeia is a periodical one, and that it returns once in 150 years. Mr Keill is of the same opinion: and Mr Pigot thinks, that its not being observed at the expiration of each period is no argument against the truth of that opinion; "since (says he), perhaps, as with most of the variables, it may at different periods have different degrees of lustre, so as sometimes only to increase to the ninth magnitude; and if this should be the case, its period is probably much shorter." For this reason, in September 1782, he took a plan of the small stars near the place where it formerly appeared, but in four years had observed no alteration.

202 Mr Pigot's remarks on the accounts of variable stars.

203 Star in Collo Ceti.

The star in the neck of the Whale had also been examined by Mr Pigot from the end of 1782 to 1786; but he never found it exceed the sixth magnitude; though Mr Goodricke had observed it on the 9th of August to be of the second magnitude, and on the 3d of September the same year it was of the third magnitude. Mr Pigot deduced its period from its apparent equality with a small star in the neighbourhood, and thence found it to be 320, 328, and 337 days.

204 Algol.

The most remarkable of these changeable stars is that called *Algol*, in the head of Medusa. It had long been known to be variable; but its period was first ascertained by Mr Goodricke of York, who began to observe it in the beginning of 1783. It changes continually from the first to the fourth magnitude; and the time taken up from its greatest diminution to its least is found, at a mean, to be 2 d. 20 h. 49 m. and 3 sec. During four hours it gradually diminishes in lustre, which it recovers during the succeeding four hours; and in the remaining part of the period it invariably preserves its greatest lustre, and after the expiration of the term its diminution again commences. According to Mr Pigot, the degree of brightness of this star when at its *minimum* is variable in different periods, and he is of the same opinion with regard to its brightness when at its full; but whether these differences return regularly or not, has not been determined.

The 420th of Mayer's catalogue, in Leo, has lately been shown to be variable by Mr Koch. Some years before 1782, that gentleman perceived it undoubtedly smaller than the 419th of the same catalogue. In February that year, it was of the same brightness with the 419th, that is, of the seventh magnitude. In April 1783, it was of the ninth magnitude; and in the same month 1784, it was of the tenth. Mr Pigot could never observe this star, though he frequently looked for it with a night-glass, and on the fifth of April 1785 with a three feet achromatic transit instrument.

205 Variable star in Hydra.

In 1704, Maraldi observed a variable star in Hydra, whose period he settled at about two years, though with considerable variations: but from the observations even of Maraldi, Mr Pigot concludes, that its period was then only 494 days; and from some others made by himself, he thinks that now it is only 487 days; so that since the time of Maraldi it has shortened seven days. The particulars relating to this star are as follow. 1. When at its full brightness it is of the fourth magnitude, and does not perceptibly change for a fortnight. 2. It is about six months in increasing from the tenth magnitude and returning to the same: so that it may be considered as invisible during that time. 3. It is considerably more quick, perhaps one half more so, in its increase than in its decrease. 4. Though when at its full it may always be styled a star of the fourth magnitude, it does not constantly attain the same degree of brightness, but the differences are very small. This star is the 30th of Hydra in Hevelius's catalogue, and is marked by him of the sixth magnitude.

The new star in Serpentarius, observed by Kepler, seems to have been of the same nature with that of Cassiopeia; and Mr Pigot therefore looks upon it also to be a periodical one, though, after taking a plan of the nearest stars in that part of the heavens, in the year 1782, he could, in four years time, perceive no alteration.

206 Swan's Head.

The variation of the star β Lyræ was discovered by Mr Goodricke above-mentioned, who suspects its period to be six days nine hours; which coincides with the opinion of Mr Pigot.

The new star near the Swan's Head, observed by Don Anthelme in December 1669, soon became of the third magnitude, and disappeared in 1672. Mr Pigot has constantly looked for it since November 1781, but without success. He is of opinion, that had it only increased to the 10th or 11th magnitude, he would have seen it, having taken a plan of all the neighbouring small stars.

The next variable star in Mr Pigot's catalogue is the η Antinoi, whose variation and period he discovered in 1785. From his corrected observations, he concludes that it continues at its greatest brightness 40 hours without decreasing; it is 66 hours after it begins to decrease before it comes to its full diminution; after which it continues stationary for 30 hours more, and then increases for 36 hours. In every period it seems to acquire its full brightness, and to be equally decreased.

207 Swan's Neck.

The variable star in the Swan's Neck was observed for three years. The period of this star had been settled by Maraldi and Cassini at 405, and by M. le Gentil at 405.3 days; but from a mean of the observations of Mr Pigot, it appears to be only 392.

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"Perhaps (says he) its period is irregular; to determine which several intervals of 15 years ought to be taken; and I am much inclined to believe that it will be found only 396 days 21 hours." The particulars relating to this star are, 1. When at its full brightness it undergoes no perceptible change for a fortnight. 2. It is about three months and a half in increasing from the 11th magnitude to its full brightness, and the same in decreasing; for which reason it may be considered as invisible during six months. 3. It does not always attain the same degree of lustre, being sometimes of the fifth and sometimes of the seventh magnitude.

208 Swan's Breast.

In 1600, G. Jansonius discovered a variable star in the breast of the Swan, which was afterwards observed by different astronomers, and supposed to have a period of about 10 years. The results of Mr Pigot's calculations from the observations of former astronomers are, 1. That it continues in full lustre for five years. 2. It decreases rapidly for two years. 3. It is invisible to the naked eye for four years. 4. It increases slowly during seven years. 5. All these changes are completed in 18 years. 6. It was at its *minimum* at the end of the year 1663. 7. It does not always increase to the same degree of brightness, being sometimes of the third, and at others only of the sixth, magnitude. "I am entirely ignorant (says Mr Pigot) whether it is subject to the same changes in this century, having not met with any series of observations on it; but if the above conjectures are right, it will be at its minimum in a very few years. Since November 1781 I have constantly seen it of the sixth magnitude. Sometimes I have suspected that it has decreased within these two last years, though in a very small degree."

The last star in Mr Pigot's first class is the δ Cephei, whose variation was discovered by Mr Goodricke. Its changes are very difficult to be seen, unless it is observed at the times of its greatest and least brightness. The result of the observations hitherto made upon it are, that its period consists of 5 days 8 hours 37′ on a mean. The following observations relate to some stars of the second class.

209 Stars, variation of which is less certain.

1. Hevelius's 6th Cassiopeiæ was missing in 1782, nor could Mr Pigot find it in 1783 and 1784.

2. ξ or 46 Andromedæ, said to be variable, but the evidence is not convincing to Mr Pigot.

3. Flamstead's 50, 52, υ Andromedæ, and Hevelius's 41 Andromedæ. The position and characters of these stars differ considerably in different catalogues, and some of them are said by Cassini to have disappeared and reappeared. Mr Pigot therefore gives their comparative brightness as observed in the years 1783, 1784, and 1785, during which time he does not mention any particular change.

4. Tycho's 20th Ceti. "This (says Mr Pigot) must be the star which Hevelius said had disappeared, being Tycho's second in the Whale's Belly. There can hardly be any doubt that it is the χ, misplaced by Tycho. This χ is of the fourth or fifth magnitude.

5. ε, or the 17th Eridani of Ptolemy and Ulug Beigh. Flamstead says he could not see this star in 1691 and 1692; but in 1782, 1783, and 1784, Mr Pigot observed in that place one of the seventh magnitude, which appeared always of the same lustre.

6. Flamstead's 41 Tauri was supposed by Cassini to be either a new or variable star; but Mr Pigot thinks there is no reason to be of that opinion. "That it is not new (says he) is evident, since it is Ulug Beigh's 26th and Tycho's 43d.

7. A star about 2½° north of 53 Eridani, and 47 Eridani. Cassini supposed the first of these stars to be a new one, and that it was not visible in 1664. He mentions another star thereabouts, which he also esteemed a new one.

8. γ Canis Majoris. Maraldi could not see this star in 1670; but in 1692 and 1693 it appeared of the fourth magnitude. Mr Pigot made frequent observations upon it from 1782 to 1786, but could perceive no variation.

9. α β Geminorum. "If any of these stars (says our author) have changed in brightness, it is probably the β. In 1783, 1784, and 1785, the β was undoubtedly brighter than α."

10. ξ Leonis. According to Montanari, this star was hardly visible in 1693. In 1783, 1784, and 1785, it was of the fifth magnitude. By Tycho, Flamstead, Mayer, Bradley, &c. it is marked of the fourth.

11. ψ Leonis. This star is said to have disappeared before the year 1667; but according to Mr Pigot's observations, was constantly of the fifth or sixth magnitude since 1783.

12. 25th Leonis. In 1783, our author first perceived that this star was missing, and could not perceive it in 1784 and 1785, even with a transit instrument.

13. Bayer's ι Leonis, or Tycho's 16 Leonis was not visible in 1709, nor could it be seen in 1785. It is a different star from the ι Leonis of the other catalogues, though Tycho's description of its place is the same.

14. δ Ursæ Majoris. This star is suspected to change in brightness, on account of its being marked by Tycho, the prince of Hesse, &c. of the second magnitude, while Hevelius, Bradley, and others, have marked it of the third. In 1786, and for three years before, it appeared as a bright star of the fourth magnitude.

15. ν Virginis. This is supposed to be variable, because Flamstead, on the 27th of January 1680, could not see it; but he observed it in 1677, and some years afterwards. Mr Pigot observed it frequently in 1784 and 1785, and found it a star of the sixth magnitude without any perceptible change.

16. Bayer's star of the sixth magnitude 1° south of *g* Virginis. "This star (says Mr Pigot) is not in any of the nine catalogues that I have. Maraldi looked for it in vain; and in May 1785 I could not see the least appearance of it." It certainly was not of the eighth magnitude.

17. A star in the northern thigh of Virgo, marked by Ricciolus of the sixth magnitude, could not be seen by Maraldi in 1709; nor was it of the ninth magnitude, if at all visible in 1785.

18. The 91 and 92 Virginis. In 1685, one of these stars, probably the 91, was missing: the remaining one is of the sixth or seventh magnitude.

19. α Draconis. Mr Pigot coincides in opinion with Dr Herschel, that this star is variable. Bradley, Flamstead, &c. mark it of the second magnitude, but in 1786 it was only a bright fourth. It was frequently examined

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examined by Mr Pigot from the fourth of October 1782, but without any alteration being perceived.

20. Bayer's star in the west scale of Libra. Maraldi could not see this star, and it was likewise invisible to Mr Pigot in 1784 and 1785.

21. N° 6 of Ptolemy and Ulug Beigh's unformed in Libra. This star is not mentioned in any other catalogues than the above. Mr Pigot frequently observed a little star of the seventh magnitude very near its place

22. κ Libræ. This star is thought to be variable, but Mr Pigot is not of that opinion, though "certainly (says he) it is rather singular, that Hevelius, whose attention was directed to that part of the heavens to find Tycho's 11th, did not find the κ; and the more so, as he has noticed two much smaller stars not far from it. During these three years I have found the κ constantly of the fifth magnitude."

23. Tycho's 11th Libræ. Mr Pigot is of opinion that no such star as this ever existed; and that it is no other than the κ with an error of 2 degrees of longitude.

24. 33 Serpentis. This star was missing in 1784; nor could it be perceived with a night-glass in 1785.

25. A star marked by Bayer near ι Ursæ majoris. This star could not be seen by Cassini; nor was Mr Pigot able to discover it with a night-glass in 1782.

26. The ρ, or Ptolemy and Ulug Beigh's 14th Ophiuchi, or Flamstead's 36th. Mr Pigot has no doubt that this is the star which is said to have disappeared before the year 1695; and it is evident that it was not seen by Hevelius. In 1784 and 1785 Mr Pigot found it of the fourth or fifth magnitude; but he is far from being certain of its having undergone any change, especially as it has a southern declination of 26 degrees; for which reason great attention must be paid to the state of the atmosphere.

27. Ptolemy's 13th and 18th Ophiuchi, fourth magnitude. Mr Pigot is of opinion that these stars are misplaced in the catalogues. The 18th of Ptolemy he thinks ought to be marked with a north latitude instead of a south, which would make it agree nearly with Flamstead's 58th; and he is also of opinion that the 13th of Ptolemy is the 40th of Flamstead.

28. σ Sagittarii. Dr Herschel, as well as Mr Pigot, is of opinion, that this star has probably changed its magnitude, though the reason seems only to be the great disagreement concerning it among the different catalogues of stars.

29. θ Serpentis. This star, according to Mr Montanari, is of variable magnitude; but Mr Pigot never could perceive any alteration.

30. Tycho's 27th Capricorni was missing in Hevelius's time, and Mr Pigot could not find it with a transit instrument.

31. Tycho's 22d Andromedæ, and ι Andromedæ. Mr Cassini informs us, that in his time the former had grown so small that it could scarcely be seen; and Mr Pigot, that no star was to be seen in its place in 1784 and 1785: but he is of opinion that Cassini may have mistaken the ι Andromedæ for the 22d; for which reason he observed this star three years, but without any alteration in its brightness.

32. Tycho's 19th Aquarii. Hevelius says that this star was missing, and that Flamstead could not see it with his naked eye in 1679. Mr Pigot could not see it in 1782; but is persuaded that it is the same with Flamstead's 56th, marked *f* by Bayer, from which it is only a degree and a half distant. The 53d of Flamstead, marked *f* in Ptolemy's catalogue, is a different star.

33. La Caille's 483 Aquarii was first discovered to be missing in 1778, and was not visible in 1783 and 1784.

Besides these there are several others certainly variable, but which cannot be seen in this country. There are some also suspected to be variable, but for which Mr Pigot thinks there is no reason. Dr Herschel also gives strong reasons for not laying great stress on all the observations by which new stars have been said to be discovered. Mr Pigot assures us from repeated experience, that even more than a single observation, if not particularised and compared with neighbouring stars, is very little to be depended upon; different streaks of the clouds, the state of the weather, &c. having often caused him to err a whole magnitude in the brightness of a star.

210 Wollaston's method of discovering variations among the fixed stars.

As these changes to which the fixed stars are liable do not seem to be subject to any certain rule, Mr Wollaston has given an easy method of observing whether they do take place in any part of the heavens or not, and that without much expence of instruments or waste of time, which are great objections to astronomical observations in general. His first idea was, that the work should be undertaken by astronomers in general; each taking a particular district of the heavens, and from time to time observing the right ascension and declination of every star in that space allotted to him, framing an exact map of it, and communicating their observations to one common place of information.—This method, however, being too laborious, he next proposes the noting down at the time, or making a drawing of what one sees while they are observing. A drawing of this kind once made, would remain, and could be consulted on any future occasion; and if done at first with care, a transient review would discover whether any sensible change had taken place since it was last examined, which could not so well be done by catalogues or verbal description. For this purpose he recommends the following method: "To a night glass, but of Dollond's construction, which magnifies about six times, and takes in about as many degrees of a great circle, I have added cross wires intersecting one another at an angle of 45 degrees. More wires may be crossed in other directions; but I apprehend these will be sufficient. This telescope I mount on a polar axis. One coarsely made, and without any divisions on its circle of declination, will answer the purpose, as there is no great occasion for accuracy in that respect; but as the heavenly bodies are more readily followed by an equatorial motion of the telescope, so their relative positions are much more easily discerned when they are looked at constantly as in the same direction. A horizontal motion, except in the meridian, would be apt to mislead the judgment. It is scarcely necessary to add, that the wires must stand so as for one to describe a parallel of the equator nearly; another will then be a horary circle, and the whole area will be divided into eight equal sectors.

"Thus prepared, the telescope is to be pointed to a known

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known star, which is to be brought into the centre or common intersection of all the wires. The relative positions of such other stars as appear within the field are to be judged of by the eye; whether at $\frac{1}{4}$, $\frac{1}{3}$, or $\frac{1}{2}$, from the centre towards the circumference, or *vice versa;* and so with regard to the nearest wire respectively. These, as one sees them, are to be noted down with a black-lead pencil upon a large message-card held in the hand, upon which a circle similarly divided is ready drawn. One of three inches diameter seems most convenient. The motion of the heavenly bodies in such a telescope is so slow, and the noting down of the stars so quickly done, that there is commonly full time for it without moving the telescope. When that is wanted, the principal star is easily brought back again into the centre of the field at pleasure, and the work resumed. After a little practice, it is astonishing how near one can come to the truth in this way: and though neither the right ascensions nor the declinations are laid down by it, nor the distances between the stars measured; yet their apparent situations being preserved in black and white, with the day and year, and hour, if thought necessary, written underneath, each card then becomes a register of the then appearance of the heavens; which is easily re-examined at any time with little more than a transient view; and which will yet show, on the first glance, if there should have happened in it any alteration of consequence."

Fig. 80. shows part of the Corona Borealis delineated in this manner, and which was afterwards fully taken down by making the stars α, β, γ, δ, ϵ, ζ, θ, ι, κ, π, ρ, σ, and τ, successively central; and these were joined with some of the stars of Bootes, for the sake of connecting the whole, and united into one map, as represented in fig. 81.

In observing in this way, it is evident, that the places of such stars as happen to be under or very near any of the wires, are more to be depended upon than those which are in the intermediate spaces, especially if towards the edges of the fields; so also those which are nearest to the centre, because better defined, and more within the reach of one wire or another. For this reason, different stars of the same set must successively be made central, or brought towards one of the wires, where any suspicion arises of a mistake, in order to approach nearer to a certainty; but if the stand of the telescope be tolerably well adjusted and fixed, this is soon done.

In such a glass it is seldom that light sufficient for discerning the wires is wanting. When an illuminator is required, a piece of card or white pasteboard projecting on one side beyond the tube, and which may be brought forward occasionally, is better than any other. By cutting across a small segment of the object-glass, it throws a sufficient light down the tube though the candle be at a great distance, and one may lose sight of the false glare by drawing back the head, and moving the eye a little to one side, when the small stars will be seen as if no illuminator was there. See a delineation of the principal fixed stars, with the apparent path of the sun among them, in figures 82 and 83.

211 Galaxy, or milky-way.

A very remarkable appearance in the heavens is that called the *galaxy*, or *milky-way*. This is a broad circle, sometimes double, but for the most part single, surrounding the whole celestial concave. We perceive also in different parts of the heavens small white spots, which appear to be of the same nature with the milky-way. These spots are called *nebulæ*.

We shall subjoin in this place, for the entertainment of the reader, the theories of Mr Michell and Dr Herschel, concerning the nature and position of the fixed stars.

212 Mr Michell's conjectures concerning the nature of the fixed stars.

"The very great number of stars (says Mr Michell) that have been discovered to be double, triple, &c. particularly by Mr Herschel, if we apply the doctrine of chances, as I have heretofore done in my inquiry into the probable parallax, &c. of the fixed stars, published in the Philosophical Transactions for the year 1767, cannot leave a doubt with any one who is properly acquainted with the force of those arguments, that by far the greatest part, if not all of them, are systems of stars so near each other, as probably to be liable to be affected sensibly by their mutual gravitation; and it is therefore not unlikely, that the periods of the revolutions of some of these about their principals (the smaller ones being, upon this hypothesis, to be considered as satellites to the other) may some time or other be discovered." Having then shown in what manner the magnitude of a fixed star, if its density were known, would affect the velocity of its light, he

213 In what cases light may be supposed to return to the body that emits it.

concludes at last, that "if the semidiameter of a sphere of the same density with the sun were to exceed his in the proportion of 500 to 1, a body falling from an infinite height towards it (or moving in a parabolic curve at its surface) would have acquired a greater velocity than that of light; and consequently, supposing light to be attracted by the same force in proportion to its *vis inertiæ* with other bodies, all light emitted from such a body would be made to return towards it by its own proper gravity. But if the semidiameter of a sphere, of the same density with the sun, was of any other size less than 497 times that of the sun, though the velocity of light emitted by such a body would never be wholly destroyed, yet it would always suffer some diminution, more or less according to the magnitude of the sphere. The same effects would likewise take place if the semidiameters were different from those already mentioned, provided the density was greater or less in the duplicate ratio of these semidiameters inversely.

214 Comparative brightness of the sun and fixed stars.

After proceeding in his calculations, in order to find the diameter and distance of any star, he proceeds thus: "According to Mr Bouguer the brightness of the sun exceeds that of a wax-candle in no less a proportion than that of 8000 to 1. If therefore the brightness of any of the fixed stars should not exceed that of our common candles, which, as being something less luminous than wax, we will suppose in round numbers to be only one ten thousandth part as bright as the sun, such a star would not be visible at more than one hundredth part of the distance at which it would be seen if it were as bright as the sun. Now, because the sun would still, I apprehend, appear as bright and luminous as the star Sirius, if removed to 400,000 times his present distance, such a body, if no brighter than our common candles, would only appear equally luminous with that star at 4000 times the distance of the sun; and we might then be able, with the best telescopes, to distinguish some sensible apparent

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parent diameter of it: but the apparent diameters of the stars of lesser magnitudes would still be too small to be distinguishable even with our best telescopes, unless they were yet a good deal less luminous; which may possibly, however, be the case with some of them: for though we have indeed very slight grounds to go upon with regard to the specific brightness of the fixed stars, compared with that of the sun at present, and can therefore form only very uncertain and random conjectures concerning it; yet from the infinite variety which we find in the works of the creation, it is not unreasonable to suspect, that very possibly some of the fixed stars may have so little natural brightness in proportion to their magnitude, as to admit of their diameters having some sensible apparent size when they shall come to be more carefully examined, and with larger and better telescopes than have been hitherto in common use.

215 Luminous appearance of the sun supposed to proceed from an atmosphere.

"With respect to the sun, we know that his whole surface is extremely luminous, a very small and temporary interruption sometimes, from a few spots, excepted. This universal and excessive brightness of the whole surface is probably owing to an atmosphere, which being luminous throughout, and in some measure also transparent, the light proceeding from a considerable depth of it, all arrives at the eye, in the same manner as the light of a great number of candles would do if they were placed one behind another, and their flames were sufficiently transparent to permit the light of the more distant ones to pass through those that were nearer without interruption.

"How far the same constitution may take place in the fixed stars we do not know: probably, however, it may still do so in many; but there are some appearances, with regard to a few of them, which seem to make it probable that it does not do so universally. Now, if I am right in supposing the light of the sun to proceed from a luminous atmosphere which must necessarily diffuse itself equally over the whole surface, and I think there can be very little doubt that this is really the case, this constitution cannot well take place in those stars which are in some degree periodically more and less luminous, such as that in Collo Ceti, &c. It is also not very improbable, that there is some difference from that of the sun in the constitution of those stars which have sometimes appeared and disappeared, of which that in the constellation of Cassiopeia is a notable instance. And if these conjectures are well founded which have been formed by some philosophers concerning stars of this kind, that they are not wholly luminous, or at least not constantly so, but that all, or by far the greatest part of their surfaces, is subject to considerable changes, sometimes becoming luminous, at other times extinguished; it is amongst stars of this sort that we are most likely to meet with instances of a sensible apparent diameter, their light being much more likely not to be so great in proportion as that of the sun, which if removed to 400,000 times his present distance, would still appear, I apprehend, as bright as Sirius, as I have observed above; whereas it is hardly to be expected, with any telescope whatsoever, that we should ever be able to distinguish a well-defined disk of any body of the same size with the sun at much more than 10,000 times his present distance.

216 Of the variable stars.

"Hence the greatest distance at which it would be possible to distinguish any sensible apparent diameter of a body as dense as the sun, cannot well greatly exceed five hundred times ten thousand; that is, five million times the distance of the sun; for if the diameter of such a body was not less than 500 times that of the sun, its light, as has been shown above, could never arrive at us."

217 Dr Herschel's opinion concerning the construction of the universe.

Dr Herschel, improving on Mr Michell's idea of the fixed stars being collected into groups, and assisted by his own observations with the extraordinary telescopic powers already mentioned, has suggested a theory concerning the construction of the universe entirely new and singular. It had been the opinion of former astronomers, that our sun, besides occupying the centre of the system which properly belongs to him, occupied also the centre of the universe: but Dr Herschel is of a very different opinion. "Hitherto (says he) the sidereal heavens have, not inadequately for the purpose designed, been represented by the concave surface of a sphere, in the centre of which the eye of the observer might be supposed to be placed. It is true, the various magnitudes of the fixed stars even then plainly suggested to us, and would have better suited, the idea of an expanded firmament of three dimensions; but the observations upon which I am now going to enter, still farther illustrate and enforce the necessity of considering the heavens in this point of view. In future therefore we shall look upon those regions into which we may now penetrate by means of such large telescopes (A), as a naturalist regards a rich extent of ground or chain of mountains containing strata variously inclined and directed, as well as consisting of very different materials. A surface of a globe or map therefore will but ill delineate the interior parts of the heavens."

218 His observations on the Via Lactea.

With the powerful telescope mentioned in the note, Dr Herschel first began to survey the Via Lactea, and found that it completely resolved the whitish appearance into stars, which the telescopes he formerly used had not light enough to do. The portion he first observed was that about the hand and club of Orion; and found therein an astonishing multitude of stars, whose number he endeavoured to estimate by counting many *fields* (B), and computing from a mean of these how many might be contained in a given portion of the milky-way. In the most vacant place to be met with in that neighbourhood he found 63 stars; other six fields contained 110, 60, 70, 90, 70, and 74 stars; a mean of all which gave 79 for the number of stars to each field; and thus he found, that by allowing 15 minutes

(A) Dr Herschel's observations, on which this theory is founded, were made with a Newtonian reflector of 20 feet focal length, and an aperture of 18 inches.

(B) By this word we are to understand the apparent space in the heavens he could see at once through his telescope.

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minutes for the diameter of his field of view, a belt of 15 degrees long and two broad, which he had often seen pass before his telescope in an hour's time, could not contain less than 50,000 stars, large enough to be distinctly numbered; besides which, he suspected twice as many more, which could be seen only now and then by faint glimpses for want of sufficient light.

219
On the nebulæ.

The success he had within the milky-way soon induced him to turn his telescope to the nebulous parts of the heavens, of which an accurate list had been published in the *Connoisance des Temps* for 1783 and 1784. Most of these yielded to a Newtonian reflector of 20 feet focal distance and 12 inches aperture; which plainly discovered them to be composed of stars, or at least to contain stars, and to show every other indication of consisting of them entirely. "The nebulæ (says he) are arranged into strata, and run on to a great length; and some of them I have been able to pursue, and to guess pretty well at their form and direction. It is probable enough that they may surround the whole starry sphere of the heavens, not unlike the milky-way, which undoubtedly is nothing but a stratum of fixed stars: And as this latter immense starry bed is not of equal breadth or lustre in every part, nor runs on in one straight direction, but is curved, and even divided into two streams along a very considerable portion of it; we may likewise expect the greatest variety in the strata of the clusters of stars and nebulæ. One of these nebulous beds is so rich, that, in passing through a section of it in the time of only 36 minutes, I have detected no less than 31 nebulæ, all distinctly visible upon a fine blue sky. Their situation and shape, as well as condition, seem to denote the greatest variety imaginable. In another stratum, or perhaps a different branch of the former, I have often seen double and treble nebulæ variously arranged; large ones with small seeming attendants; narrow, but much extended lucid nebulæ or bright dashes; some of the shape of a fan, resembling an electric brush issuing from a lucid point; others of the cometic shape, with a seeming nucleus in the centre, or like cloudy stars, surrounded with a nebulous atmosphere: a different sort again contain a nebulosity of the milky kind, like that wonderful inexplicable phenomenon about θ Orionis; while others shine with a fainter mottled kind of light, which denotes their being resolvable into stars.

220
They are arranged into strata.

221
Variety of shapes assumed by them.

222
Why the milky-way appears to surround the heavens.

"It is very probable that the great stratum called the *milky-way*, is that in which the sun is placed, though perhaps not in the very centre of its thickness. We gather this from the appearance of the galaxy, which seems to encompass the whole heavens, as it certainly must do if the sun is within the same. For suppose a number of stars arranged between two parallel planes, indefinitely extended every way, but at a given considerable distance from one another, and calling this a sidereal stratum, an eye placed somewhere within it will see all the stars in the direction of the planes of the stratum projected into a great circle, which will appear lucid on account of the accumulation of the stars, while the rest of the heavens at the sides will only seem to be scattered over with constellations, more or less crowded according to the distance of the planes or number of stars contained in the thickness or sides of the stratum.

"Thus in fig. 83. an eye at S within the stratum *a b*, will see the stars in the direction of its length *a b*, or height *e d*, with all those in the intermediate situation, projected into the lucid circle ABCD; while those in the sides *m e*, *n w*, will be seen scattered over the remaining part of the heavens at MVNW.

223
Celestial appearances solved on Dr Herschel's hypothesis.

"If the eye were placed somewhere without the stratum, at no very great distance, the appearance of the stars within it would assume the form of one of the lesser circles of the sphere, which would be more or less contracted to the distance of the eye; and if this distance were exceedingly increased, the whole stratum might at last be drawn together into a lucid spot of any shape, according to the position, length, and height of the stratum.

"Let us now suppose, that a branch or smaller stratum should run out from the former in a certain direction, and let it also be contained between two parallel planes extended indefinitely onwards, but so that the eye may be placed in the great stratum somewhere before the separation, and not far from the place where the strata are still united; then will this second stratum not be projected into a bright circle like the former, but will be seen as a lucid branch proceeding from the first, and returning to it again at a certain distance less than a semicircle. Thus, in the same figure, the stars in the small stratum *p g* will be projected into a bright arch at PRRP, which after its separation from the circle CBD, unites with it again at P.

"What has been instanced in parallel planes may easily be applied to strata irregularly bounded, and running in various directions; for their projection will of consequence vary according to the quantities of the variations in the strata and the distance of the eye from the same. And thus any kind of curvatures, as well as various degrees of brightness, may be produced in the projections.

224
Of the sun's place in the universe.

"From appearances, then, as I observed before, we may infer, that the sun is most likely placed in one of the great strata of the fixed stars, and very probably not far from the place where some smaller stratum branches out from it. Such a supposition will satisfactorily, and with great simplicity, account for all the phenomena of the milky-way; which according to this hypothesis, is no other than the appearance of the projection of the stars contained in this stratum and its secondary branch. As a farther inducement to look on the galaxy in this point of view, let it be considered, that we can no longer doubt of its whitish appearance arising from the mixed lustre of the numberless stars that compose it. Now, should we suppose it to be an irregular ring of stars, in the centre nearly of which we must then suppose the sun to be placed, it will appear not a little extraordinary, that the sun, being a fixed star, like those which compose this imagined ring, should just be in the centre of such a multitude of celestial bodies, without any apparent reason for this singular distinction; whereas, on our supposition, every star in this stratum, not very near the termination of its length or height, will be so placed as also to have its own galaxy, with only such variations in the form and lustre of it as may arise from the particular situation of each star.

225
Herschel's method of gauging the heavens.

"Various methods may be taken to come to a knowledge of the sun's place in the sidereal stratum, one

one of which I have already begun to put in practice: I call it *gauging the heavens*; or the *star-gauge*. It consists in repeatedly taking the number of stars in ten fields of view of my reflector very near each other; and by adding their sums, and cutting off one decimal on the right, a mean of the contents of the heavens in all the parts which are thus gauged are obtained. Thus it appears that the number of stars increases very much as we approach the milky-way; for in the parallel from 92 to 94 degrees north polar distance, and right ascension 15 h. 10′, the star-gauge runs up from 9.4 stars in the field to 18.6 in about an hour and a half; whereas in the parallel from 78 to 80 degrees north polar distance, and R. A. 11, 12, 13, and 14 hours, it very seldom rises above 4. We are, however, to remember, that, with different instruments, the account of the gauges will be very different, especially on our supposition of the sun in a stratum of stars. For let *ab* fig. 84. be the stratum, and suppose the small circle *ghlk* to represent the space into which, by the light and power of a given telescope, we are enabled to penetrate, and let GHLK be the extent of another portion which we are enabled to visit by means of a larger aperture and power, it is evident, that the gauges with the latter instrument will differ very much in their account of stars contained at MN and at KG or LH, when with the former they will hardly be affected with the change from *mn* to *kg* or *lk*.

226 How to find the place of the sun in the sidereal stratum.

"The situation of the sun in the sidereal stratum will be found by considering in what manner the star-gauge agrees with the length of a ray revolving in several directions about an assumed point, and cut off by the bounds of the stratum. Thus, in fig. 85. let S be the place of an observer: S r r r, *S r r r*, lines in the plane r S r, *r S r*, drawn from S within the stratum to one of the boundaries here represented by the plane AB. Then, since neither the situation of S nor the form of the limiting surface AB is known, we are to assume a point, and apply to it lines proportional to the several gauges that have been obtained, and at such angles from each other as they may point out: then will the termination of these lines delineate the boundary of the stratum, and consequently manifest the situation of the sun within the same.

227 Observations on nebulæ.

"In my late observations on nebulæ, I soon found, that I generally detected them in certain directions rather than in others: that the spaces preceding them were generally quite deprived of their stars, so as often to afford many fields without a single star in it: that the nebulæ generally appeared some time after among stars of a certain considerable size, and but seldom among very small stars: that when I came to one nebula, I generally found several more in the neighbourhood: that afterwards a considerable time passed before I came to another parcel. These events being often repeated in different altitudes of my instrument, and some of them at considerable distances from each other, it occurred to me that the intermediate spaces between the sweeps might also contain nebulæ; and finding this to hold good more than once, I ventured to give notice to my assistant at the clock, that I 'found myself on nebulous ground.' But how far these circumstances of vacant places preceding and following the nebulous strata, and their being as it were contained in a bed of stars sparingly scattered between them, may hold good in more distant portions of the heavens, and which I have not been yet able to visit in any regular manner, I ought by no means to hazard a conjecture. I may venture, however, to add a few particulars about the direction of some of the capital strata or their branches. The well-known nebula of Cancer, visible to the naked eye, is probably one belonging to a certain stratum, in which I suppose it to be so placed as to lie nearest to us. This stratum I shall call that of Cancer. It runs from ι Cancri towards the south, over the 67th nebula of the *Connoissance des Temps*, which is a very beautiful and pretty much compressed cluster of stars, easily to be seen by any good telescope; and in which I have observed above 200 stars at once in the field of view of my great reflector with a power of 157. This cluster appearing so plainly with any good common telescope, and being so near to the one which may be seen with the naked eye, denotes it to be probably the next in distance to that within the quartile formed by γ, δ, η, θ. From the 67th nebula the stratum of Cancer proceeds towards the head of Hydra; but I have not yet had time to trace it farther than the equator.

228 Direction of some of the principal strata of stars.

"Another stratum, which perhaps approaches nearer to the solar system than any of the rest, and whose situation is nearly at rectangles with the great sidereal stratum in which the sun is placed, is that of Coma Berenices, as I shall call it. I suppose the Coma itself to be one of the clusters in it, and that on account of its nearness it appears to be so scattered. It has many capital nebulæ very near it: and in all probability this stratum runs out a very considerable way. It may perhaps even make the circuit of the heavens, though very likely not in one of the great circles of the sphere; for unless it should chance to intersect the great sidereal stratum of the milky-way before mentioned, in the very place in which the sun is stationed, such an appearance would hardly be produced. However, if the stratum of Coma Berenices should extend so far as I apprehend it may, the direction of it towards the north lies probably, with some windings, through the Great Bear onwards to Cassiopeia, thence through the girdle of Andromeda and the Northern Fish, proceeding towards Cetus; while towards the south it passes through the Virgin, probably on to the tail of Hydra and Centaurus."

229 Of the interior construction of the heavens.

By a continued series of observations, Dr Herschel became confirmed in his notions; and in a succeeding paper * has given a sketch of his opinions concerning the interior construction of the heavens. "That the milky-way (says he) is a most extensive stratum of stars of various sizes, admits no longer of the least doubt; and that our sun is one of the heavenly bodies belonging to it is as evident. I have now viewed and gauged this shining zone in almost every direction, and find it composed of shining stars, whose number, by the account of those gauges, constantly increases and decreases in proportion to its apparent brightness to the naked eye. But in order to develope the ideas of the universe that have been suggested by my late observations, it will be best to take the subject from a point of view at a considerable distance both of space and time.

* Phil. Trans. vol. lxxv.

"Let us then suppose numberless stars of various sizes scattered over an indefinite portion of space, in such

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such a manner as to be almost equally distributed through the whole. The laws of attraction, which no doubt extend to the remotest regions of the fixed stars, will operate in such a manner as most probably to produce the following remarkable effects.

230 Consequences of the laws of attraction acting among the stars.

"I. It will frequently happen, that a star, being considerably larger than its neighbouring ones, will attract them more than they will be attracted by others that are immediately around them; by which means they will be in time, as it were, condensed about a centre: or, in other words, form themselves into a cluster of stars of almost a globular figure, more or less regularly so according to the size and original distance of the surrounding stars. The perturbations of these mutual attractions must undoubtedly be very intricate, as we may easily comprehend, by considering what Sir Isaac Newton has said, *Princip.* lib. 1. prop. 38. *et seq.*: but in order to apply this great author's reasoning of bodies moving in ellipses to such as are here for a while supposed to have no other motion than what their mutual gravity has imparted to them, we must suppose the conjugate axes of these ellipses indefinitely diminished, whereby the ellipses will become straight lines.

231 Nebulæ, how formed.

"II. The next case, which will happen almost as frequently as the former, is where a few stars, though not superior in size to the rest, may change to be rather nearer each other than the surrounding ones; for here also will be formed a prevailing attraction in the combined centre of gravity of them all, which will occasion the neighbouring stars to draw together; not, indeed, so as to form a regular globular figure, but, however, in such a manner as to be condensed towards the common centre of gravity of the whole irregular cluster. And this construction admits of the utmost variety of shapes, according to the number and situation of the stars which first gave rise to the condensation of the rest.

"III. From the composition and repeated conjunction of both the foregoing forms, a third may be derived, when many large stars, or combined small ones, are situated in long extended regular or crooked rows, hooks, or branches; for they will also draw the surrounding ones so as to produce figures of condensed stars coarsely similar to the former, which gave rise to these condensations.

"IV. We may likewise admit of still more extensive combinations; when, at the same time that a cluster of stars is forming in one part of space, there may be another collecting in a different, but perhaps not far distant quarter, which may occasion a mutual approach towards their common centre of gravity.

232 Vacancies, how they are occasioned in the heavens.

"V. In the last place, as a natural consequence of the former cases, there will be great cavities or vacancies formed by the retreat of the stars towards the various centres which attract them; so that, upon the whole, there is evidently a field of the greatest variety for the mutual and combined attractions of the heavenly bodies to exert themselves in.

"From this theoretical view of the heavens, which has been taken from a point not less distant in time than in space, we will now retreat to our own retired station, in one of the planets attending a star in its great combination with numberless others: and in order to investigate what will be the appearances from this contracted situation, let us begin with the naked eye. The stars of the first magnitude, being in all probability the nearest, will furnish us with a step to begin our scale. Setting off, therefore, with the distance of Sirius or Arcturus, for instance, as unity, we will at present suppose, that those of the second magnitude are at double, those of the third at treble, the distance, &c. Taking it for granted, then, that a star of the seventh magnitude (the smallest supposed visible with the naked eye) is about seven times as far as one of the first, it follows, that an observer who is enclosed in a globular cluster of stars, and not far from the centre, will never be able with the naked eye to see to the end of it; for since, according to the above estimations, he can only extend his view to above seven times the distance of Sirius, it cannot be expected that his eyes should reach the borders of a cluster which has perhaps not less than 50 stars in depth everywhere around him. The whole universe to him, therefore, will be comprised in a set of constellations richly ornamented with scattered stars of all sizes: Or, if the united brightness of a neighbouring cluster of stars should, in a remarkable clear night, reach his sight, it will put on the appearance of a small, faint, whitish, nebulous cloud, not to be perceived without the greatest attention. Let us suppose him placed in a much extended stratum or branching cluster of millions of stars, such as may fall under the third form of nebulæ already considered. Here also the heavens will not only be richly scattered over with brilliant constellations, but a shining zone or milky-way will be perceived to surround the whole sphere of the heavens, owing to the combined light of these stars which are too small, that is, too remote, to be seen. Our observer's sight will be so confined, that he will imagine this single collection of stars, though he does not even perceive the thousandth part of them, to be the whole contents of the heavens. Allowing him now the use of a common telescope, he begins to suspect that all the milkiness of the bright path which surrounds the sphere may be owing to stars. He perceives a few clusters of them in various parts of the heavens, and finds also that there are a kind of nebulous patches: but still his views are not extended to reach so far as to the end of the stratum in which he is situated; so that he looks upon these patches as belonging to that system which to him seems to comprehend every celestial object. He now increases his power of vision; and, applying himself to a close observation, finds that the milky-way is indeed no other than a collection of very small stars. He perceives, that those objects which had been called *nebulæ*, are evidently nothing but clusters of stars. Their number increases upon him; and when he resolves one nebula into stars, he discovers ten new ones which he cannot resolve. He then forms the idea of immense strata of fixed stars, of clusters of stars, and of nebulæ; till, going on with such interesting observations, he now perceives, that all these appearances must naturally arise from the confined situation in which we are placed. *Confined* it may justly be called, though in no less a space than what appeared before to be the whole region of the fixed stars, but which now has assumed the shape of a crookedly branching nebula; not indeed one of the least, but perhaps very far from being the most considerable, of those numberless

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233 How the stars must appear to us according to this hypothesis.

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numberless clusters that enter into the construction of the heavens."

Our author now proceeds to show that this theoretical view of the heavens is perfectly consistent with facts, and seems to be confirmed by a series of observations.

234 Arguments in favour of the foregoing theory from observations on nebulæ.

Many hundreds of nebulæ of the first and second forms are to be seen in the heavens; and their places, he says, will hereafter be pointed out; many of the third form described, and instances of the fourth related; a few of the cavities mentioned in the fifth particularized, though many more have been already observed: so that, "upon the whole (says he), I believe it will be found, that the foregoing theoretical view, with all its consequential appearances, as seen by an eye enclosed in one of the nebulæ, is no other than a drawing from nature, wherein the features of the original have been closely copied: and I hope the resemblance will not be called a bad one, when it shall be considered how very limited must be the pencil of an inhabitant of so small and retired a portion of an indefinite system in attempting the picture of so unbounded an extent."

235 Method of measuring the dimensions of the heavens.

Dr Herschel next presents us with a long table of star-gauges, or accounts of the number of stars at once in the field of his telescope, which go as high as 588; after which he proposes the following

Problem.

"The stars being supposed nearly equally scattered, and their number, in a field of view of a known angular diameter, being given; to determine the length of the visual ray.

"Here, the arrangement of the stars not being fixed upon, we must endeavour to find which way they may be placed so as to fill a given space most equally. Suppose a rectangular cone cut into frustula by many equidistant planes perpendicular to the axis; then, if one star be placed at the vertex and another in the axis at the first intersection, six stars may be set around it so as to be equally distant from one another and from the central star. These positions being carried on in the same manner, we shall have every star within the cone surrounded by eight others at an equal distance from that star taken as a centre. Fig. 100. contains four sections of such a cone distinguished by alternate shades; which will be sufficient to explain what sort of arrangement I would point out.

"The series of the number of stars contained in the several sections will be 1, 7, 19, 37, 61, 91, &c. which continued to n terms, the sum of it, by the differential method, will be $na+n.\frac{n-1}{2}d+n.\frac{n-1}{2}.\frac{n-2}{3}d''$, &c. where a is the first term, d', d'', d''', &c. the first, second, and third differences. Then, since $a=1$, $d'=6$, $d''=6$, $d'''=0$, the sum of the series will be n^3. Let S be the given number of stars; 1 the diameter of the base of the field of view; and B the diameter of the great rectangular cone; and by trigonometry we shall have $B=\frac{\text{Radius}}{\text{Tang. } \frac{1}{2} \text{ field}}$. Now, since the field of view of a telescope is a cone, we shall have its solidity to that of the great cone of the stars formed by the above construction, as the square of the diameter of the base of the field of view, to the square of the diameter of the great cone, the height of both being the same; and the stars in each cone being in the ratio of the solidity, as being equally scattered, we have $n=\sqrt[3]{B^2S}$; and the length of the visual ray $=n-1$, which was to be determined." Another solution of this problem, on the supposition of another arrangement of stars, is given; but Dr Herschel prefers the former.

236 Proof of our sidereal system being a nebula.

From the data now laid down, Dr Herschel next endeavours to prove that the earth is 'the planet of a star belonging to a compound nebula of the third form.' "I shall now (says he) proceed to show, that the stupendous sidereal system we inhabit, this extensive stratum, and its secondary branch, consisting of many millions of stars, is in all probability *a detached nebula*. In order to go upon grounds that seem to me to be capable of great certainty, they being no less than an actual survey of the boundaries of our sidereal system, which I have plainly perceived as far as I have yet gone round it, everywhere terminated, and in most places very narrowly too, it will be proper to show the length of my sounding line, if I may so call it, that it may appear whether it was sufficiently long for the purpose.

237 Length of the line by which Dr Herschel measures the heavens.

"In the most crowded parts of the milky-way, I have had fields of view that contained no fewer than 588 stars, and these were continued for many minutes: so that in one quarter of an hour's time there passed no less than 116,000 stars through the field of view of my telescope. Now, if we compute the length of the visual ray, by putting $S=588$, and the diameter of the field of view 15 minutes, we shall find $n=\sqrt[3]{B^2S}=498$; so that it appears the length of what I have called my Sounding Line, or $n-1$, was not probably less than 497 times the distance of Sirius from the sun.

"It may seem inaccurate that we should found an argument on the stars being equally scattered, when, in all probability, there may not be any two of them in the heavens whose mutual distance shall be equal to that of any other two given stars: but it should be considered, that when we take all the stars collectively, there will be a mean distance which may be assumed as the general one; and an argument founded on such a supposition will have in its favour the greatest probability of not being far short of truth. And here I must observe, that the difference between a crowded place and a cluster (none of the latter being put into the gauge table), may easily be perceived by the arrangement as well as the size and mutual distance of the stars; for in a cluster they are generally not only resembling each other pretty nearly in size, but a certain uniformity of distance also takes place: they are more and more accumulated towards the centre, and put on all the appearances which we should naturally expect from a number of them collected into a group at a certain distance from us. On the other hand, the rich parts of the milky-way, as well as those in the distant broad parts of the stratum, consist of a mixture of stars of all possible sizes, that are seemingly placed without any particular apparent order. Perhaps, we might recollect, that a greater condensation towards the centre of our system than towards the borders of it should be taken into consideration; but with a nebula of the third form containing such various and extensive combinations

238 Cluster of stars defined.

binations

binations as I have found to take place in ours, this circumstance, which in one of the first form would be of considerable moment, may, I think, be safely neglected.

"If some other high gauge be selected from the table, such as 472 or 344, the length of the visual ray will be found 461 and 415. And although, in consequence of what has been said, a certain degree of doubt may be left about the arrangement and scattering of the stars, yet when it is recollected, that in those parts of the milky-way, where these high gauges were taken, the stars were neither so small nor so crowded as they must have been, on a suppostion of a much farther continuance of them, when certainly a milky or nebulous appearance must have come on, I need not fear to have overrated the extent of my visual ray; and indeed every thing that can be said to shorten it will only contract the limits of our nebula, as it has in most places been of sufficient length to go far beyond the bounds of it. Thus in the sides of our stratum, opposite to our situation in it, where the gauges often

239 Extent of our nebula.

run below 5, our nebula cannot extend to 100 times the distance of Sirius; and the same telescope which could show 588 stars in a field of view of 15 minutes, must certainly have presented me also with the stars in these situations, had they been there. If we should answer this by observing, that they might be at too great a distance to be perceived, it will be allowing that there must at least be a vacancy amounting to the length of a visual ray, not short of 400 times the distance of Sirius; and this is amply sufficient to make our nebula a detached one. It is true, that it would not be consistent confidently to affirm that we were on an island, unless we had found ourselves everywhere bounded by the ocean; and therefore I shall go no farther than the gauges will authorize; but considering the little depth of the stratum in all those places which have been actually gauged, to which must be added all the intermediate parts that have been viewed and found to be much like the rest, there is but little room to expect a connection between our nebula and any of the neighbouring ones. A telescope, with a much larger aperture than my present one, grasping together a greater quantity of light, and thereby enabling us to see farther into space, will be the surest means of completing and establishing the arguments that have been used: for if our nebula is not absolutely a detached one, I am firmly persuaded that an instrument may be made large enough to discover the places where the stars continue onwards. A very bright milky nebulosity must there undoubtedly come on, since the stars in a field of view will increase in the ratio of n^3 greater than that of the cube of the visual ray. Thus, if 588 stars in a given field of view are to be seen by a ray of 497 times the distance of Sirius, when this is lengthened to 1000, which is but little more than double the former, the number of stars in the same field of view will be no less than 4774; for when the visual ray r is given, the number of stars S will be $=\frac{n^3}{B^2}$; where $n=r+$; and a telescope with a threefold power of extending into space, or with a ray of 1500, which I think may easily be constructed, will give us 16,096 stars. Nor would these be so close, but that a good power applied to such an instrument might easily distinguish them; for they need not, if arranged in regular squares, approach nearer to each other than 6″.27; but the milky nebulosity I have mentioned, would be produced by the numberless stars beyond them, which, in one respect, the visual ray might also be said to reach. To make this appear, we must return to the naked eye: which, as we have before estimated, can only see the stars of the seventh magnitude so as to distinguish them: but it is nevertheless very evident, that the united lustre of millions of stars, such as I suppose the nebula in Andromeda to be, will reach our sight in the shape of a very small faint nebulosity; since the nebula of which I speak may easily be seen in a fine evening. In the same manner, my present telescope, as I have argued, has not only a visual ray that will reach the stars at 497 times the distance of Sirius, so as to distinguish them, and probably much farther, but also a power of showing the united lustre of the accumulated stars that compose a milky nebulosity at a distance far exceeding the former limits: so that from these considerations it appears again highly probable, that my present telescope not showing such a nebulosity in the milky-way, goes already far beyond its extent; and consequently much more would an instrument, such as I have mentioned, remove all doubt on the subject, both by showing the stars in the continuation of the stratum, and by exposing a very strong milky nebulosity beyond them, that could no longer be mistaken for the dark ground of the heavens.

240 Analogical arguments in favour of his doctrine.

"To these arguments, which rest on the firm basis of a series of observation, we may add the following considerations drawn from analogy. Among the great number of nebulæ which I have now already seen, amounting to more than 900, there are many which in all probability are equally extensive with that which we inhabit; and yet they are all separated from each other by very considerable intervals. Some, indeed, there are that seem to be double and treble; and though with most of these it may be that they are at a very great distance from each other, yet we allow that some such conjunctions really are to be found; nor is this what we mean to exclude: But then these compound or double nebulæ, which are those of the third and fourth forms, still make a detached link in the great chain. It is also to be supposed, that there may be some thinly scattered solitary stars between the large interstices of nebulæ; which being situated so as to be nearly equally attracted by the several clusters when they were forming, remain unassociated: and though we cannot expect to see those stars on account of their vast distance, yet we may well presume that their number cannot be very considerable in comparison to those that are already drawn into systems; which conjecture is also abundantly confirmed in situations where the nebulæ are near enough to have their stars visible; for they are all insulated, and generally to be seen upon a very clear and pure ground, without any star near them that might be thought to belong to them. And though I have often seen them in beds of stars, yet from the size of these latter we may be certain, that they were much nearer to us than those nebulæ, and belong undoubtedly to our own system."

Having thus determined that the visible system of nature, by us called the *universe*, consisting of all the

celestial

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celestial bodies, and many more than can be seen by the naked eye, is only a group of stars or suns with their planets, constituting one of those patches called a *nebula*, and perhaps not one ten-thousandth part of what is really the universe, Dr Herschel goes on to delineate the figure of this vast nebula, which he is of opinion may now be done; and for this purpose he gives a table, calculating the distances of the stars which form its extreme boundaries, or the length of the visual ray in different parts, by the number of stars contained in the field of his telescope at different times, according to the principles already laid down. He does not, however, as yet attempt the whole nebula, but of a particular section, represented fig. 160. "I have taken one (says he) which passes through the poles of our system, and is at rectangles to the conjunction of the branches, which I have called its *length*. The name of *poles* seems to me not improperly applied to those points which are 90 degrees distant from a circle passing along the milky-way; and the north pole is here supposed to be situated in right ascension 186°, and polar distance (that is from the pole commonly so called) 58°. The section is one which makes an angle of 35° with our equator, crossing it in $124\frac{1}{2}°$ and $304\frac{1}{2}°$. A celestial globe, adjusted to the latitude of 55° north, and having σ Ceti near the meridian, will have the plane of this section pointed out by the horizon. The visual rays are to be projected on the plane of the horizon of the latitude just mentioned, which may be done accurately enough by a globe adjusted in the manner directed. The stars in the border, which are marked larger than the rest, are those pointed out by the gauges. The intermediate parts are filled up by smaller stars, arranged in straight lines between the gauged ones. From this figure, which I hope is not a very inaccurate one, we may see that our nebula, as we observed before, is of the third form; that is, a very extensive, branching, compound congeries of many millions of stars, which most probably owes its origin to many remarkably large, as well as pretty closely scattered, small stars, that may have drawn together the rest. Now, to have some idea of the wonderful extent of this system, I must observe, that this section of it is drawn upon a scale where the distance of Sirius is no more than the 80th part of an inch; so that probably all the stars, which in the finest nights we are able to distinguish with the naked eye, may be comprehended within a sphere drawn round the large star near the middle, representing our situation in the nebula, of less than half a quarter of an inch radius."

241 How the figure of our nebula may be delineated.

Dr Herschel now proceeds to offer some further thoughts on the origin of the nebulous strata of the heavens: in doing which he gives some hints concerning the antiquity of them. "If it were possible (says he) to distinguish between the parts of an indefinitely extended whole, the nebula we inhabit might be said to be one that has fewer marks of antiquity than any of the rest. To explain this idea perhaps more clearly, we should recollect, that the condensation of clusters of stars has been ascribed to a gradual approach; and whoever reflects on the number of ages that must have passed before some of the clusters that are to be found in my intended catalogue of them could be so far condensed as we find them at present, will not wonder if I ascribe a certain air of youth and vigour to many very regularly scattered regions of our sidereal stratum. There are, moreover, many places in it in which, if we may judge from appearances, there is the greatest reason to believe that the stars are drawing towards secondary centres, and will in time separate into clusters, so as to occasion many subdivisions. Hence me may surmise, that when a nebulous stratum consists chiefly of nebulæ of the first and second forms, it probably owes its origin to what may be called the decay of a great compound nebula of the third form; and that the subdivisions which happened to it in length of time, occasioned all the small nebulæ which sprung from it to lie in a certain range, according as they were detached from the primary one. In like manner, our system, after numbers of ages, may very possibly become divided, so as to give rise to a stratum of two or three hundred nebulæ; for it would not be difficult to point out so many beginning or gathering clusters in it. This throws a considerable light upon that remarkable collection of many hundreds of nebulæ which are to be seen in what I have called the *nebulous stratum* in Coma Berenices. It appears, from the extended and branching figure of our nebula, that there is room for the decomposed small nebulæ of a large reduced former great one to approach nearer to us in the sides than in any other parts. Nay, possibly there might originally be another very large joining branch, which in time became separated by the condensation of the stars: and this may be the reason of the little remaining breadth of our system in that very place; for the nebulæ of the stratum of the Coma are brightest and most crowded just opposite to our situation, or in the pole of our system. As soon as this idea was suggested, I tried also the opposite pole; where accordingly I have met with a great number of nebulæ, though under a much more scattered form.

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242 Of the decay and recomposition of nebulæ.

"Some parts of our system indeed seem already to have sustained greater ravages of time than others; for instance, in the body of the Scorpion is an opening or hole, which is probably owing to this cause. It is at least four degrees broad; but its height I have not yet ascertained. It is remarkable, that the 80th *Nebuleuse sans Etoiles* of the *Connoissance des Temps*, which is one of the richest and most compressed clusters of small stars I remember to have seen, is situated just on the west border of it, and would almost authorize a suspicion that the stars of which it is composed were collected from that place, and had left the vacancy. What adds not a little to this surmise, is, that the same phenomenon is once more repeated with the fourth cluster of the *Connoissance des Temps;* which is also on the western border of another vacancy, and has moreover a small miniature cluster, or easily resolvable nebula, of about $2\frac{1}{2}$ minutes in diameter north, following it at no very great distance.

"There is a remarkable purity or clearness in the heavens when we look out of our stratum at the sides; that is, towards Leo, Virgo, and Coma Berenices on one hand, and towards Cetus on the other; whereas the ground of the heavens becomes troubled as we approach towards the length or height of it. These troubled appearances are easily to be explained by ascribing them to some of the distant straggling stars that yield hardly light enough to be distinguished. And

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And I have indeed often experienced this to be the cause, by examining these troubled spots for a long while together, when at last I generally perceived the stars which occasioned them. But when we look towards the poles of our system, where the visual ray does not graze along the side, the straggling stars will of course be very few in number: and therefore the ground of the heavens will assume that purity which I have always observed to take place in those regions."

243 Universe composed of nebulæ.

Thus, then, according to Dr Herschel, the universe consists of *nebulæ*, or innumerable collections of innumerable stars, each individual of which is a sun not only equal, but much superior to ours: at least if the words of Mr Nicholson have any weight; for he tells us, that "each individual sun is destined to give light to *hundreds* of worlds that revolve about it, but which can no more be seen by us, on account of their great distance, than the solar planets can be seen from the fixed stars." "Yet (continues he), as in this unexplored, and perhaps unexplorable, abyss of space, it is no necessary condition that the planets should be of the same magnitudes as those belonging to our system, it is not impossible but that planetary bodies may be discovered among the double and triple stars."

Nat. Phil. i. 195, 196.

Though in the above extracts from Dr Herschel's papers, the words *condensations*, *clusters*, &c. of stars frequently occur, we are by no means from thence to imagine that any of the celestial bodies in our nebula are nearer to one another than we are to Sirius, whose distance is supposed not to be less than 400,000 times that of the sun from us, or 38 millions of millions of miles. The whole extent of the nebula being in some places near 500 times as great, must be such, that the light of a star placed at its extreme boundary, supposing it to fly with the velocity of 12 millions of miles every minute, must have taken near 3000 years to reach us. Dr Herschel, however, is by no means of opinion, that our nebula is the most considerable in the universe. "As we are used (says he) to call the appearance of the heavens, where it is surrounded with a bright zone, the *milky-way*, it may not be amiss to point out some other very remarkable nebulæ, which cannot well be less, but are probably much larger, than our own system; and being also extended, the inhabitants of the planets that attend the stars which compose them, must likewise perceive the same phenomena: for which reason they may also be called *milky-ways*, by way of distinction.

244 Of the size and distance of nebulæ.

"My opinion of their size is grounded on the following observations: There are many round nebulæ of the first form, of about five or six minutes in diameter, the stars of which I can see very distinctly; and on comparing them with the visual ray calculated from some of my long gauges, I suppose by the appearance of the small stars in those gauges, that the centres of these round nebulæ may be 600 times the distance of Sirius from us."—He then goes on to tell us, that the stars in such nebulæ are probably twice as much condensed as those of our system; otherwise the centre of it would not be less than 6000 times the distance of Sirius from us; and that it is possibly much underrated by supposing it only 600 times the distance of that star.

"Some of these round nebulæ (says Dr Herschel) have others near them, perfectly similar in form, colour, and the distribution of stars, but of only half the diameter: and the stars in them seem to be doubly crowded, and only at about half the distance from each other. They are indeed so small, as not to be visible without the utmost attention. I suppose these miniature nebulæ to be at double the distance of the first. An instance equally remarkable and instructive is a case where, in the neighbourhood of two such nebulæ as have been mentioned, I met with a third similar, resolvable, but much smaller and fainter nebula. The stars of it are no longer to be perceived; but a resemblance of colour with the former two, and its diminished size and light, may well permit us to place it at full twice the distance of the second, or about four or five times the distance of the first. And yet the nebulosity is not of the milky kind; nor is it so much as difficultly resolvable or colourless. Now in a few of the extended nebulæ, the light changes gradually, so as from the resolvable to approach to the milky kind; which appears to me an indication, that the milky light of nebulæ is owing to their much greater distance. A nebula, therefore, whose light is perfectly milky, cannot well be supposed to be at less than six or eight thousand times the distance of Sirius; and though the numbers here assumed are not to be taken otherwise than as very coarse estimates, yet an extended nebula, which an oblique situation, where it is possibly foreshortened by one-half, two-thirds, or three-fourths of its length, subtends a degree or more in diameter, cannot be otherwise than of a wonderful magnitude, and may well outvie our milky-way in grandeur."

245 Vast length of time requisite to form the nebulæ.

Dr Herschel next proceeds to give an account of several remarkable nebulæ, and then concludes thus: "Now, what great length of time must be required to produce these effects (the formation of nebulæ) may easily be conceived, when, in all probability, our whole system of about 800 stars in diameter, if it were seen at such a distance that one end of it might assume the resolvable nebulosity, would not, at the other end, present us with the irresolvable, much less with the colourless and milky, sort of nebulosities." Great indeed must be the length of time requisite for such distant bodies to form combinations by the laws of attraction, since, according to the distances he has assumed, the light of some of his nebulæ must be thirty-six or forty-eight thousand years in arriving from them to us. It would be worth while then to inquire, whether *attraction* is a virtue propagated in time or not; or whether it moves quicker or slower than light?

246 Why the stars do not fall upon one another.

In the course of Dr Herschel's observations and inquiries concerning the structure of the heavens, an objection occurred, that if the different systems were formed by the mutual attractions of the stars, the whole would be in danger of destruction by the falling of them one upon another. A sufficient answer to this, he thinks, is, that if we can really prove the system of the universe to be what he has said, there is no doubt but that the great Author of it has amply provided for the preservation of the whole, though it should not appear to us in what manner this is effected. Several circumstances, however, he is of opinion, manifestly tend to a general preservation: as, in the first place, the indefinite extent of the sidereal heavens; which must produce a balance that will effectually secure all the parts of the great whole from approaching to each other.

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other. There remains then (says he) only to see how the particular stars belonging to separate clusters are prevented from rushing on to their centres of attraction." This he supposes may be done by projectile forces; "the admission of which will prove such a barrier against the seeming destructive power of attraction, as to secure from it all the stars belonging to a cluster, if not for ever, at least for millions of ages. Besides, we ought perhaps to look upon such clusters, and the destruction of a star now and then in some thousands of ages as the very means by which the whole is preserved and renewed. These clusters may be the *laboratories* of the universe, wherein the most salutary remedies for the decay of the whole are prepared."

247 Of the planetary nebulæ.

In speaking of the planetary nebulæ, by which name he distinguishes those spots that are all over equally luminous, he says, "if we should suppose them to be single stars, with large diameters, we shall find it difficult to account for their not being brighter, unless we should admit that the intrinsic light of some stars may be very much inferior to that of the generality; which, however, can hardly be imagined to extend to such a degree. We might suppose them to be comets about their aphelion, if the brightness, as well as magnitude of their diameters did not oppose this idea; so that, after all, we can hardly find any hypothesis so probable as that of their being nebulæ; but then they must consist of stars that are compressed and accumulated in the highest degree. If it were not perhaps too hazardous to pursue a former surmise of a renewal in what I figuratively called the *Laboratories of the Universe*, the stars forming these extraordinary nebulæ, by some decay or waste of nature being no longer fit for their former purposes, and having their projectile forces, if any such they had, retarded in each other's atmosphere, may rush at last together; and, either in succession or by one general tremendous shock, unite into a new body. Perhaps the extraordinary and sudden blaze of a new star in Cassiopeia's chair, in 1572, might possibly be of such a nature. If a little attention to these bodies should prove that, having no annual parallax, they belong most probably to the class of nebulæ, they may then be expected to keep their station better than any one of the stars belonging to our system, on account of their being probably at a very great distance."

248 Method of ascertaining the situation of the stars.

As the fixed stars constantly keep nearly the same situation relative to each other, astronomers have agreed to refer to them, as to so many fixed points, the different motions of the other heavenly bodies. Hence the reason of dividing them into constellations. But it was necessary besides, for the sake of perfect precision, to mark exactly the relative situation of every star in the celestial sphere. This is accomplished in the following manner.

"A great circle is supposed to pass through the two poles, and through the centre of every star. This circle is called a circle of *declination*. The arc of this circle included between the star and the equator measures the *declination* of the star. The declination of a star then is its perpendicular distance from the equator. It is north or south, according as the star is situated on the north or south side of the equator. All the stars situated in the same parallel of the equator have of course the same declination.

The declination then marks the situation of a star north or south from the equator. Precision requires still another circle from which their distance east or west may be marked, in order to give the real place. The *circle of declination* which passes through that point of the equator, called the *vernal equinoctial point*, has been chosen for that purpose. The distance of the circle of declination of a given star from that point measured on the equator, or the arc of the equator included between the vernal equinox and the circle of declination of the star, is called its *right ascension*. If we know the declination and the right ascension of a star, we know its precise situation in the heavens.

The declination of any star may be easily found by observing the following rule: Take the meridian altitude of the star, at any place where the latitude is known, the complement of this is the *zenith distance*, and is called north or south, as the star is north or south at the time of observation. Then, 1. When the latitude of the place and zenith distance of the star are of different kinds, namely, one north and the other south, their difference will be the declination; and it is of the same kind with the latitude, when that is the greatest of the two, otherwise it is of the contrary kind. 2. If the latitude and the zenith distance are of the same kind, i. e. both north or both south, their sum is the declination; and it is of the same kind with the latitude.

249 Rules for finding the declination.

To prove the truth of this rule, turn to fig. 86. where Z is the zenith of the place, EQ the equinoctial, and EZ the latitude. 1. Let r represent the place of a star on the meridian, and Zr the zenith distance, the latitude being greater: then Er (the declination) will be equal to EZ—Zr (the zenith distance); again, let c be the place of a star in the meridian, when the zenith distance exceeds the latitude; then Ec (the declination)=Zc (the zenith distance)—EZ (the latitude). And it is manifest, that in the former instance Z and r are on the same side of the equinoctial; and that in the latter case Z and c are on contrary sides. 2dly, Let y be the place of a star on the meridian, having its zenith distance Zy of the same kind with EZ the latitude of the place: then Ey (the declination)= EZ +Zy; and the declination is of the same kind as the latitude, because Z and y are on the same side of the equinoctial. Q. E. D.

For an example, suppose that in north latitude 52° 15′, the meridian altitude of a star is 51° 28′ on the south; then 38° 32′ the zenith distance, being taken from 52° 15′ the latitude, leaves 13° 43′ for declination of the star *north*.

250 and right ascension.

Having, by means of the above, found the declination of a star, it becomes requisite, in the next place, to know *the right ascension*, as its situation with regard to the equator will then be known. Now the right ascension being estimated from the point where the equator and ecliptic intersect each other in the spring, a point which is marked out by nothing that comes under the cognizance of our senses; some phenomenon, therefore, must be chosen, whose right ascension is either given, or may be readily known at any time, that the right ascensions of other objects may be discovered by comparison with *it*. For this purpose nothing appears to

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so proper as the sun; because its motion is the most simple, and its right ascension quickly found.

For if, in fig. 87. we have given QS the declination of the sun (which may be easily taken every day at noon by observation), and the angle SEQ the obliquity of the ecliptic—i. e. one leg of a right-angled spherical triangle, and its opposite angle, to find the adjacent leg EQ, the right ascension—it may be done by this proportion; as the tangent of the obliquity of the ecliptic: the tangent of the declination :: radius : the sine of the right ascension reckoned from the nearer equinoctial point.

For example: suppose on the 13th of February the sun's south declination is found to be 13° 24′, and the obliquity of the ecliptic is 23° 28′; we shall thus find the sun's right ascension:

As tangt. 23° 28′	9.6376106
To tangt. 13° 24′	9.3770030
So is radius	10.0000000
To sine 33° 16′ 58″	9.7393924

Here 33° 16′ 58″ is the sun's distance from ♈; but as the declination is at that time decreasing, and the sun approaching ♈, this must be taken from 360°, and the remainder 326° 43′ 2″ is the right ascension.

In a similar manner may the sun's right ascension be calculated for every day at noon, and arranged in tables for use: for any intermediate time between one day at noon and the following, the right ascension may be determined by proportion.

The longitude ES of the sun, when required, may be readily found by the rules to ascertain the hypothenuse of the same triangle.

The apparent diurnal motion of the heavenly bodies being uniform, and performed in circles parallel to the equator, the interval of the times in which two stars pass over any meridian must bear the same proportion to the period of the diurnal motion, as that arc of the equator intercepted between the two secondaries passing through the stars, does to 360°, as is evident from the nature of the sphere: we may therefore find the right ascension of a star thus: Let an accurate pendulum clock be so regulated that the index may pass over the twenty-four hours during the time in which any fixed star after departing from the meridian will return to it again, which is rather less than twenty-four hours. Then let the index of a clock thus regulated be set to twelve o'clock when the sun is on the meridian; and observe the time the index points to, when the fixed star whose right ascension is sought comes to the meridian; which may be most accurately known by means of a transit telescope. Let these hours and parts, as marked by the clock, be converted into degrees, &c. of the equator, by allowing 15° to an hour; and the difference between the right ascensions of the fixed star and the sun will be known; this difference added to the sun's right ascension for that day at noon, gives the right ascension of the fixed star sought.

Or, if a clock whose dial plate is divided into 360°, instead of twelve hours, be ordered in such a manner, that the index may pass round the whole circle in the interval which a star requires to come to the same meridian again, and another index be so managed as to point out the sexagesimal parts: then, when the sun is on the meridian, let the indices of the clock be put to his right ascension at noon that day; and when the star comes to the meridian, its right ascension will be shown by the clock, without any kind of reduction.

The stars are referred likewise to the ecliptic as well as to the equator. In that case the terms *longitude* and *latitude* are used.

The longitude of any of the heavenly bodies is an arc of the ecliptic contained between the first point of Aries, and a secondary to the ecliptic or circle of latitude, passing through the body; it is always measured according to the order of the signs. If the body be supposed seen from the centre of the earth, it is called *geocentric* longitude; but if it be supposed seen from the centre of the sun, then is the longitude *heliocentric*. 251 Longitude of the heavenly bodies.

The latitude of a heavenly body is its distance from the ecliptic, measured upon a secondary to the ecliptic drawn through the body. If the latitude be such as is seen from the earth's centre, it is called *geocentric* latitude; but if it be supposed seen from the centre of the sun, it is *heliocentric*. 252 Latitudes.

The equator being the principal circle which respects the earth, the latitudes and longitudes of terrestrial objects are referred to it; and, for a similar reason (the sun's motion in the ecliptic rendering that the principal of the celestial circles), the situations of heavenly objects are generally ascertained by their latitudes and longitudes referred to the ecliptic: it has therefore become a useful problem to find the latitudes and longitudes of the stars, &c. having their declinations, and right ascensions, with the obliquity of the ecliptic, given. One of the best methods of performing this problem has been thus investigated: Let 253 How found. S be the place of the body (fig. 88.), EC the ecliptic, EQ the equator: and SL and SR being respectively perpendicular to EC and EQ, ER will represent the right ascension, SR the declination, EL the longitude, and SL the latitude; then, by spherics, rad. : sine ER :: co-tang. SR : co-tang. SER; and SER∓CEQ=SEL. Also, co-sine SER : rad :: tang. ER : tang. ES; and rad. : co-sine SEL :: tang. ES : tang. EL; therefore, co-sine SER : co-sine SEL :: tang. ER : tang. EL; whence we readily get $\frac{\text{co-sine SEL} \times \text{tang. ER}}{\text{co-sine SER}}$ = the tangent of EL, the longitude. Then, rad. : sine of EL :: tang. SEL : tang. SL, the latitude.

But the same thing may be performed very expeditiously by means of the following excellent rule, given by Dr Maskelyne, the present worthy astronomer royal:

1. The sine of the right ascension + co-tang. declination —10 = co-tang. of arc A, which call *north*, or *south*, according as the declination is north or south. 2. Call the obliquity of the ecliptic south in the six first signs of right ascension, and north in the six last. Let the sum of arc A, and obliquity of ecliptic, according to their titles, = arc B with its proper title. [If one be north and the other south, the proper title is that which belongs to the greater; and in this case, arc B is their difference.] 3, The arithmetical complement of co-sine arc A + co-sine arc B × tang. right ascension = tangent of the longitude: this is of the same kind as the right ascension, unless arc B be more than 90°, when the quantity found of the same kind as the

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the right ascension must be subtracted from 12 signs, or 360°. 4. The sine of longitude + tang. arc B — 10 = tang. of the required latitude, of the same title as arc B. Note, If the longitude be found near 0° or near 180°, for the sine of longitude, in the last operation, substitute tang. longitude + co-sine longitude — 10; and then the last operation will be tang. longitude + co-sine longitude + tang. arc B — 20 = tang. latitude. By sine, tang. &c. are meant logarithm sine, log. tang. &c.

This rule may be exemplified by inquiring what are the latitude and longitude of a star whose declination is $12^\circ\ 59'$ north, and right ascension $4^s\ 29^\circ\ 38'$, the obliquity of the ecliptic being $29^\circ\ 28'$?

Here, sine of right ascension	$4^s\ 29^\circ$	$38'$	9·7037486
Co-tang. of declination	12	59	10·6372126
Co-tang. of arc A, north	24	31	10·34069612
Obliquity of ecliptic south	23	28	
Arc B, north -	1	3	cos. 9·9999271
Arith. comp. of co-sine arc A			0·0410347
Tangent of right ascension			9·7678344
Tangent of longitude $147^\circ\ 13'\ 26''$			9·8087962
Or $4^s\ 27^\circ\ 13'\ 26''$, answering to $27^\circ\ 13'\ 26''$ of Leo.			
Then, sine of longitude - -			9·7334843
Tangent of arc B - -			8·2631153
Tang. of latitude, north, $34'\ 6''$			7·9965996

254 Stars vary in right ascension and declination.

Astronomers have observed that the stars vary in right ascension and in declination, but keep the same latitude: hence it was concluded that their variations in declination and right ascension were owing to the revolution of the celestial sphere round the poles of the ecliptic. Or they may be accounted for by supposing that the poles of the equator revolve slowly round those of the ecliptic. This revolution is called the precession of the equinoxes. A more particular account of it will be necessary.

255 Observations of the Asiatic shepherds.

By a long series of observations, the shepherds of Asia were able to mark out the sun's path in the heavens; he being always in the opposite point to that which comes to the meridian at midnight, with equal but opposite declination. Thus they could tell the stars among which the sun then was, although they could not see them. They discovered that this path was a great circle of the heavens, afterwards called the ECLIPTIC; which cuts the equator in two opposite points, dividing it, and being divided by it, into two equal parts. They farther observed, that when the sun was in either of those points of intersection, his circle of diurnal revolution coincided with the equator, and therefore the days and nights were equal. Hence the equator came to be called the EQUINOCTIAL LINE, and the points in which it cuts the ecliptic were called the EQUINOCTIAL POINTS, and the sun was then said to be in the equinoxes. One of these was called the VERNAL and the other the AUTUMNAL EQUINOX.

256 To determine the time of the sun's occupying the equinoctial points.

It was evidently an important problem in practical astronomy to determine the exact moment of the sun's occupying these stations; for it was natural to compute the course of the year from that moment. Accordingly this has been the leading problem in the astronomy of all nations. It is susceptible of considerable precision, without any apparatus of instruments. It is only necessary to observe the sun's declination on the noon of two or three days before and after the equinoctial day. On two consecutive days of this number, his declination must have changed from north to south, or from south to north. If his declination on one day was observed to be $11'$ north, and on the next $5'$ south, it follows that his declination was nothing, or that he was in the equinoctial point about 23 minutes after 7 in the morning of the second day. Knowing the precise moments, and knowing the rate of the sun's motion in the ecliptic, it is easy to ascertain the precise point of the ecliptic in which the equator intersected it.

257 Hipparchus's discoveries.

By a series of such observations made at Alexandria between the years 161 and 127 before Christ, Hipparchus, the father of our astronomy, found that the point of the autumnal equinox was about six degrees to the eastward of the star called SPICA VIRGINIS. Eager to determine every thing by multiplied observations, he ransacked all the Chaldean, Egyptian, and other records, to which his travels could procure him access, for observations of the same kind; but he does not mention his having found any. He found, however, some observations of Aristillus and Timochares made about 150 years before. From these it appeared evident that the point of the autumnal equinox was then about eight degrees east of the same star. He discusses these observations with great sagacity and rigour; and, on their authority, he asserts that the equinoctial points are not fixed in the heavens, but move to the westward about a degree in 75 years or somewhat less.

258 Why called the precession of the equinoxes.

This motion is called the PRECESSION OF THE EQUINOXES, because by it the time and place of the sun's equinoctial station precedes the usual calculations: it is fully confirmed by all subsequent observations. In 1750 the autumnal equinox was observed to be $20^\circ\ 21'$ westward of Spica Virginis. Supposing the motion to have been uniform during this period of ages, it follows that the annual precession is about $50''\frac{1}{3}$; that is, if the celestial equator cuts the ecliptic in a particular point on any day of this year, it will on the same day of the following year cut it in a point $50''\frac{1}{3}$ to the west of it, and the sun will come to the equinox $20'\ 23''$ before he has completed his round of the heavens. Thus the equinoctial or tropical year, or true year of seasons, is so much shorter than the revolution of the sun or the sidereal year.

259 Importance of the discovery.

It is this discovery that has chiefly immortalized the name of Hipparchus, though it must be acknowledged that all his astronomical researches have been conducted with the same sagacity and intelligence. It was natural therefore for him to value himself highly for the discovery. It must be acknowledged to be one of the most singular that has been made, that the revolution of the whole heavens should not be stable, but its axis continually changing. For it must be observed, that since the equator changes its position, and the equator is only an imaginary circle, equidistant from the two poles or extremities of the axis; these poles and this axis must equally change their positions. The equinoctial points make a complete revolution in about 25,745 years, the equator being all the while inclined to the ecliptic in nearly the same angle. Therefore the poles of this diurnal revolution must describe a circle

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circle round the poles of the ecliptic at the distance of about $23\frac{1}{2}$ degrees in 25,745 years; and in the time of Timochares the north pole of the heavens must have been 30 degrees eastward of where it now is.

260
Hipparchus has been accused of plagiarism,

Hipparchus has been accused of plagiarism and insincerity in this matter. It is now very certain that the precession of the equinoxes was known to the astronomers of India many ages before the time of Hipparchus. It appears also that the Chaldeans had a pretty accurate knowledge of the year of seasons. From their saros we deduce their measure of this year to be 365 days 5 hours 49 minutes and 11 seconds, exceeding the truth only by 26″, and much more exact than the year of Hipparchus. They had also a sidereal year of 365 days 6 hours 11 minutes. Now what could occasion an attention to two years, if they did not suppose the equinoxes moveable? The Egyptians also had a knowledge of something equivalent to this: for they had discovered that the dog-star was no longer the faithful forewarner of the overflowing of the Nile: and they combined him with the star Fomalhaset * in their mystic calendar. This knowledge is also involved in the precepts of the Chinese astronomy, of much older date than the time of Hipparchus.

* See *Dupins sur le zodiaque des Egyptiens, Mem. de l'Acad. des Inscrip.*

261
but falsely.

But all these acknowledged facts are not sufficient for depriving Hipparchus of the honour of the discovery, or fixing on him the charge of plagiarism. This motion was a thing unknown to the astronomers of the Alexandrian school, and it was pointed out to them by Hipparchus in the way in which he ascertained every other position in astronomy, namely, as the mathematical result of actual observations, and not as a thing deducible from any opinions on other subjects related to it. We see him, on all other occasions, eager to confirm his own observations, and his deductions from them, by every thing he could pick up from other astronomers; and he even adduced the above-mentioned practice of the Egyptians in corroboration of his doctrine. It is more than probable then that he did not know any thing more. Had he known the Indian precession of 54″ annually, he had no temptation whatever to withhold him from using it in preference to one which he acknowledges to be inaccurate, because deduced from the very short period of 150 years, and from the observations of Timochares, in which he had no great confidence.

Small periodical irregularities in the inclination of the equator to the ecliptic, and in the precession of the equinoxes, were discovered and examined by Bradley with great sagacity. He found that the pole described an epicycle, whose diameter was about 18″, having for its centre that point of the circle round the pole of the ecliptic in which the pole would have been found independent of this new motion. He also observed, that the period of this epicyclical motion was 18 years and seven months. It struck him, that this was precisely the period of the revolution of the nodes of the moon's orbit. He gave a brief account of these results to Lord Macclesfield, then president of the Royal Society, in 1747. Mr Machin, to whom he also communicated the observations, gave him in return a very neat mathematical hypothesis, by which the motion might be calculated.

Let E (fig. 89.) be the pole of the ecliptic, and SPQ a circle distant from it 23° 28′, representing the circle described by the pole of the equator during one revolution of the equinoctial points. Let P be the place of this last-mentioned pole at some given time. Round P describe a circle ABCD, whose diameter AC is 18″. The real situation of the pole will be in the circumference of this circle; and its place, in this circumference,

262
Mathematical theory if the poles of the equator be supposed to describe a circle.

depends on the place of the moon's ascending node. Draw EPF and GPL perpendicular to it; let GL be the colure of the equinoxes, and EF the colure of the solstices. Dr Bradley's observations showed that the pole was in A when the node was in L, the vernal equinox. If the node recede to H, the winter solstice, the pole is in B. When the node is in the autumnal equinox at G, the pole is at C; and when the node is in F, the summer solstice, the pole is in D. In intermediate situations of the moon's ascending node, the pole is in a point of the circumference ABCD, three signs or 90° more advanced.

263
More exact if an ellipse be substituted for the circle.

Dr Bradley, by comparing together a great number of observations, found that the mathematical theory, and the calculation depending on it, would correspond much better with the observations, if an ellipse were substituted for the circle ABCD, making the longer axis AC 18″, and the shorter, BD, 16″. M. d'Alembert determined, by the physical theory of gravitation, the axis to be 18″ and 13″.4.

264
These observations and this theory are facts in astronomy.

These observations, and this mathematical theory, must be considered as so many facts in astronomy, and we must deduce from them the methods of computing the places of all celestial phenomena, agreeable to the universal practice of determining every point of the heavens by its longitude, latitude, right ascension, and declination.

265
Obliquity of the ecliptic.

It is evident, in the first place, that the equation of the pole's motion makes a change in the obliquity of the ecliptic. The inclination of the equator to the ecliptic is measured by the arch of a great circle intercepted between their poles. Now, if the pole be in O instead of P, it is plain that the obliquity is measured by EO instead of EP. If EP be considered as the mean obliquity of the ecliptic, it is augmented by 9″ when the moon's ascending node is in the vernal equinox, and consequently the pole in A. It is, on the contrary, diminished 9″ when the node is in the autumnal equinox, and the pole in C; and it is equal to the mean when the node is in the colure of the solstices. This change of the inclination of the earth's axis to the plane of the ecliptic was called the nutation of the axis by Sir Isaac Newton.

Dr Bradley also discovered a general and periodical motion in all the stars, which alter a little their relative situations. To form an idea of this motion, let us suppose that each star describes annually a small circumference parallel to the ecliptic, whose centre is the mean position of the star, and whose diameter, as seen from the earth, subtends an angle of about 40″; and that it was in that circumference as the sun in its orbit, but so that the sun always precedes it by 60°. This circumference, projected upon the surface of the celestial sphere, appears under the form of an ellipse, more or less flattened according to the height of the star above the equator, the smaller axis of the ellipse being to the greater axis as the sine of that height to radius. These periodical movements of the stars have received the name of *aberrations of the fixed stars*.

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Besides these general motions, particular motions have been detected in several stars, excessively slow indeed, but which a long succession of ages has rendered sensible. These motions have been chiefly observed in Sirius and Arcturus. But astronomers suppose that all the stars have similar motions, which may become evident in process of time.

266 Distance of the fixed stars immeasurable.

No method of ascertaining the distance of fixed stars hath hitherto been found out. Those who have formed conjectures concerning them, have thought that they were at least 400,000 times farther from us than we are from the sun.

They are said to be fixed, because they have been generally observed to keep at the same distances from each other; their apparent diurnal revolutions being caused solely by the earth's turning on its axis. They appear of a sensible magnitude to the bare eye, because the retina is affected not only by the rays of light which are emitted directly from them, but by many thousands more, which falling upon our eyelids, and upon the aerial particles about us, are reflected into our eyes so strongly as to excite vibrations not only in those points of the retina where the real images of the stars are formed, but also in other points at some distance round about. This makes us imagine the stars to be much bigger than they would appear, if we saw them only by the few rays which come directly from them, so as to enter our eyes without being intermixed with others. Any one may be sensible of this, by looking at a star of the first magnitude through a long narrow tube; which, though it takes in as much of the sky as would hold 1000 such stars, yet scarcely renders that one visible.

267 Why they seem so big to our naked eye.

The more a telescope magnifies, the less is the aperture through which the star is seen; and consequently, the fewer rays it admits into the eye. Now, since the stars appear less in a telescope which magnifies 200 times, than they do to the bare eye, insomuch that they seem to be only indivisible points, it proves at once that the stars are at immense distances from us, and that they shine by their own proper light. If they shone by borrowed light, they would be as invisible without telescopes as the satellites of Jupiter are; for these satellites appear bigger when viewed with a good telescope than the largest fixed stars do.

268 Parallax of the fixed stars.

Dr Herschel has proposed a method of ascertaining the parallax of the fixed stars, something similar, but more complete, than that mentioned by Galileo and others; for it is by the parallax of the fixed stars that we should be best able to determine their distance. The method pointed out by Galileo, and first attempted by Hooke, Flamstead, Molineux, and Bradley, of taking distances of stars from the zenith that pass very near it, has given us a much juster idea of the immense distance of the stars, and furnished us with an approximation to the knowledge of their parallax, that is much nearer the truth than we ever had before. But Dr Herschel mentions the insufficiency of their instruments, which were similar to the present zenith sectors, the method of zenith distances being liable to considerable errors on account of refraction, the change of position of the earth's axis arising from nutation, precession of the equinoxes, and other causes, and the aberration of the light. The method of his own is by means of double stars; which is exempted from these errors, and of such a nature, that the annual parallax, even if it should not exceed the tenth part of a second, may still become more visible, and be ascertained, at least to a much greater degree of approximation than it has ever been done. This method is capable of every improvement which the telescope and mechanism of micrometers can furnish. The method and its theory will be seen by the following investigation, extracted from his paper on the subject. Let O, E, (fig. 90.) be two opposite points in the annual orbit, taken in the same plane with two stars, a, b, of unequal magnitudes. Let the angle a O b be observed, when the earth is at O, and a E b be observed when the earth is at E. From the difference of these angles, if there should be any, we may calculate the parallax of the stars, according to the theory subjoined. These two stars ought to be as near each other as possible, and also to differ as much in magnitude as we can find them.

Phil. Trans. vol. lxxii. p. 82.

Dr Herschel's theory of the annual parallax of double stars, with the method of computing from thence what is generally called the parallax of the fixed stars, or of single stars of the first magnitude, such as are nearest to us, supposes, *first*, that the stars, one with another, are about the size of the sun; and, *secondly*, that the difference of their apparent magnitudes is owing to their different distances; so that the star of the second, third, or fourth magnitude, is two, three, or four times as far off as one of the first. These principles which he premises as postulata, have so great a probability in their favour, that they will hardly be objected to by those who are in the least acquainted with the doctrine of chances. Accordingly, let OE (fig. 91.) be the whole diameter of the earth's annual orbit, and let a, b, c, be three stars situated in the ecliptic, in such a manner that they may be seen all in one line O $a\,b\,c$, when the earth is at O. Let the line O $a\,b\,c$ be perpendicular to OE, and draw PE parallel to c O; then, if Oa, $a\,b$, $b\,c$, are equal to each other, a will be a star of the first magnitude, b of the second, and c of the third. Let us now suppose the angle O a E, or parallax of the whole orbit of the earth to be 1″ of a degree; then we have PE a=O a E=1″: and because very small angles, having the same subtense OE, may be taken to be in the inverse ratio of the lines O a, O b, O c, &c. we shall have O b E$=\frac{1}{2}''$, O c E$=\frac{1}{3}''$, &c. Now when the earth is removed to E, we shall have PE b=E b $o=\frac{1}{2}''$, and PE a—PE b=a E $b=\frac{1}{2}''$, i. e. the stars a, b, will appear to be $\frac{1}{2}''$ distant. We also have PE c=E c O$=\frac{1}{3}''$, and PE a—PE c=a E $c=\frac{2}{3}''$; i. e. the stars a, c, will appear to be $\frac{2}{3}''$ distant when the earth is at E. Now, since we have b EP$=\frac{1}{2}''$, and c EP$=\frac{1}{3}''$, therefore b EP—c EP=b E $c=\frac{1}{2}''-\frac{1}{3}''=\frac{1}{6}''$; i. e. the stars b, c, will appear to be only $\frac{1}{6}''$ removed from each other when the earth is at E. Whence we may deduce the following expression, to denote the parallax that will become visible in the change of distance between the two stars, by the removal of the earth from one extreme of its orbit to the other. Let P express the total parallax of a fixed star of the first magnitude, M the magnitude of the largest of the two stars, m the magnitude of the smallest, and p the partial parallax to to be observed by the change in the distance of a double star; then will $p = \frac{m-M}{mM}P$; and p, being found by observation, will give us $P = \frac{PMm}{m-M}$. *E. G.* Suppose a star of the first magnitude should have a small star of the twelfth magnitude near it; then will the partial parallax we are to expect to see be $\frac{12 \times 1 P}{12-1}$, or $\frac{11}{12}$ of the total parallax of a fixed star of the first magnitude; and if we should, by observation, find the partial parallax between two such stars to amount to $1''$, we shall have the total parallax $P = \frac{1 \times 1 \times 12}{12-1} = 1''.0909$. If the stars are of the third and twenty-fourth magnitude, the partial parallax will be $\frac{24-3}{3 \times 24} = \frac{21}{72}P$; and if, by observation, p is found to be a tenth of a second, the whole parallax will come out $\frac{.1 \times 3 \times 24}{24-3} = 0''.3428$.

Farther, suppose the stars, being still in the ecliptic, to appear in one line, when the earth is in any other part of its orbit between O and E; then will the parallax still be expressed by the same algebraic formula, and one of the maxima will still lie at O, the other at E; but the whole effect will be divided into two parts, which will be in proportion to each other as radius — sine to radius + sine of the stars distance from the nearest conjunction or opposition.

When the stars are anywhere out of the ecliptic, situated so as to appear in one line O $a\,b\,c$ perpendicular to OE, the maximum of parallax will still be expressed by $\frac{m-M}{Mm}P$; but there will arise another additional parallax in the conjunction and opposition, which will be to that which is found 90° before or after the sun, as the sine (S) of the latitude of the stars seen at O is to the radius (R); and the effect of this parallax will be divided into two parts; half of it lying on one side of the large star, the other half on the other side of it. This latter parallax, moreover, will be compounded with the former, so that the distance of the stars in the conjunction and opposition will then be represented by the diagonal of a parallelogram, whereof the two semiparallaxes are the sides; a general expression for which will be $\sqrt{\overline{\frac{m-M}{2MP}P}\Big|^2 \times \frac{SS}{BR} + 1}$; for the stars will apparently describe two ellipses in the heavens, whose transverse axes will be to each other in the ratio of M to m (fig. 93.), and A a, B b, C c, D d, will be the cotemporary situations. Now, if b Q be drawn parallel to AC, and the parallelogram $b\,q$ BQ be completed, we shall have $b\text{Q} = \frac{1}{2}\text{CA} - \frac{1}{2}ca = \frac{1}{2}\text{C}c = \frac{1}{2}p$, or semiparallax 90° before or after the sun, and B b may be resolved into, or is compounded of, b Q and $b\,q$; but $bq = \frac{1}{2}\text{BD} - \frac{1}{2}bd =$ the semiparallax in the conjunction or opposition. We also have R : S :: bQ : $bq = \frac{pS}{2R}$; therefore the distance B b (or D d) $= \sqrt{\frac{p}{2}\Big|^2 \times \frac{pS}{2R}\Big|^2}$; and by substituting the value of p in this expression, we obtain $\sqrt{\frac{m-M}{2Mm}P\Big|^2 \times \frac{SS}{RR} + 1}$, as above. When the stars are in the pole of the ecliptic, $b\,q$ will become equal to b Q, and B b will be $7071\,P\frac{m-M}{Mm}$. Again, let the stars be at some distance, *e. g.* 5″ from each other, and let them both be in the ecliptic. This case is resolvable into the first; for imagine the star a (fig. 92.) to stand at x, and in that situation the stars x, b, c, will be in one line, and their parallax expressed by $\frac{m-M}{Mm}P$. But the angle aEx may be taken to be equal to aOx; and as the foregoing formula gives us the angles xEb xEc, we are to add aEx or 5″ to xEb, and we shall have aEb. In general, let the distance of the stars be d, and let the observed distance at E be D, then will $D = d + p$, and therefore the whole parallax of the annual orbit will be expressed by $\frac{DMm - dMm}{m-M} = P$.

Suppose the two stars now to differ only in latitude, one being in the ecliptic, the other, *e. g.* 5″ north when seen at O. This case may also be resolved by the former; for imagine the stars b, c, (fig. 91.) to be elevated at right angles above the plane of the figure, so that aOb, or aOc, may make an angle of 5″ at O; then, instead of the line O $a\,b\,c$, E a, E b, E c, EP, imagine them all to be planes at right angles to the figure; and it will appear that the parallax of the stars in longitude must be the same as if the small star had been without latitude. And since the stars b, c, by the motion of the earth from O to E, will not change their latitude, we shall have the following construction for finding the distance of the stars $a\,b$, $a\,c$, at E, and from thence the parallax B. Let the triangle $a\,b\,\beta$ (fig. 94.) represent the situation of the stars; $a\,b$ is the subtense of 5″, the angle under which they are supposed to be seen at O. The quantity b, by the former theorem, is found $\frac{m-M}{mM}P$, which is the partial parallax that would have been seen by the earth's moving from O to E, if both stars had been in the ecliptic, but on account of the difference in latitude, it will be now represented by $a\,\beta$, the hypothenuse of the triangle $a\,b\,\beta$: therefore, in general, putting $a\,b = d$, and $a\,\beta = D$, we have $\sqrt{\frac{DD - d.d \times Mm}{m-M}} = P$. Hence D being taken by observation, and d, M, and m, given, we obtain the total parallax.

If the stuation of the stars differs in longitude as well as latitude, we may resolve this case by the following method. Let the triangle $a\,b\,\beta$ (fig. 169.) represent the situation of the stars, $a\,b = d$ being their distance seen at O, $a\,\beta = D$ their distance seen at E. That the change $b\,\beta$, which is produced by the earth's motion will be truly expressed by $\frac{m-M}{Mm}P$ may be proved as before, by supposing the star a to have been placed at

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α. Now let the angle of position $b\,a\,\alpha$ be taken by a micrometer, or by any other method sufficiently exact; then, by solving the triangle $a\,b\,\alpha$, we shall have the longitudinal and latitudinal differences $a\,\alpha$ and $b\,\alpha$ of the two stars. Put $a\,\alpha = x$, $b\,\alpha = y$, and it will be $x + b\beta = a\,q$, whence $D = \sqrt{\overline{x + \frac{m-MP}{M\,m}}\Big| + y\,y}$; and $\dfrac{\sqrt{D^2 - y^2} \times \overline{M^2 m - M\,m}}{m - M} = P$.

If neither of the stars should be in the ecliptic, nor have the same longitude or latitude, the last theorem will still serve to calculate the total parallax whose maximum will lie in E. There will, moreover, arise another parallax, whose maximum will be in the conjunction and opposition, which will be divided, and lie on different sides of the large star; but as we know the whole parallax to be exceedingly small; it will not be necessary to investigate every particular case of this kind; for by reason of the division of the parallax, which renders observations taken at any other time, except where it is greatest, very unfavourable, the formulæ would be of little use. Dr Herschel closes his account of this theory with a general observation on the time and place where the maxima of parallax will happen.

When two unequal stars are both in the ecliptic, or, not being in the ecliptic, have equal latitudes, north or south, and the largest star has most longitude; the maximum of the apparent distance will be when the sun's longitude is 90 degrees more than the stars, or when observed in the morning; and the minimum when the longitude of the sun is 90 degrees less than that of the stars, or when observed in the evening. When the small star has most longitude, the maximum and minimum, as well as the time of observation, will be the reverse of the former. When the stars differ in latitudes, this makes no alteration in the place of the maximum or minimum, nor in the time of observation; i. e. it is immaterial whether the largest star has the least or the greatest distance of the two stars.

Chap. VI. *Of the Figure of the Earth.*

Having now described the apparent motions of the heavenly bodies, let us return to the earth, in order to examine the information which has been collected concerning its figure.

269 Earth spherical.

We have seen already, that the earth is spherical. The force of *gravity* constantly directed towards its centre retains bodies on its surface, though situated on places diametrically opposite, or though *antipodes* to each other. The sun and stars appear always *above* the earth; for *above* and *below* are merely relative to the direction of *gravity*.

270 Dimensions how ascertained.

As soon as the spherical figure of the earth was discovered, curiosity naturally led men to endeavour to measure its dimensions. Hence it is probable, that attempts of that nature were made in very ancient times. The reference which several of the ancient measures have to the size of the globe is a confirmation of this. But among the moderns, Picard was the first who executed the task with any degree of success. He measured a degree of the meridian in France about the middle of the 17th century.

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Since a meridian, or any other circle on a sphere, may be conceived to be divided into 360 equal parts, called degrees, and these into minutes and seconds, as explained by the writers on trigonometry, the circumference of the earth, and thence its diameter, may be determined by measuring the length of a degree on the meridian or any other great circle. To perform this important problem, there have been various methods invented by different philosophers of early and later times; one of these methods, which unites considerable accuracy with great facility, will be readily understood from fig. 95. where PB and ST represent two mountains or very high buildings, the distance PS between which must be very nicely determined by longimetry: then, by measuring the angles RBT and RTB with an accurate instrument, their sum taken from 180° leaves the angle BRT, which is measured also by the arc PS; whence PS is known in parts of the whole circle. Thus, if the angle BTR be 89° 45′ 32″, the angle TBR 89° 54′ 28″, and the distance PS $23\frac{1}{15}$ English miles; then the angle R or arc PS being equal to $180^\circ - \overline{89^\circ\,45'\,32'' + 89^\circ\,54'\,28''} = 20'$ it will be, as $20' : 60'$ or $1^\circ :: 23\frac{1}{15} : 69\frac{1}{5}$ English miles, length of a degree. Hence the circumference of the earth is (according to this example) 24912 miles, and its diameter nearly 7930 miles.—A material advantage attending this method is, that there is no occasion to measure the altitudes of the mountains, an object which can seldom be attained without considerable difficulty.

The method which is given above is, it must be confessed, as well as all the other methods which aim at the measurement of a degree without having recourse to the heavenly bodies, liable to some inaccuracy; for, by reason of the changes in the state of the atmosphere, distant terrestrial objects never appear in their true places; they always seem more or less elevated or distant, according to the nature of the season, and the time of the day. On this account—and because it could not escape observation, that as persons changed their situation on the earth by moving towards the north or the south, the stars and other heavenly bodies either increased or decreased their apparent altitudes proportionally—the measurement of a degree was attempted even by the earliest philosophers, by means of known fixed stars. Every person who is acquainted with plane trigonometry will admit, that the distance of two places, north and south of each other, may be accurately measured by a series of triangles; for if we measure the distance of any two objects, and take the angles which each of them make with a third, the triangle formed by the three objects will become known; so that the other two sides may be as truly determined by calculation, as if they had been actually measured. And by making either of these sides the base of a new triangle, the distances of other objects may be found in the same manner; and thus by a series of triangles, properly connected at their bases, we might measure any part of the circumference of the earth. And if these distances were reduced to the north and south, or meridian line, and the altitude of some star was measured at the extremities of the distance,

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distance, the difference of the altitudes would be equal to the length of the grand lines in degrees, minutes, &c. whence the length of a degree would be known. This method was, we believe, first practised by Eratosthenes in Egypt; and has been frequently used since with greater and greater accuracy, in proportion as the instruments for taking angles became, by gradual improvements, more exact and minute.

By this method, or some others not widely different, and which it is needless here to explain, the length of a degree has been measured in different parts of the earth; the results of the most noted of these admeasurements it may be proper to give.

271 Different measurements.

Snell found the length of a degree by two different methods: by one method he made it 57064 Paris toises, or 342384 feet; and by the other 57057 toises, or 342342 feet.

M. Picard, in 1669, found by mensuration from Amiens to Malvoisin, the quantity of a degree to be 57060 toises, or 342360 feet; being nearly an arithmetical mean between the numbers of Snell.

Our countryman Norwood, about the year 1635, by measuring between London and York, determined a degree at 367196 English feet, or 57300 Paris toises, or 69 miles 288 yards.

Muschenbroek, in 1700, with a view of correcting the errors of Snell, found by particular observations that the degree between Alcmaer and Bergen-op-zoom contained 57033 toises.

Messrs Maupertuis, Clairaut, Monnier, and others from France, were sent on a northern expedition, and began their operations in July 1736; they found the length of a degree in Sweden to be 57439 toises, when reduced to the level of the sea. About the same time Messrs Godin, Bouguer, and Condamine, from France, with some philosophers from Spain, were sent to South America, and measured a degree in the province of Quito in Peru; the medium of their results gives about 56750 toises for a degree.

M. de la Caille, being at the Cape of Good Hope in 1752, found the length of a degree on the meridian there to be 57037 toises. In 1755 Father Boscovich found the length of a degree between Rome and Rimini in Italy to be 56972 toises.

In 1764, F. Beccaria measured a degree near Turin; from his measurement he deduced the length of a degree there 57024 toises. At Vienna the length of a degree was found 57091 toises.

And in 1766 Messrs Mason and Dixon measured a degree in Maryland and Pennsylvania, North America, which they determined to be 363763 English feet, or $56904\frac{1}{2}$ Paris toises.

The difference of these measures leads us to conclude that the earth is not exactly spherical, but that its axis which passes through the poles, is shorter than that which passes through the equator. But the observations which have been made to determine the magnitude and figure of the earth, have not hitherto led to results completely satisfactory. They have indeed demonstrated the compression or oblateness of the terrestrial spheroid, but they have left an uncertainty as to the quantity of that compression, extending from about the 170th, to the 330th part of the radius of the equator. Between these two quantities, the former of which is nearly double of the latter, most of the results are placed, but in such a manner that those best entitled to credit are much nearer to the least extreme than to the greatest. Sir Isaac Newton, as is well known, supposing the earth to be of uniform density, assigned for the compression at the poles $\frac{1}{230}$, nearly a mean between the two limits just mentioned; and it is probable, that, if the compression is less than this, it is owing to the increase of the density toward the centre. Boscovich, taking a mean from all the measures of degrees, so as to make the positive and negative errors equal, found the difference of the axis of the meridian $= \frac{1}{248}$. By comparing the degrees measured by Father Leisganic in Germany, with eight others that have been measured in different latitudes, La Lande finds $\frac{1}{311}$, and, suppressing the degree in Lapland, which appears to err in excess, $\frac{1}{331}$ for the compression. La Place makes it $\frac{1}{321}$; Sejour $\frac{1}{307}$, and lastly, Carouge and La Lande $\frac{1}{300}$.

272 Supposed figure of the earth.

These anomalies have induced some astronomers, especially M. de la Place, to give up the spheroidal figure of the earth altogether, to suppose that it is not a solid of revolution, and that its surface is a curve of double curvature. Mr Playfair, on the other hand, in an excellent dissertation on the subject, published in the fifth volume of the Edinburgh Transactions, supposes, that the anomalies may be owing to the different densities of the strata near the surface where the degrees were measured, occasioning errors in the measurement.

273 Latitudes and longitudes how found.

The position of the different places on the earth's surface is determined by their distance from the equator, called their *latitude*, and from a first meridian called their *longitude*. The latitude is easily ascertained by observing the height of the pole: The longitude is calculated by observing some celestial phenomenon, as an eclipse of Jupiter's satellites at the same instant in two places situated in different meridians. The difference in point of apparent time in the two places, gives their distance east or west from each other, and consequently the difference of their longitude; for it is not noon at the same time in all the different parts of the earth's surface. When it is noon at London, it is only eleven o'clock in all the places 15° west from London, while it is one o'clock in all places 15° east from London. Every 15° east or west causes the difference of an hour. Hence the difference in time, when any celestial phenomenon is observed, gives us the distance east and west, or in longitude, between the places where it is observed.

The eclipses of Jupiter's satellites are of the greatest service in determining the longitude of places on this earth, astronomers therefore have been at great pains to calculate tables for the eclipses of these satellites by their primary, for the satellites themselves have never been observed to eclipse one another. The construction

tion of such tables is indeed much easier for these satellites than of any other celestial bodies, as their motions are much more regular.

The English tables are calculated for the meridian of Greenwich, and by these it is very easy to find how many degrees of longitude any place is distant either east or west from Greenwich; for, let an observer, who has these tables, with a good telescope and a well-regulated clock at any other place of the earth, observe the beginning or ending of an eclipse of one of Jupiter's satellites, and note the precise moment of time that he saw the satellite either immerge into, or emerge out of, the shadow, and compare that time with the time shown by the tables for Greenwich: then 15 degrees difference of longitude being allowed for every hour's difference of time, will give the longitude of that place from Greenwich; and if there be any odd minutes of time, for every minute a quarter of a degree, east or west, must be allowed, as the time of observation is later or earlier than the time shown by the tables. Such eclipses are very convenient for this purpose at land, because they happen almost every day; but are of no use at sea, because the rolling of the ship hinders all nice telescopical observations.

Fig. 95.

To explain this by a figure, let J be Jupiter, K, L, M, N, his four satellites in the respective orbits, 1, 2, 3, 4; and let the earth be at F (suppose in November, although that month is no otherwise material than to find the earth readily in this scheme, where it is shown in eight different parts of the orbit). Let Q be a place on the meridian of Greenwich, R a place on some other meridian eastward from Greenwich. Let a person at R observe the instantaneous vanishing of the first satellite K into Jupiter's shadow, suppose at three o'clock in the morning; but by the tables he finds the immersion of that satellite to be at midnight at Greenwich; he then can immediately determine, that as there are three hours difference of time between Q and K, and that R is three hours forwarder in reckoning than Q, it must be 45 degrees of east longitude from the meridian of Q. Were this method as practicable at sea as at land, any sailor might almost as easily, and with equal certainty, find the longitude as the latitude.

From its impracticability, the seaman is obliged to have recourse to other celestial phenomena, and the most useful are the motions of the moon. On this subject we shall satisfy ourselves with inserting the following observations of Mr Lowe, who has pointed out a very simple method of ascertaining the longitude on land.

Philosophical Magazine, vol. xv. p. 97.

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Mr Lowe's method of finding the longitude.

Although the method of determining the difference of longitude at sea from the lunar observations has been accurately laid down by Dr Maskelyne and other able nautical astronomers, it has, however, happened that several writers on longitude and astronomy have, in the course of the last twenty years, given rules for finding the difference of longitude at land from the moon's transits, either so erroneous or imperfect, that the adoption thereof might do a serious injury both to navigation and geography: they have given examples, but no demonstrations; or at least such obscure and imperfect ones, as prove that they had not a clear conception of the matter.

It is for these reasons that the following demonstration of a rule both easy and accurate for finding the difference of longitude is now proposed. The data are the observed increase of the moon's right ascension in passing from the first to the second meridian, and the increase of the sun's and moon's right ascension in twelve hours apparent time, which may be had from the Nautical Almanack.

Fig. 97.

Demonstration.—Let the circle ABC represent the equator, P its pole, and APD the first meridian, as that of Greenwich. Suppose that the centres of the sun, the moon, and a fixed star, are on that meridian at the same moment of time as represented at A, and that they move from thence to the westward with their respective velocities, the earth being considered as at rest. Then, after twelve hours apparent time, the sun will be at D, the opposite point to A, or 180° distant from it; but the fixed star, moving in appearance over a greater space than 180° in twelve hours apparent time, will be at E; while the moon, with a motion apparently slower than the sun and the star, will appear after twelve hours at the point B, or on a meridian BP. But ED is the distance of the sun from the star after an interval of twelve hours apparent time, and EB the distance of the moon, or, in other words, the increase of their respective right ascensions: and since ED and EB are known from the Nautical Almanack, if we subtract the first from the last, we have DB, equal to the difference between the increase of the sun's and moon's right ascension in twelve hours apparent time. Now the difference of longitude between the two meridians AP and BP is the arc A β B, equal to A β D less the arc DB; that is, equal to 180° less the difference between the increase of the sun's and moon's right ascension in twelve hours; and, since the increase of the moon's right ascension from the time of its passing the meridian AP to the time of its passing BP is known from observation, and equal to EB, we can make the following proportion for finding the difference of longitude between any other two meridians, AP and β P, from the observed increase of the moon's right ascension ι β.

As EB : A β D—DB :: ι β : A β the difference of longitude; or, in more familiar language, as the increase of the moon's right ascension in twelve hours apparent time is to 180° or 12 h. less the difference between the increase of the sun's and moon's right ascension in that time :: so is any other observed increase of the moon's right ascension between two meridians : to their difference of longitude.

If the increase of the moon's right ascension in 12 hours were uniform, or such that equal parts of it would be produced in equal times, the above rule would be strictly accurate; but as that increase arises from a motion continually accelerated or retarded, and seldom uniform but for a short space of time, it will therefore be necessary to find the mean increase of the moon's right ascension when it is at the intermediate point between A and β, in order to determine their difference of longitude with the greatest precision; and for that purpose, Taylor's Tables of Second Difference are very useful.

Example.—April the 8th, 1800, the transit of the moon's first limb was observed at the royal observatory

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ry (A); and, allowance being made for the error of the clock, its right ascension was

	H.	M.	Sec.
	12	35	18.22
Add the time that the moon's semidiameter took to pass the meridian	0	1	8.38
Right ascension of the moon's centre	12	36	26.6
On a meridian (β) far to the westward, the transit of the moon's first limb was observed the same day, and being reduced to the centre, its right ascension was - - - - -	12	47	56.7
Increase of right ascension between A and β. - - - - -	0	11	30.1
The increase of the moon's right ascension in 12 hours apparent time per The Nautical Almanack was -	0	26	3
The increase of the sun's in the same time - - - - - -	0	1	49.65
Difference - - - -	0	24	13.35

And 12 hours minus this difference is = 11 h. 35 m. 46.65 sec.; therefore, as 26 m. 3 sec. : 11 h. 35 m. 46.65 sec. :: 11 m. 30.1 sec. : to 5 h. 7 m. 12 sec. the correct difference of longitude between A and β.

By reducing the three terms to seconds, and using logarithms, the operation is much shortened.

In a book published by Mr Mackay on longitude about 15 or 16 years ago, there is a rule given, and also an example, for finding the difference of longitude at land from the transits of the moon, but no demonstration. The rule, when divested of its high-sounding enunciation, runs thus:

As the increase of the moon's right ascension in 12 hours apparent time : is to 180° :: so is any other observed increase between two meridians : to their difference of longitude. It follows from this, that the moon as well as the sun would, in 12 hours apparent time, pass over an arc of 180°, although the apparent motion of the moon to the westward in 12 hours, or 180° of space, be less than that of the sun by six or seven degrees; and so much error would this method produce, if the two places differed about 180° in longitude.

The above example, wrought according to Mackay's rule, would come out thus:

	H.	M.	Sec.
As 26 m. 3 sec. : 12 h. :: 11 m. 30.1 sec. to	5	17	53.7
But the correct difference as above is	5	7	12
Error - - - - - -	0	10	41.7

which amounts to more than $2\frac{1}{2}^{\circ}$, or 150 miles, in a difference of longitude little exceeding five hours.

Mr Edward Pigot adopts the very same rule for determining the difference of longitude between Greenwich and York, and states the result in the Philosophical Transactions for 1785, p. 417.

Mr Vince has inserted this rule and example in his Treatise of Practical Astronomy; but we have to regret that they were not accompanied with a strict demonstration.

The Rev. Mr Wollaston, in the appendix to his *Fasciculus Astronomicus*, published two or three years ago, has given a rule, without demonstration or example, for finding the difference of longitude from the moon's transits, which produces the same error as Mackay's and Pigot's, although worded differently from theirs. Mr Wollaston makes the first term of his proportion apparent, and the third mean time; this renders the result erroneous. Since the motions of the sun, moon, and planets are computed for apparent time, and given so in the Nautical Almanack, mean time is not at all requisite for resolving the difference of longitude either at sea or at land. We shall therefore endeavour to apply Mr Wollaston's rule, according to its literal meaning, for finding the difference of longitude from the above observations.

The right ascension of the moon's centre on the meridian of Greenwich being known, we can easily deduce the mean and apparent time corresponding to it; and in like manner the mean and apparent time at the distant meridian β. The apparent and mean time of the transits of the moon's centre over the meridians of A and β, when strictly computed, were as follows:

	Apparent Time.			*Mean Time.*		
	H.	M.	Sec.	H.	M.	Sec.
At A - -	11	26	47.81	11	28	33.5
At β - -	11	37	29.5	11	39	11.4
Time later at β than at A	0	10	41.69	0	10	37.9
From the increase of the moon's right ascension in 12 hours -		26	3			
Subtract the increase of the sun's right ascension in that time -		1	49.65			
The moon's retardation in 12 hours -		24	13.35			

Then, "As twice the moon's retardation in 12 hours : is to 24 hours ::

"So is the mean time later at β than at A : to the difference of longitude west from A."

After doubling 24 m. 13.25 sec. and also 12, which is totally unnecessary, as the result would be the same if they stood single, we state the following proportion:

As 48 m. 26.7 sec. : 34 h. :: 10 m. 37.9 sec. to 5 h. 15 m. 1.3 sec. the difference of longitude between A and β.

But as the third term is improperly reduced to mean time, we shall take the apparent time above found, and then 48 m. 26.7 sec. : 24 h. :: 10 m. 41.69 sec. to 5 h. 17 m. 53.7 sec.; the same as results from Mackay's and Pigot's rules.

We shall only remark, that 5 h. 17 m. 53.7 sec. is the apparent time that the moon took in passing from the meridian of A to the meridian of β; but from what has been demonstrated, the apparent time at β will be equal to the difference between the increase of the sun's and moon's right ascension in that interval of apparent time; for DB, or 24 m. 13.35 sec. is the difference for 12 hours, and therefore by proportion ϡβ, or 10 m. 41.69 sec. will be the difference for 5 h. 17 m. 53.7 sec.; subtracting the former from the latter, we have 5 h. 7 m. 12 sec. the difference of longitude as before, and

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a clear proof that the authors above mentioned have omitted to deduct the apparent time at the distant place or station β, from the apparent time at Greenwich.

A very important fact relative to the earth has been ascertained by astronomers, namely, that the weight of bodies does not continue the same when carried to different parts of it. It is impossible to ascertain this variation by the balance, because it affects equally the bodies weighed and the weight by which we estimate its gravity. But the pendulum affords a certain method of detecting every such change; because the number of oscillations made by a given pendulum in a given time depends upon the force of gravity. The smaller that force, the fewer vibrations will it make. Therefore, if the force of gravity diminish, the pendulum will move slower; if it decreases, it will oscillate with more celerity. In different pendulums the slowness of vibration is proportional to the length of the pendulum: If a pendulum be lengthened it moves slower, if it be shortened it moves swifter than before. Mr Richer in a voyage made to Cayenne, found that the pendulum of his clock did not vibrate so frequently there, as it did when at Paris; but that it was necessary to shorten it by about the eleventh part of an inch to make it vibrate in exact seconds. The nearer the equator a pendulum is placed it vibrates the slower, the nearer the pole it is placed it vibrates the faster. Hence it follows that the force of gravity is greatest at the poles, and that it gradually diminishes as we approach the equator, where it is smallest.

PART III. OF THE REAL MOTIONS OF THE HEAVENLY BODIES.

WE have now enumerated and explained the apparent motions of the heavenly bodies. Nothing can appear more intricate and perplexed, or more remote from what we are accustomed to consider as the simplicity of nature. Hence mankind have in all ages been tempted to consider them as merely apparent, and not real; and the object of astronomers has always been to detect the real motions of the heavenly bodies from those which they exhibit to the eye of a spectator on the earth. Neither industry nor address was spared to gain this desirable end. Hypothesis was formed after hypothesis; every new supposition was a step towards the truth; and at last the real motions have not only been ascertained but demonstrated in the most satisfactory manner. It shall be our object in this part of our treatise to lay before our readers the result of these discoveries.

Chap. I. *Of the Rotation of the Earth.*

WE find that the sun, and those planets on which there are visible spots, turn round their axis: for the spots move regularly over their disks (B). From hence we may reasonably conclude, that the other planets on which we see no spots, and the earth, which is likewise a planet, have such rotations. But being incapable of leaving the earth, and viewing it at a distance, and its rotation being smooth and uniform, we can neither see it move on its axis as we do the planets, nor feel ourselves affected by its motion. Yet there is one effect of such a motion, which will enable us to judge with certainty whether the earth revolves on its axis or not. All globes which do not turn round their axis will be perfect spheres, on account of the equality of the weight of bodies on their surfaces; especially of the fluid parts. But all globes which turn on their axis will be oblate spheroids; that is, their surfaces will be higher or farther from the centre in the equatorial than in the polar regions: for as the equatorial parts move quickest, they will recede farthest from the axis of motion, and enlarge the equatorial diameter. That our earth is really of this figure, is demonstrable from the unequal vibrations of a pendulum, and the unequal lengths of degrees in different latitudes. Since then the earth is higher at the equator than at the poles, the sea, which naturally runs downward, or towards the places which are nearest the centre, would run towards the polar regions, and leave the equatorial parts dry, if the centrifugal force of these parts, by which the waters were carried thither, did not keep them from returning. The earth's equatorial diameter is 36 miles longer than its axis.

275 Argument for the earth's motion from its spheroidal figure.

276 Weight of bodies increases towards the poles.

Bodies near the poles are heavier than those towards the equator, because they are nearer the earth's centre, where the whole force of the earth's attraction is accumulated. They are also heavier, because their centrifugal force is less, on account of their diurnal motion being slower. For both these reasons, bodies carried from the poles towards the equator gradually lose their weight. Experiments prove, that a pendulum which vibrates seconds near the poles vibrates slower near the equator, which shows that it is lighter or less attracted there. To make it oscillate in the same time it is found necessary to diminish its length. By comparing the different lengths of pendulums swinging seconds at the equator and at London, it is found that a pendulum must be $2\frac{169}{1000}$ lines shorter at the equator than at the poles. A line is a twelfth part of an inch.

If the earth turned round its axis in 84 minutes 43 seconds, the centrifugal force would be equal to the power of gravity at the equator; and all bodies there would entirely lose their weight. If the earth revolved quicker, they would all fly off and leave it.

A person on the earth can no more be sensible of its undisturbed motion on its axis, than one in the cabin of

(B) This, however, must be understood with some degree of limitation, as will evidently appear from what has been already said concerning the variable motion both of the spots of the sun and planets.

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of a ship on smooth water can be sensible of the ship's motion, when it turns gently and uniformly round. It is therefore no argument against the earth's diurnal motion that we do not feel it; nor is the apparent revolutions of the celestial bodies every day a proof of the reality of these motions; for whether we or they revolve, the appearance is the very same. A person looking through the cabin windows of a ship, as strongly fancies the objects on land to go round when the ship turns as if they were actually in motion.

277 Earth's motion proved from the celestial appearances from different planets.

If we could translate ourselves from planet to planet, we should still find that the stars would appear of the same magnitudes, and at the same distances from each other, as they do to us here; because the width of the remotest planet's orbit bears no sensible proportion to the distance of the stars. But then the heavens would seem to revolve about very different axes; and consequently, those quiescent points, which are our poles in the heavens, would seem to revolve about other points, which, though apparently in motion as seen from the earth, would be at rest as seen from any other planet. Thus the axis of Venus, which lies at right angles to the axis of the earth, would have its motionless poles in two opposite points of the heavens lying almost in our equinoctial, where the motion appears quickest, because it is seemingly performed in the greatest circle: and the very poles, which are at rest to us, have the quickest motion of all as seen from Venus. To Mars and Jupiter the heavens appear to turn round with very different velocities on the same axis, whose poles are about $23\frac{1}{2}$ degrees from ours. Were we on Jupiter, we should be at first amazed at the rapid motion of the heavens; the sun and stars going round in 9 hours 56 minutes. Could we go from thence to Venus, we should be as much surprised at the slowness of the heavenly motions; the sun going but once round in 584 hours, and the stars in 540. And could we go from Venus to the moon, we should see the heavens turn round with a yet slower motion; the sun in 708 hours, the stars in 655. As it is impossible these various circumvolutions in such different times, and on such different axes, can be real, so it is unreasonable to suppose the heavens to revolve about our earth more than it does about any other planet. When we reflect on the vast distance of the fixed stars, to which 190,000,000 of miles, the diameter of the earth's orbit, is but a point, we are filled with amazement at the immensity of the distance. But if we try to frame an idea of the extreme rapidity with which the stars must move, if they move round the earth in 24 hours, the thought becomes so much too big for our imagination, that we can no more conceive it than we do infinity or eternity. If the sun was to go round the earth in 24 hours, he must travel upwards of 300,000 miles in a minute: but the stars being at least 400,000 times as far from the sun as the sun is from us, those about the equator must move 400,000 times as quick. And all this to serve no other purpose than what can be as fully and much more simply obtained by the earth's turning round eastward as on an axis, every 24 hours, causing thereby an apparent diurnal motion of the sun westward, and bringing about the alternate returns of day and night.

278 Another objection answered.

As to the common objections against the earth's motion on its axis, they are all easily answered and set aside. That it may turn without being seen or felt by us to do so, has been already shown. But some are apt to imagine, that if the earth turns eastward (as it certainly does if it turns at all), a ball fired perpendicularly upward in the air must fall considerably westward of the place it was projected from. The objection which at first seems to have some weight, will be found to have none at all, when we consider that the gun and ball partake of the earth's motion; and therefore the ball being carried forward with the air as quick as the earth and air turn, must fall down on the same place. A stone let fall from the top of a mainmast, if it meets with no obstacle, falls on the deck as near the foot of the mast when the ship sails as when it does not. If an inverted bottle full of liquor be hung up to the ceiling of the cabin, and a small hole be made in the cork, to let the liquor through on the floor, the drops will fall just as far forward on the floor when the ship sails as when it is at rest. And gnats or flies can as easily dance among one another in a moving cabin as in a fixed chamber. As for those Scripture expressions which seem to contradict the earth's motion, this general answer may be made to them all, viz. it is plain from many instances, that the Scriptures were never intended to instruct us in philosophy or astronomy; and therefore on those subjects expressions are not always to be taken in the literal sense, but for the most part as accommodated to the common apprehensions of mankind. Men of sense in all ages, when not treating of the sciences purposely, have followed this method: and it would be in vain to follow any other in addressing ourselves to the vulgar, or bulk of any community.

Chap. II. *Of the Revolution of the Planets round the Sun.*

The apparent motions of the planets lead us to conclude that they all move in orbits nearly circular round the sun, while the sun moves round the earth: that the orbits of Venus and Mercury are nearer the sun than the earth; but the orbits of the other planets include the earth within them. All the apparent motions are reconcilable to this opinion, and lead us to form it. It removes all the inexplicable intricacy of their apparent motions.

But the earth itself is a planet, and bears a very exact resemblance to the rest. Shall we suppose all the other planets to revolve round the sun while it alone remains stationary? Or shall we suppose that the earth, like the other planets, revolves round the sun in the course of a year? The phenomena in both cases will be exactly the same, but the motion of the earth will reduce the whole system to the greatest simplicity, whereas the motion of the sun carrying with it the revolving planets would leave the whole complicated and involved. Various opinions on this subject have been maintained by astronomers.

Concerning the opinion of the very first astronomers about the system of nature, we are necessarily as ignorant as we are of those astronomers themselves. Whatever opinions are handed down to us, must be of a vastly later date than the introduction of astronomy among mankind. If we may hazard a conjecture, however, we are inclined to think that the first opinions on

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on this subject were much more just than those that were held afterwards for many ages. We are told that Pythagoras maintained the motion of the earth, which is now universally believed, but at that time appears to have been the opinion of only a few detached individuals of Greece.

279 Pythagorean system.

As the Greeks borrowed many things from the Egyptians, and Pythagoras had travelled into Egypt and Phenice, it is probable he might receive an account of this hypothesis from thence: but whether he did so or not, we have now no means of knowing, neither is it of any importance whether he did or not. Certain it is, however, that this opinion did not prevail in his days, nor for many ages after. In the second century after Christ, the very name of the Pythagorean hypothesis was suppressed by a system erected by the famous geographer and astronomer Claudius Ptolemæus.

280 Suppressed by the Ptolemaic.

This system, which commonly goes by the name of the *Ptolemaic*, he seems not to have originally invented, but adopted as the prevailing one of that age; and perhaps made it somewhat more consistent than it was before. He supposed the earth at rest in the centre of the universe. Round the earth, and the nearest to it of all the heavenly bodies, the moon performed its monthly revolutions. Next to the moon was placed the planet Mercury; then Venus; and above that the sun, Mars, Jupiter, and Saturn, in their proper orbits; then the sphere of the fixed stars; above these, two spheres of what he called *crystalline* heavens; above these was the primum mobile, which, by turning round once in 24 hours, by some unaccountable means or other, carried all the rest along with it. This primum mobile was encompassed by the empyrean heaven, which was of a cubic form, and the seat of angels and blessed spirits. Besides the motions of all the heavens round the earth once in 24 hours, each planet was supposed to have a particular motion of its own; the moon, for instance, once in a month, performed an additional revolution, the sun in a year, &c. See fig. 98.

281 Ptolemy's system insufficient.

It is easy to see, that, on this supposition, the confused motions of the planets already described could never be accounted for. Had they circulated uniformly round the earth, their apparent motion ought always to have been equal and uniform, without appearing either stationary or retrograde in any part of their courses. In consequence of this objection, Ptolemy was obliged to invent a great number of circles, interfering with each other, which he called *epicycles* and *eccentrics*. These proved a ready and effectual salvo for all the defects of his system; as, whenever a planet was deviating from the course it ought on his plan to have followed, it was then only moving in an epicycle or an eccentric, and would in due time fall into its proper path. As to the natural causes by which the planets were directed to move in these epicycles and eccentrics, it is no wonder that he found himself much at a loss, and was obliged to have recourse to divine power for an explanation, or, in other words, to own that his system was unintelligible.

282 Pythagorean system revived by Copernicus.

This system continued to be in vogue till the beginning of the 16th century, when Nicolaus Copernicus, a native of Thorn (a city of Regal Prussia), and a man of great abilities, began to try whether a more satisfactory manner of accounting for the apparent motions of the heavenly bodies could not be obtained than was afforded by the Ptolemaic hypothesis. He had recourse to every author upon the subject, to see whether any had been more consistent in explaining the irregular motions of the stars than the mathematical schools: but he received no satisfaction, till he found first from Cicero, that Nicetas the Syracusan had maintained the motion of the earth; and next from Plutarch, that others of the ancients had been of the same opinion. From the small hints he could obtain from the ancients, Copernicus then deduced a most complete system, capable of solving every phenomenon in a satisfactory manner. From him his system hath ever afterwards been called the *Copernican*, and is represented fig. 99. Here the sun is supposed to be in the centre; next him revolves the planet Mercury; then Venus; next, the Earth, with the Moon: beyond these, Mars, Jupiter, and Saturn; and far beyond the orbit of Saturn, he supposed the fixed stars to be placed, which formed the boundaries of the visible creation.

283 Tychonic system.

Though this hypothesis afforded the only natural and satisfactory solution of the phenomena which so much perplexed Ptolemy's system, it met with great opposition at first; which is not to be wondered at, considering the age in which he lived. Even the famous astronomer Tycho Brahe could never assent to the earth's motion, which was the foundation of Copernicus's scheme. He therefore invented another system, whereby he avoided the ascribing of motion to the earth, and at the same time got clear of the difficulties with which Ptolemy was embarrassed. In this system, the earth was supposed the centre of the orbits of the sun and moon; but the sun was supposed to be the centre of the orbits of the five planets; so that the sun with all the planets were by Tycho Brahe supposed to turn round the earth, in order to save the motion of the earth round its axis once in 24 hours. This system was never much followed, the superiority of the Copernican scheme being evident at first sight.

Fig. 100.

The sun is so immensely bigger and heavier than the earth, that, if he was moved out of his place, not only the earth, but all the other planets, if they were united into one mass, would be carried along with the sun as the pebble would be with the mill-stone.

284 From the proportional decrease of gravity, &c.

By considering the law of gravitation, which takes place throughout the solar system, in another light, it will be evident that the earth moves round the sun in a year, and not the sun round the earth. It has been observed, that the power of gravity decreases as the square of the distance increases; and from this it follows with mathematical certainty, that when two or more bodies move round another as their centre of motion, the squares of their periodic times will be to one another in the same proportion as the cubes of their distances from the central body. This holds precisely with regard to the planets round the sun, and the satellites round the planets; the relative distances of all which are well known. But, if we suppose the sun to move round the earth, and compare its period with the moon's by the above rule, it will be found that the sun would take no less than 173.510 days to move round the earth; in which case our year would be 475 times as long as it now is. To this we may add, that the aspects of increase and decrease of the planets, the times of their seeming to stand still, and to move direct and retrograde, answer precisely to the earth's motion; but

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but not at all to the sun's without introducing the most absurd and monstrous suppositions, which would destroy all harmony, order, and simplicity, in the system. Moreover, if the earth be supposed to stand still, and the stars to revolve in free spaces about the earth in 24 hours, it is certain that the forces by which the stars revolve in their orbits are not directed to the earth, but to the centres of the several orbits; that is, of the several parallel circles which the stars on different sides of the equator describe every day; and the like inferences may be drawn from the supposed diurnal motion of the planets, since they are never in the equinoctial but twice in their courses with regard to the starry heavens. But, that forces should be directed to no central body, on which they physically depend, but to innumerable imaginary points in the axis of the earth produced to the poles of the heavens, is an hypothesis too absurd to be allowed of by any rational creature. And it is still more absurd to imagine that these forces should increase exactly in proportion to the distances from this axis; for this is an indication of an increase to infinity; whereas the force of attraction is found to decrease in receding from the fountain from whence it flows. But the farther any star is from the quiescent pole, the greater must be the orbit which it describes; and yet it appears to go round in the same time as the nearest star to the pole does. And if we take into consideration the twofold motion observed in the stars, one diurnal round the axis of the earth in 24 hours, and the other round the axis of the ecliptic in 25,920 years, it would require an explication of such a perplexed composition of forces, as could by no means be reconciled with any physical theory.

285 Objections against the earth's motion answered.

The strongest objections that can be made against the earth's motion round the sun is, that in opposite points of the earth's orbit, its axis, which always keeps a parallel direction, would point to different fixed stars; which is not found to be fact. But this objection is easily removed, by considering the immense distance of the stars in respect of the diameter of the earth's orbit; the latter being no more than a point when compared to the former. If we lay a ruler on the side of a table, and along the edge of the ruler view the top of a spire at ten miles distance; then lay the ruler on the opposite side of the table in a parallel situation to what it had before, and the spire will still appear along the edge of the ruler; because our eyes, even when assisted by the best instruments, are incapable of distinguishing so small a change at so great a distance.

286 Earth's motion demonstrated from the aberration of light.

Dr Bradley, our late astronomer-royal, found by a long series of the most accurate observations, that there is a small apparent motion of the fixed stars, occasioned by the aberration of their light; and so exactly answering to an annual motion of the earth, as evinces the same, even to a mathematical demonstration. He considered this matter in the following manner: he imagined CA, fig. 101. to be a ray of light falling perpendicularly upon the line BD; that, if the eye is at rest at A, the object must appear in the direction AC, whether light be propagated in time or in an instant. But if the eye is moving from B towards A, and light is propagated in time, with a velocity that is to the velocity of the eye as CA to BA; then light moving from C to A, whilst the eye moves from B to A, that particle of it by which the object will be discerned when the eye comes to A, is at C when the eye is at B. Joining the points BC, he supposed the line CB to be a tube, inclined to the line BD in the angle DBC, of such diameter as to admit but one particle of light. Then it was easy to conceive, that the particle of light at C, by which the object must be seen, when the eye, as it moves along, arrives at A, would pass through the tube BC, if it is inclined to BD, in the angle DBC, and accompanies the eye in its motion from B to A; and that it could not come to the eye placed behind such a tube, if it had any other inclination to the line BD. If, instead of supposing CB so small a tube, we imagine it to be the axis of a larger; then, for the same reason, the particle of light at C would not pass through the axis, unless it is inclined to BD in the angle CBD. In like manner, if the eye moved the contrary way, from D towards A, with the same velocity, then the tube must be inclined in the angle BCD. Although, therefore, the true or real place of an object is perpendicular to the line in which the eye is moving, yet the visible place will not be so; since that, no doubt, must be in the direction of the tube; but the difference between the true and apparent place will be *cæteris paribus* greater or less, according to the different proportion between the velocity of light and that of the eye. So that, if we could suppose that light was propagated in an instant, then there would be no difference between the real and visible place of an object, although the eye was in motion; for in that case, AC being infinite with respect to AB, the angle ACB, the difference between the true and visible place, vanishes. But if light be propagated in time, it is evident, from the foregoing considerations, that there will be always a difference between the real and visible place of an object, unless the eye is moving either directly towards or from the object. And in all cases the sine of the difference between the real and visible place of the object will be to the sine of the visible inclination of the object to the line in which the eye is moving, as the velocity of the eye is to the velocity of light.

He then shows, that if the earth revolve round the sun annually, and the velocity of light be to the velocity of the earth's motion in its orbit, as 1000 to 1, that a star really placed in the very pole of the ecliptic would, to an eye carried along with the earth, seem to change its place continually; and, neglecting the small difference on the account of the earth's diurnal revolution on its axis, would seem to describe a circle round that pole every way distant from it $3\frac{1}{2}'$; so that its longitude would be varied through all the points of the ecliptic every year, but its latitude would always remain the same. Its right ascension would also change; and its declination, according to the different situation of the sun with respect to the equinoctial points, and its apparent distance from the north pole of the equator, would be 7′ less at the autumnal than at the vernal equinox.

287 Velocity of light.

By calculating exactly the quantity of aberration of the fixed stars from their place, he found that light came from the sun to us in 8′ 13″; so that its velocity is to the velocity of the earth in its orbit as 10.201 to 1.

288 Errors in the observation of small angles.

It must here be taken notice of, however, that Mr Nevil Maskelyne, in attempting to find the parallax of Sirius,

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Sirius, with a ten-feet sector, observed, that by the friction of the plummet-line on the pin which suspended it, an error of 10″, 20″, and sometimes 30″, was committed. The pin was $\frac{1}{40}$ of an inch diameter; and though he reduced it to $\frac{1}{70}$ of an inch, the error still amounted to 3″. All observations, therefore, that have hitherto been made in order to discover the parallax of the fixed stars are to be disregarded.

289 Another objection against the earth's motion answered.

It is also objected, that the sun seems to change his place daily, so as to make a tour round the starry heavens in a year. But whether the sun or earth moves, this appearance will be the same; for when the earth is in any part of the heavens, the sun will appear in the opposite. And, therefore, this appearance can be no objection against the motion of the earth.

It is well known to every person who has sailed on smooth water, or been carried by a stream in a calm, that, however fast the vessel goes he does not feel its progressive motion. The motion of the earth is incomparably more smooth and uniform than that of a ship, or any machine made and moved by human art; and therefore it is not to be imagined that we can feel its motion.

290 Diurnal motion of the earth, and different changes of the seasons illustrated by experiment.

The following experiment will give a plain idea of the diurnal or annual motions of the earth, together with the different length of days and nights, and all the beautiful variety of seasons, depending on those motions.

Fig. 102.

Take about seven feet of strong wire, and bend it into a circular form, as a b *c* d, which being viewed obliquely appears elliptical, as in the figure. Place a lighted candle on a table; and having fixed one end of a silk thread K to the north pole of a small terrestrial globe H, about three inches diameter, cause another person to hold the wire circle, so that it may be parallel to the table, and as high as the flame of the candle I, which should be in or near the centre. Then having twisted the thread as towards the left hand, that by untwisting it may turn the globe round eastward, or contrary to the way that the hands of a watch move, hang the globe by the thread within this circle, almost contiguous to it; and as the thread untwists, the globe (which is enlightened half round by the candle as the earth is by the sun) will turn round its axis, and the different places upon it will be carried through the light and dark hemispheres, and have the appearance of a regular succession of days and nights, as our earth has in reality by such a motion. As the globe turns, move your hand slowly, so as to carry the globe round the candle according to the order of the letters a b *c* d, keeping its centre even with the wire circle; and you will perceive, that the candle, being still perpendicular to the equator, will enlighten the globe from pole to pole in its whole motion round the circle; and that every place on the globe goes equally through the light and the dark, as it turns round by the untwisting of the thread, and therefore has a perpetual equinox. The globe thus turning round, represents the earth turning round its axis: and the motion of the globe round the candle represents the earth's annual motion round the sun; and shows, that if the earth's orbit had no inclination to its axis, all the days and nights of the year would be equally long, and there would be no different seasons. Hence also it appears why the planets Mars and Jupiter have a perpetual equinox, namely, because the axis is perpendicular to the plane of their orbit, as the thread round which the globe turns in this experiment is perpendicular to the plane of the area enclosed by the wire.—But now desire the person who holds the wire to hold it obliquely in the position ABCD, raising the side ♋ just as much as he depresses the side ♑, that the flame may be still in the plane of the circle; and twisting the thread as before, that the globe may turn round its axis the same way as you carry it round the candle, that is, from west to east; let the globe down into the lowermost part of the wire circle at ♑: and, if the circle be properly inclined, the candle will shine perpendicularly on the tropic of Cancer; and the frigid zone, lying within the arctic or north polar circle, will be all in the light, as in the figure; and will keep in the light, let the globe turn round its axis ever so often. From the equator to the north polar circle, all the places have longer days and shorter nights; but from the equator to the south polar circle, just the reverse. The sun does not set to any part of the north frigid zone, as shown by the candle's shining on it, so that the motion of the globe can carry no place of that zone into the dark; and at the same time the south frigid zone is involved in darkness, and the turning of the globe brings none of its places into the light. If the earth were to continue in the like part of its orbit, the sun would never set to the inhabitants of the north frigid zone, nor rise to those of the south. At the equator it would be always equal day and night; and as places are gradually more and more distant from the equator towards the arctic circle, they would have longer days and shorter nights; while those on the south side of the equator would have their nights longer than their days. In this case, there would be continual summer on the north side of the equator, and continual winter on the south side of it.

But as the globe turns round its axis, move your hand slowly forward, so as to carry the globe from H towards E, and the boundary of light and darkness will approach towards the north pole, and recede from the south pole; the northern places will go through less and less of the light, and the southern places through more and more of it; showing how the northern days decrease in length and the southern days increase, whilst the globe proceeds from H to E. When the globe is at E, it is at a mean state between the lowest and highest parts of its orbit; the candle is directly over the equator, the boundary of light and darkness just reaches to both the poles, and all places on the globe go equally through the light and dark hemispheres, showing that the days and nights are then equal at all places of the earth, the poles only excepted; for the sun is then setting to the north pole and rising to the south pole.

Continue moving the globe forward, and as it goes through the quarter A, the north pole recedes still farther into the dark hemisphere, and the south pole advances more into the light, as the globe comes nearer to ♋: and when it comes there at F, the candle is directly over the tropic of Capricorn; the days are at the shortest and nights at the longest, in the northern hemisphere, all the way from the equator to the arctic circle; and the reverse in the southern hemisphere from the equator to the antarctic circle; within which circles

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circles it is dark to the north frigid zone, and light to the south.

Continue both motions; and as the globe moves through the quarter B, the north pole advances towards the light, and the south pole recedes towards the dark; the days lengthen in the northern hemisphere and shorten in the southern; and when the globe comes to G, the candle will be again over the equator (as when the globe was at E), and the days and nights will again be equal as formerly; and the north pole will be just coming into the light, the south pole going out of it.

Thus we see the reason why the days lengthen and shorten from the equator to the polar circles every year; why there is sometimes no day or night for many turnings of the earth, within the polar circles; why there is but one day and one night in the whole year at the poles; and why the days and nights are equally long all the year round at the equator, which is always equally cut by the circle bounding light and darkness.

The inclination of an axis or orbit is merely relative, because we compare it with some other axis or orbit which we consider as not inclined at all. Thus, our horizon being level to us, whatever place of the earth we are upon, we consider it as having no inclination; and yet, if we travel 90 degrees from that place, we shall then have a horizon perpendicular to the former; but it will still be level to us.

291 Different seasons particularly explained.

Let us now take a view of the earth in its annual course round the sun, considering its orbit as having no inclination; and its axis as inclining $23\frac{1}{2}$ degrees from a line perpendicular to the plane of its orbit, and keeping the same oblique direction in all parts of its annual course; or, as commonly termed, keeping always parallel to itself.

Fig. 102.

Let *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, be the earth in eight different parts of its orbit, equidistant from one another; N *s* its axis, N its north pole, *s* its south pole, and S the sun nearly in the centre of the earth's orbit. As the earth goes round the sun according to the order of the letters *a b c d*, &c. its axis N *s* keeps the same obliquity, and is still parallel to the line MN *s*. When the earth is at *a*, its north pole inclines towards the sun S, and brings all the northern places more into the light, than at any other time of the year. But when the earth is at *e* in the opposite time of the year, the north pole declines from the sun, which occasions the northern places to be more in the dark than in the light, and the reverse at the southern places; as is evident by the figure which is taken from Dr Long's astronomy. When the earth is either at *c* or *g*, its axis inclines not either to or from the sun, but lies sidewise to him, and then the poles are in the boundary of light and darkness; and the sun, being directly over the equator, makes equal day and night at all places. When the earth is at *b*, it is half-way between the summer solstice and harvest equinox; when it is at *d* it is half-way from the harvest equinox to the winter solstice; at *f*, half-way from the winter solstice to the spring equinox; and at *h*, half-way from the spring equinox to the summer solstice.

From this oblique view of the earth's orbit, let us suppose ourselves to be raised far above it, and placed just over its centre S, looking down upon it from its north pole; and as the earth's orbit differs but very little from a circle, we shall have its figure in such a view represented by the circle ABCDEFG. Let us suppose this circle to be divided into 12 equal parts, called *signs*, having their names affixed to them; and each sign into 30 equal parts, called *degrees*, numbered 10, 20, 30, as in the outermost circle of the figure, which represents the great ecliptic in the heavens. The earth is shown in eight different positions in this circle; and in each position Æ is the equator, T the tropic of Cancer, the dotted circle the parallel of London, U the artic or north polar circle, and P the north pole, where all the meridians or hour-circles meet. As the earth goes round the sun, the north pole keeps constantly towards one part of the heavens, as it keeps in the figure towards the right-hand side of the place.

Fig. 103.

When the earth is at the beginning of Libra, namely on the 20th of March, in this figure the sun S as seen from the earth, appears at the beginning of Aries in the opposite part of the heavens, the north pole is just coming into the light, and the sun is vertical to the equator; which, together with the tropic of Cancer, parallel of London, and arctic circle, are all equally cut by the circle bounding light and darkness, coinciding with the six-o'clock hour-circle, and therefore the days and nights are equally long at all places: for every part of the meridian ÆTL *a* comes into the light at six in the morning, and, revolving with the earth according to the order of the hour-letters, goes into the dark at six in the evening. There are 24 meridians or hour-circles drawn on the earth in this figure, to show the time of sun-rising and setting at different seasons of the year.

As the earth moves in the ecliptic according to the order of the letters ABCD, &c. through the signs Libra, Scorpio, and Sagittarius, the north pole P comes more and more into the light; the days increase as the nights decrease in length, at all places north of the equator Æ; which is plain by viewing the earth at *b* on the 5th of May, when it is in the 15th degree of Scorpio, and the sun as seen from the earth appears in the 15th degree of Taurus. For then the tropic of Cancer T is in the light from a little after five in the morning till almost seven in the evening; the parallel of London, from half an hour past four till half an hour past seven; the polar circle U, from three till nine; and a large tract round the north pole P has day all the 24 hours, for many rotations of the earth on its axis.

When the earth comes to *c* (fig. 104.) at the beginning of Capricorn, and the sun as seen from the earth appears at the beginning of Cancer, on the 21st of June, as in this figure, it is in the position C in fig. 103.; and its north pole inclines towards the sun, so as to bring all the north frigid zone into the light, and the northern parallels of latitude more into the light than the dark from the equator to the polar circle: and the more so as they are farther from the equator. The tropic of Cancer is in the light from five in the morning till seven at night, the parallel of London from a quarter before four till a quarter after eight; and the polar circle just touches the dark, so that the sun has only the lower half of his disk hid from the inhabitants on that circle for a few minutes about midnight,

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night, supposing no inequalities in the horizon, and no refractions.

A bare view of the figure is enough to show, that as the earth advances from Capricorn towards Aries, and the sun appears to move from Cancer towards Libra, the north pole recedes from the light, which causes the days to decrease and the nights to increase in length, till the earth comes to the beginning of Aries, and then they are equal as before; for the boundary of light and darkness cuts the equator and all its parallels equally or in halves. The north pole then goes into the dark, and continues therein until the earth goes half-way round its orbit; or, from the 23d of September till the 20th of March. In the middle between these times, viz. on the 22d of December, the north pole is as far as it can be in the dark, which is $23\frac{1}{2}$ degrees, equal to the inclination of the earth's axis from a perpendicular to its orbit: and then the northern parallels are as much in the dark as they were in the light on the 21st of June; the winter nights being as long as the summer days, and the winter days as short as the summer nights. Here it must be noted, that of all that has been said of the northern hemisphere, the contrary must be understood of the southern: for on different sides of the equator the seasons are contrary, because, when the northern hemisphere inclines towards the sun, the southern declines from him.

292 Effects of the earth's motion on the appearances of the planets.

Taking it for granted, then, that the earth revolves round the sun, let us see what effect that motion has upon the apparent motions of the other planets. For the better comprehending of these motions, however, we have hitherto supposed the earth to stand still in some part of its orbit, while they go round the sun in theirs: but as this is not the case, it now remains to consider the changes which take place in consequence of the earth's motion. Were the earth to stand still in any part of its orbit, as at A, the places of conjunction both in the superior and inferior semicircle, as also of the greatest elongation, and consequently the places of direct and retrograde motion, and of the stations of an inferior planet, would always be in the same part of the heavens. Thus, in fig. 105. upon this supposition, the places of Mercury's stations would always be the points P and R, the arc of his motion PR, and of his retrograde motion RP; whereas, on account of the earth's motion, the places where these appearances happen are continually advancing forward in the ecliptic according to the order of the signs. In fig. 106. let ABCD be the orbit of the earth; *efgh* that of Mercury; ☉ the sun; GKI an arch of the ecliptic extended to the fixed stars. When the earth is at A, the sun's geocentric place is at F: and Mercury, in order to a conjunction, must be in the line AF; that is, in his orbit he must be at *f* or *h*. Suppose him to be at *f* in his inferior semicircle: if the earth stood still at A, his next conjunction would be when he is in his superior semicircle at *h*; the places of his greatest elongation also would be at *e* and *g*, and in the ecliptic at E and G: but supposing the earth to go on in its orbit from A to B; the sun's geocentric place is now at K; and Mercury, in order to be in conjunction, ought to be in the line BK at *m*. As by the motion of the earth, the places of Mercury's conjunctions with the sun are thus continually carried round in the ecliptic in consequence, so the places of his utmost elongations must be carried in consequence also. Thus, when the earth is at A, the places of his longest elongation from the sun are in the ecliptic E and G; the motion of the earth from A to B advances them forward from G to L and from E to I. But the geocentric motion of Mercury will best be seen in fig. 107. Here we have part of the extended ecliptic marked ♈, ♉, ♊, &c. in the centre of which S represents the sun, and round him are the orbits of Mercury and the earth. The orbit of Mercury is divided into 11 equal parts, such as he goes through once in eight days; and the divisions are marked by numeral figures 1, 2, 3, &c. Part of the orbit of the earth is likewise divided into 22 equal arcs, each arc being as much as the earth goes through in eight days. The points of division are marked with the letters *a*, *b*, *c*, *d*, *e*, *f*, &c. and show as many several stations from whence Mercury may be viewed from the earth. Suppose then the planet to be at 1 and the earth at *a*; draw a line from *a* to 1, and it shows Mercury's geocentric place at A. In eight days he will be got to 2, and the earth to *b*; draw a line from 2 to *b*, and it shows his geocentric place at B. In other eight days he will have proceeded to 3, and the earth to *c*; a line drawn from 3 to *c* will show his geocentric place at C. In this manner, going through the figure, and drawing lines from the earth at *d*, *e*, *f*, *g*, &c. through 4, 5, 6, 7, &c. we shall find his geocentric places successively at the points D, E, F, G, &c. where we may observe, that from A to B, and from B to C, the motion is direct; from C to D, and from D to E, retrograde. In this figure 22 stations are marked in the earth's orbit, from whence the planet may be viewed; corresponding to which there ought to be as many in the orbit of Mercury: and for this purpose the place of that planet is marked at the end of every eight days for two of his periodical revolutions; and to denote this, two numeral figures are placed at each division.

The geocentric motion of Venus may be explained in a similar manner; only as the motion of Venus is much slower than that of Mercury, his conjunctions, oppositions, elongations, and stations, all return much more frequently than those of Venus.

To explain the stationary appearances of the planets, it must be remembered, that the diameter of the earth's orbit, and even of that of Saturn, are but mere points in comparison of the distance of the fixed stars; and therefore, any two lines, absolutely parallel, though drawn at the distance of the diameter of Saturn's orbit from each other, would, if continued to the fixed stars, appear to us to terminate in the same point. Let, then, the two circles, fig. 108. represent the orbits of Venus and of the Earth; let the lines AE, BF, CG, DH, be parallel to SP, we may nevertheless affirm, that if continued to the distance of the fixed stars, they would all terminate in the same point with the line SP. Suppose, then, Venus at E while the earth is at A, the visual ray by which she is seen is the line AE. Suppose again, that while Venus goes from E to F, the Earth goes from A to B, the visual ray by which Venus is now seen is BF parallel to AE; and therefore Venus will be all that time stationary appearing in that point of the heaven where SP extended would terminate: this station is at her changing from direct to retrograde. Again, suppose, when the Earth is at C,

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C, Venus is at G, and the visual line CG; if, while the earth goes from C to D, Venus goes from G to H, so that she is seen in the line GH parallel to CG, she will be all that time stationary, appearing in the point where a line drawn from S through P would terminate. This station is at her changing from retrograde to direct; and both are in her inferior semicircle.

293 Perigee and apogee of the planets explained.

An inferior planet, when in conjunction with the sun in its inferior semicircle, is said to be in *perigee*, and in the other in *apogee*, on account of its different distances from the earth. Their real distances from the earth when in perigee are variable, partly owing to the eccentricities of their orbits, as well as that of the earth; and partly owing to the motions of the different bodies, by which it happens that they are in perigee in different parts of their orbits. The least possible distance is when the perigee happens when the earth is in its perihelion, and the planet in its aphelion.

294 Differences in the apparent diameters of the planets.

The difference of distance between the earth and inferior planets at different times, makes a considerable variation in their apparent diameters, which indeed is very observable in all the planets; and thus they sometimes look very considerably larger than at others. This difference in magnitude in Mercury is nearly as $5\frac{1}{2}$ to 1; and in Venus, no less than 32 to 1. A common spectator, unassisted by any instrument, may observe an inferior planet alternately approach nearer and nearer the sun, until at last it comes into conjunction with him, and then to recede farther and farther till it is at its greatest elongation, which will be first on one side and then on the other: but if we observe the apparent change of place of an inferior planet in the sphere of the heavens, its direct motions, stations, and retrogradations, measuring its diameter frequently with the micrometer, we shall find by its decrease at some times and increase at others, that its distance from us is very considerably varied; so that, taking the whole of its course into consideration, it appears to move in a very complicated curve. See fig. 109.

295 Appearances of the superior planets explained.

As the superior planets move in a larger orbit than the earth, they can only be in conjunction with the sun when they are on that side opposite to the earth; as, on the other hand, they are in opposition to him when the earth is between the sun and them. They are in quadrature with them when their geocentric places are 90° distant from that of the sun. In order to understand their apparent motions, we shall suppose them to stand still in some part of their orbit while the earth makes a complete revolution in hers; in which case, any superior planet would then have the following appearances: 1. While the earth is in her most distant semicircle, the motion of the planet will be direct. 2. While the earth is in her nearest semicircle, the planet will be retrograde. 3. While the earth is near those places of its orbit where a line drawn from the planet would be a tangent, it would appear to be stationary. Thus, in fig. 147. let *a b c d* represent the orbit of the earth; S the Sun; EFG an arc of the orbit of Jupiter; ABC an arc of the ecliptic projected on the sphere of the fixed stars. Suppose Jupiter to continue at F, while the earth goes round in her orbit according to the order of the letters *a b c d*. While the earth is in the semicircle most distant from Jupiter, going from *a* to *b* and from *b* to *c*, his motion in the heaven would appear direct, or from A to B and from B to C: but while the earth is in its nearest semicircle *c d e*, the motion of Jupiter would appear retrograde from C to B and from B to A; for *a*, *b*, *c*, *d*, may be considered as so many different stations from whence an inhabitant of the earth would view Jupiter at different seasons of the year, and a straight line drawn from each of these stations, through F the place of Jupiter, and continued to the ecliptic, would show his apparent place there to be successively at A, B, C, B, A. While the earth is near the points of contact *a* and *c*, Jupiter would appear stationary, because the visual ray drawn through both planets does not sensibly differ from the tangent F *a* or F *c*. When the earth is at *b*, a line drawn from *b* through S and F to the ecliptic, shows Jupiter to be in conjunction with the sun at B. When the earth is at *d*, a line drawn from *d* through S, continued to the ecliptic, would terminate in a point opposite to B; which shows Jupiter then to be in opposition to the sun: and thus it appears that his motion is direct in the conjunction, but retrograde when in opposition with the sun.

The direct motion of a superior planet is swifter the nearer it is to a conjunction, and slower as it approaches to a quadrature with the sun. Thus, in fig. 111. let ☉ be the sun; the little circle round it, the orbit of the earth, whereof *a b c d e f g* is the most distant semicircle; OPQ, an arc of the orbit of Jupiter; and ABCDEFG, an arc of the ecliptic in the sphere of the fixed stars. If we suppose Jupiter to stand still at P, by the earth's motion from *a* to *g*, he would appear to move direct from A to G, describing the unequal arcs AB, BC, CD, DE, EF, FG, in equal times. When the earth is at *d*, Jupiter is in conjunction with the sun at D, and there his direct motion is swiftest. When the earth is in that part of her orbit where a line drawn from Jupiter would touch it, as in the points *e* or *g*, Jupiter is nearly in quadrature with the sun; and the nearer the earth is to any of those points, the slower is the geocentric motion of Jupiter; for the arcs CD and DE are greater than BC or EF, and the arcs BC and EF are greater than AB or FG.

The retrograde motion of a superior planet is swifter the nearer it is to an opposition, and slower as it approaches to a quadrature with the sun. Thus, let ☉, fig. 112. be the sun; the little circle round it the orbit of the earth, whereof *g h i k l m n* is the nearest semicircle; OPQ, an arc of the orbit of Jupiter; NKG an arc of the ecliptic: If we suppose Jupiter to stand still at P, by the earth's motion from *g* to *n*, he would appear to move retrograde from G to N, describing the unequal arcs GH, HI, IK, KL, LM, MN, in equal times. When the earth is at *k*, Jupiter appears at K, in opposition to the sun, and there his retrograde motion is swiftest. When the earth is either at *g* or *n*, the points of contact of the tangents P *g* and P *n*, Jupiter is nearly in quadrature with the sun: and the nearer he is to either of these points, the slower is his retrogradation; for the arcs IK and KL are greater than HI or LM; and the arcs HI and LM are greater than GH or MN. Since the direct motion is swiftest

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swiftest when the earth is at *d*, and continues diminishing till it changes to retrograde, it must be insensible near the time of change: and, in like manner, the retrograde motion being swiftest when the earth is in *k*, and diminishing gradually till it changes to direct, must also at the time of that change be insensible; for any motion gradually decreasing till it changes into a contrary one gradually increasing, must at the time of the change be altogether insensible.

The same changes in the apparent motions of this planet will also take place if we suppose him to go on slowly in his orbit; only they will happen every year when the earth is in different parts of her orbit, and consequently at different times of the year. Thus, (fig. 110.) let us suppose, that while the earth goes round her orbit, Jupiter goes from F to G; the points of the earth's orbit from which Jupiter will now appear to be stationary will be *a* and *y*; and consequently his stations must be at a time of the year different from the former. Moreover, the conjunction of Jupiter with the sun will now be when the earth is at *f*, and his opposition when it is at *e*; for which reason these also will happen at times of the year different from those of the preceding opposition and conjunction. The motion of Saturn is so slow, that it makes but little alteration either in the times or places of his conjunction or opposition; and no doubt the same will take place in a more eminent degree in the Georgium Sidus; but the motion of Mars is so much swifter than even that of Jupiter, that both the times and places of his conjunctions and oppositions are thereby very much altered.

Fig. 113. exemplifies the geocentric motion of Jupiter in a very intelligible manner; where ☉ represents the sun; the circle 1, 2, 3, 4, the orbit of the earth, divided into twelve equal arcs for the twelve months of the year; PQ an arc of the orbit of Jupiter, containing as much as he goes through in a year, and divided in like manner into twelve equal parts, each as much as he goes through in a month. Now, suppose the earth to be at 1 when Jupiter is at *a*, a line drawn through 1 and *a* shows Jupiter's place in the celestial ecliptic to be at A. In a month's time the earth will have moved from 1 to 2, Jupiter from *a* to *b*; and a line drawn from 2 to *b* will show his geocentric place to be in B. In another month, the earth will be in 3, and Jupiter at *c*, and consequently his geocentric place will be at C; and in like manner his place may be found for the other months at D, E, F, &c. It is likewise easy to observe, that his geocentric motion is direct in the arcs AB, BC, CD, DE; retrograde in EF, FG, GH, HI; and direct again in IK, KL, LM, MN. The inequality of his geocentric motion is likewise apparent from the figure.

A superior planet is in apogee when in conjunction with the sun, and in perigee when in opposition; and every one of the superior planets is at its least possible distance from the earth where it is in perigee and perihelion at the same time. Their apparent diameters are variable, according to their distances, like those of the inferior planets; and this, as might naturally be expected, is most remarkable in the planet Mars, who is nearest us. In his nearest approach, this planet is 25 times larger than when farthest off, Jupiter twice and a half, and Saturn once and a half.

Chap. III. *Of the Orbits of the Planets, and the Laws of their Motions.*

It would be exceedingly easy to ascertain the position of the planets for any given time, if their orbits were circular and uniform. But they exhibit very sensible inequalities in this respect, the laws of which are exceedingly important in astronomy, as furnishing the only clue which can lead us to the theory of the celestial motions. To ascertain these irregularities, and detect their laws, it is necessary to abstract from their apparent motions the effects produced by the motion of the earth. In the first place then, we must determine the nature and dimensions of the earth's orbit.

We have seen formerly that the sun apparently moves round the earth in an ellipse, having the earth in the focus. We have only to reverse the position to obtain the orbit of the earth. It moves round the sun in an ellipse, having that luminary in the focus; so that its radius vector describes areas proportional to the times. In general, all the remarks made formerly on the supposed orbit of the sun relative to its eccentricity, &c. apply accurately to the real orbit of the earth.

The figure of the earth's orbit being thus ascertained, let us see how astronomers have been able to determine that of the other planets. Let us take the planet Mars as an example, which, from the great eccentricity of its orbit, and its nearness to the earth, furnishes an excellent medium for discovering the laws of the planetary motions.

The motion of Mars round the sun and his orbit would be known, if we had at any given time, the angle formed by its radius vector, and a fixed straight line passing through the centre of the sun, together with the length of that radius vector. To simplify the problem, a time is chosen when one of these quantities may be had separately from the other. This happens at the oppositions, when we see the planet in the same point of the ecliptic to which it would be referred by a spectator in the sun. The difference in the velocity and periodic times of the earth and Mars causes the planet to appear when in opposition in different points of the ecliptic successively. By comparing together a great number of such oppositions, the relation which subsists between the time and the angular motion of Mars round the sun, (called *heliocentric*), may be discovered. Different methods present themselves for that purpose. But in the present case the problem is simplified by considering that the principal inequalities of Mars returning in the same manner at every sidereal revolution, the whole of them may be expressed by a rapidly converging series of the sines of the angles multiplied by its mean motion. The relative changes in the length of the radius vector, may be determined by comparing together observations made about the quadrature when the planet being about 90° from the sun, that radius presents itself under the greatest angle possible. In the triangle formed by the straight lines which join the centres of the earth, the sun, and Mars, the angle at the earth is obtained by observation, that at the sun is ascertained by the law of Mars's heliocentric motion. Hence the radius vector is deduced in parts of the earth's radius vector. By comparing together a number

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ber of such radii vectores determined in this manner, the law of their variations, corresponding to the angles which they make with a straight line fixed in position, may be determined. In this manner Kepler determined the orbit of Mars, and found it to be an ellipse with the sun in the focus. He inferred that the other planets moved likewise in ellipses round the sun, and this inference has been confirmed by actual examination.

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Heliocentric circles of the planets.

To a spectator placed in the sun, all the planets would appear to describe circles annually in the heavens; for though their motions are really elliptical, the eccentricity is so small, that the difference between them and true circles is not easily perceived even on earth; and at the sun, whether great or small, it would entirely vanish. These circles, which in such a situation would appear to be annually described among the fixed stars, are called the *heliocentric circles* of the planets; and if we suppose the orbits of the planets to be extended to the extreme bounds of the creation, they would describe among the fixed stars those circles just mentioned. To a spectator in the sun, the comets, though moving in the most eccentric orbits, would also appear to describe circles in the heavens: for though their orbits are in reality very long ellipses, the planes of them extended to the heavens would mark a great circle thereon, whereof the eye would be the centre; only, as the real motion is in an ellipsis, the body would appear to move much more slowly in some part of the circle than another, and to differ excessively in magnitude. To an inhabitant of any planet, however, the sun appears to go round in its own heliocentric circle, or to describe in the heavens that same curve which the planet would appear to do if seen from the sun. Thus (fig. 114.), when the earth is at *a*, if we draw a line from *a* through the sun at S, the point G, in the sphere of the heavens where the line terminates, is the place where the sun then appears to an inhabitant of the earth. In a month's time the earth will be got from *a* to *b*; draw a line then through the sun, and its extremity at H will point out his apparent place at that time. In like manner, if we draw lines from the earth in the twelve several situations in which it is represented for the twelve months of the year, the sun's apparent place will be found as above, and so it would be found by a spectator placed in Venus or any other planet.

The geocentric latitude of a superior planet may be understood from fig. 115. Let AB be the orbit of the earth, CD that of Mars, both viewed with the eye in their common section continued, by which they appear in straight lines. Let E and F be opposite points of the ecliptic, and suppose Mars to be in the south limit at C. If he were at that time viewed from S, the centre of the sun, he would appear in the sphere of the heavens at the point H; in which case his heliocentric latitude would be FH: But when viewed in C from the earth, or from its centre, which in this case is supposed to be the station of the spectator, he will appear to be in different places of the heavens according to the position of the earth. When the earth, for instance, is at B, the place of Mars will appear to be at *g*, and his geocentric latitude will be F *g*. When the earth is at A, his apparent place will be in G, and his geocentric latitude FG: and in like manner, supposing the earth to be in any other part of its orbit, as in I or K, it is easy to see, that his apparent places, as well as geocentric latitudes at those times, will be different.

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Nodes of a planet.

The two points where the heliocentric circle of any planet cuts the ecliptic, are called its *nodes;* and that which the planet passes through as it goes into north latitude, is called the *ascending* node, and is marked thus ☊; and the opposite to this is called the *descending* node, and is marked ☋. A line drawn from one node to the other is called the *line of the nodes of the planet*, which is the common section of the plane of the ecliptic, and that of the planet produced on each side to the fixed stars. The deviation of the orbit from a circle is called the *eccentricity* of the orbit; the point where it is farthest distant from the sun is called its *aphelion;* and where nearest, the *perihelion*.

The motion of the planets is swiftest at the perihelion when the radius vector is shortest: it diminishes as the radius vector increases, and is at its minimum at the aphelion. When Kepler compared these two quantities in the planet Mars, he observed that the velocity of the planet was always proportional to the square of the radius vector, so that the product of that velocity multiplied into the square of the radius vector is a constant quantity. This product is double the area described by the radius vector in the given time. Hence that area, supposing the radius vector to set out from a fixed line, increases as the time. This Kepler announced by saying, that the areas described by the radius vector are proportional to the times. These laws are precisely those followed by the earth in her motion round the sun. Hence Kepler established as the fundamental laws of the motions of the planets the two following:

1. The orbits of the planets are ellipses, having the sun in their focus.

2. The areas described by the radius vector of each planet are proportional to the times of describing them.

These laws suffice for determining the motions of the planets round the sun: But it is necessary to know for each of the planets seven quantities, called the elements of their elliptical motion. Five of these elements relative to the motion of the ellipse are, 1. The duration of the sidereal revolution. 2. Half the greater axis or the mean distance of the planet from the sun. 3. The eccentricity of the orbit. 4. The mean longitude of the planet at a given time. 5. The longitude of its perihelion at the same epoch. The other two elements relate to the position of the orbits. They are, 6. The longitude of the nodes of the orbit at a given epoch, or the points where the orbit intersects the ecliptic. 7. The inclination of the orbit to the plane of the ecliptic. The following table exhibits a view of these elements.

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	Sidereal revolutions.	Mean distances.	Eccentricity in 1750.	Secular variation in the eccentricity.	Mean longitude in 1750.	Longitudes of the perihelion in 1750.	Sidereal and secular motion of the perihelion.	Inclination of the orbits to the ecliptic in 1750.	Secular variation in the inclination to the ecliptic.	Longitudes of the ascending nodes in 1750.	Sidereal and secular motion of the nodes.
	Days.				°	°	"	°	"	°	"
Mercury	87.969255	0.387100	0.205513	0.000003369	281.3194	81.7401	1735.50	7.7778	55.09	50.3836	—2332.90
Venus	224.700817	0.723332	0.006885	0.000062905	51.4963	141.9759	—699.07	3.7701	13.80	82.7093	—5673.60
Earth	365.256384	1.000000	0.016814	0.000045572	311.1218	309.5790	3671.63	0.0000	0.00	0.0000	0.00
Mars	686.979579	1.523693	0.093088	0.000090685	24.4219	368.3006	4834.57	2.0556	—4.45	52.9377	—7027.41
Jupiter	4332.602208	5.202792	0.048077	0.000134245	4.1201	11.5012	2030.25	1.4636	—67.40	108.8062	—4509.50
Saturn	10759.077213	9.540724	0.056223	0.000261553	257.0438	97.9466	4967.64	2.7762	—47.87	123.9327	—5781.54
Herschel	30689.000000	19.183620	0.046683	0.000026228	353.9610	185.1262	759.85	0.8599	9.38	80.7015	—10608.00

The sign — denotes a retrograde motion.

In this table, drawn up by M. de La Place, the decimal notation is employed; the circle being divided into 400°, the degree into 100′, the minute into 100″, and so on: we did not alter it, in order to give the reader a specimen of this notation, and because the usual notation is employed in the following table.

We think it proper to subjoin here Dr Maskelyne's view of the planetary system for 1801, Dec. 1.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
	Apparent mean diameters, as seen from the earth.	Mean diameters as seen from the sun.	Mean diameters in English miles.	Mean distances from the sun in round numbers of miles.	More accurate proportional numbers of the preceding mean distances.	Densities to that of water, which is 1.	Proportions of the quantities of matter.	Inclinations of orbits to the ecliptic in 1780.	Inclinations of axes to orbits.	Rotations diurnal or round their own axes.
The Sun	32′ 1″,5		883246			$1\frac{2}{15}$	333928		82° 44′ 0″	25ᵈ 14ʰ 8ᵐ 0ˢ
Mercury	10	16″	3224	37000000	38710	$9\frac{1}{6}$	0,1654	7° 0′ 0″		
Venus	58	30	7687	68000000	72333	$5\frac{11}{13}$	0,8899	3 23 35		0 23 21
The Earth		17,2	7911,73	95000000	100000	$4\frac{1}{2}$	1	0 0 0	66 32	1
The Moon	31 8	4,6	2180	95000000	100000	$5\frac{1}{2}$	0,025	5 9 3 at a mean.	88 17	29 17 44 3
Mars	27	10	4189	144000000	152369	$3\frac{2}{7}$	0,0875	1 51 0	59 22	0 24 39 22
Ceres	1		160	260000000	273550			10 37 56,6 in 1801.		
Pallas	0,5		80	266000000	279100			34 50 40 in 1801.		
Jupiter	39	37	89170	490000000	520279	$1\frac{1}{24}$	312,1	1 18 56 in 1780.	90 nearly.	0 9 55 37
Saturn	18	16	79042	900000000	954072	$0\frac{11}{24}$	97,76	2 29 50 in 1780.	60 probably.	0 10 16 2
Herschel	3 54	4	35112	1800000000	1908352	$0\frac{22}{100}$	16,84	0 46 20 in 1780.		

XI.

	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.
	Tropical revolutions.	Sidereal revolutions.	Places of Aphelia, January 1800.	Secular motions of the Aphelia.	Eccentricities; the mean distances being 100000.	Greatest equations of the centres.	Longitudes of ☊; or places of ascending nodes in 1750.	Secular motions of nodes.
The Sun								
Mercury	$87^d\ 23^h\ 14^m\ 32{,}7^s$	$87^d\ 23^h\ 15^m\ 43{,}6^s$	$8^s\ 4^\circ\ 20'\ 50''$	$1^\circ\ 33'\ 45''$	7955.4	$23^\circ\ 40'\ 0''$	$1^s\ 15^\circ\ 20'\ 43''$	$1^\circ\ 12'\ 10''$
Venus	224 16 41 27,5	224 46 49 10,6	10 7 59 1	1 21 0	498	0 47 20	2 14 26 18	0 51 40
The Earth	365 5 48 49	365 6 9 12	9 8 40 12	0 19 35	1681,395	1 55 30,9		
The Moon								
Mars	686 22 18 27,4	686 23 30 35,6	5 2 24 15	1 51 40	14183,7	10 40 40	1 17 38 38	0 46 40
Ceres	1681 12 9 0		10 25 57 14 in 1802.		8140,64	9 20 8	2 20 58 40 in 1802.	
Pallas		1703 16 48 0			24630		5 22 28 57 in 1802.	
Jupiter	4330 14 39 2	4332 14 27 10,8	6 11 8 20 in 1800.	1 34 33	25013,3	5 30 38	3 7 55 32 in 1750.	0 59 30
Saturn	10746 19 16 15,5	10759 1 51 11,2	8 29 4 11 in 1800.	1 50 7	53640,42	6 26 42	3 21 32 22 in 1750.	0 55 30
Herschel	30637 4 0 0	30737 18 0 0	11 16 30 31 in 1800.	1 29 2	90804	5 27 16	2 12 47 in 1788	1 44 35

From the above tables it appears that this time of the revolution of the planets increases with their distance from the sun. This induced Kepler to suspect that some relation existed between them. After many attempts continued for 17 years, he at last discovered that the squares of the periodic times of the planets are proportional to the cubes of the greater axis of their orbits.

Chap. IV. *Of the Orbits of the Comets.*

Of all the celestial bodies, comets have given rise to the greatest number of speculations and conjectures. Their strange appearance has in all ages been a matter of terror to the vulgar, who uniformly have looked upon them to be evil omens and forerunners of war, pestilence, &c. Others, less superstitious, supposed them to be meteors raised in the higher regions of the air. But we find that some part of the modern doctrine concerning them had been received into the ancient Italic

298 Supposed by the ancients to be planets.

and Pythagorean schools: for they held them to be so far of the nature of planets, that they had their periodical times of appearing; that they were out of sight for a long time, while they were carried aloft at an immense distance from the earth, but became visible when they descended into the lower regions of the air, when they were nearer to us.

These opinions were probably brought from Egypt, from whence the Greeks borrowed great part of their

299 Aristotle's opinion concerning them.

learning. However, it seems not to have been generally received; for Aristotle, who mentions it, asserted that the heavens were unchangeable, and not liable to generation or corruption. Comets, therefore, which he believed to be generated when they first made their appearance, and destroyed when they vanished from our sight, he maintained could not be heavenly bodies, but rather meteors or exhalations raised into the upper regions of the atmosphere, where they blazed out for a while, and disappeared when the matter of which they were formed was consumed. Seneca, who lived in the first century, mentions Apollonius of Myndus, a very careful observer of natural causes, to have been of the same sentiments with the most ancient Greek philosophers with regard to comets. He himself had seen two; one in the reign of Claudius, the other in that of Nero; besides another which he saw while a boy, before the death of Augustus. He plainly intimates, that he thought them above the moon; and argues strongly against those who supposed them to be meteors, or held other absurd opinions concerning them: declaring his belief that they were not fires suddenly kindled, but the eternal productions of nature. He points out also the only way to come at a certainty on this subject, viz. by collecting a number of observations concerning their appearance, in order to discover whether they return periodically or not. "For this purpose (says he) one age is not sufficient; but the time will come when the nature of comets and their magnitudes will be demonstrated, and the routes they take, so different from the planets, explained. Posterity will then wonder that the preceding ages should be ignorant of matters so plain and easy to be known."

For a long time this prediction of Seneca seemed very unlikely to be fulfilled. The great authority which Aristotle maintained for many ages, determined them to be nothing but meteors casually lighted up in the air; though they were manifestly at a great height, not only above the clouds, but subject to the diurnal revolution of the earth. In the dark and superstitious ages, they were held to be the forerunners of every kind of calamity, and were supposed to have different degrees of malignity according to the shape they assumed; from whence also they were differently denominated. Thus, some were said to be bearded, some hairy; some to represent a beam, sword or spear; others

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others a target, &c.; whereas modern astronomers acknowledge only one species of comets, and account for their different appearances from their different situations from the sun and earth.

300 Only one species of them exists.

It was not till some time after people began to throw off the fetters of superstition and ignorance which had so long held them, that any rational hypothesis was formed concerning comets. Kepler, in other respects a very great genius, indulged the most extravagant conjectures, not only concerning comets, but the whole system of nature in general. The planets he imagined to be huge animals who swam round the sun by means of certain fins acting upon the ethereal fluid, as those of fishes do on the water: and agreeably to this notion, he imagined the comets to be monstrous and uncommon animals generated in the celestial spaces; and he explained how the air engendered them by an animal faculty. A yet more ridiculous opinion, if possible, was that of John Bodin, a learned man of France in the 17th century. He maintained that comets "are spirits, which have lived on the earth innumerable ages, and being at last arrived on the confines of death, celebrate their last triumph, or are recalled to the firmament like shining stars! This is followed by famine, plague, &c. because the cities and people destroy the governors and chiefs who appease the wrath of God." This opinion (he says) he borrowed from the philosopher Democritus, who imagined them to be the souls of famous heroes: but that being irreconcileable with Bodin's Christian sentiments, he was obliged to suppose them to be a kind of genii, or spirits subject to death, like those so much mentioned in the Mahometan fables. Others, again, have denied even the existence of comets, and maintained that they were only false appearances occasioned by the refraction or reflection of light.

301 Kepler and Bodin's opinion of them.

302 Bernoulli's opinion.

The first rational conjecture we meet with is that of James Bernoulli, an Italian astronomer, who imagined them to be the satellites of some very distant planet, which was invisible to us on account of its distance, as were also the satellites, unless when in a certain part of their course.

303 True doctrine concerning them revived by Tycho Brahe.

Tycho Brahe was the first who restored the comets to their true rank in the creation. Before his time, several comets had been observed with tolerable exactness by Regiomontanus, Appian, Fabricius, and others; yet they all thought them below the moon. But Tycho, being provided with much better instruments, set himself with great diligence to observe the famous comet of 1577; and, from many careful observations, deduced that it had no sensible diurnal parallax; and therefore was not only far above the regions of our atmosphere, but much higher than the moon. But though few have come so near the earth as to have any diurnal parallax, all of them have what may be called an annual parallax; that is, the revolution of the earth in her orbit causes their apparent motion to be very different from what it would be if viewed from the sun; and this shows them to be much nearer than the fixed stars, which have no such parallax. Kepler, the disciple of Tycho, notwithstanding his ridiculous conjecture already mentioned, was very attentive to the motions of the comets, and found that they did not move in straight lines, as had been supposed. He showed that their paths were concave towards the sun, and supposed them to move in parabolic trajectories.

304 Their motion exactly determined by Sir Isaac Newton.

Their true motion, however, was only discovered from the observations made by Sir Isaac Newton on the great comet of 1680. This descended almost perpendicularly towards the sun with a prodigious velocity; ascending again with the same velocity retarded, as it had been before accelerated. It was seen in the morning by a great number of astronomers in different parts of Europe, from the 4th to the 25th of November, in its way toward the sun; and in the evening from the 12th of December to the 9th of March following. The many exact observations made on this comet enabled Sir Isaac Newton to determine that they are a kind of planets which move in very eccentric ellipses; and this opinion is now looked upon to be certainly established. It was opposed, however, by M. de la Hire, and some other French philosophers; and it is evident that the whole dispute now turned on mere practical observations. If the return of any comet could be predicted, and its periodical time calculated like that of a planet, then the doctrine might be concluded certainly true, but not otherwise. Dr Halley therefore set himself to collect all the observations he could on comets; and afterwards calculated the periodical times of 24 of them, on a supposition of their being paraboles; but afterwards found that they agreed better with the supposition of their motion being performed in very eccentric elliptical orbits. On this he calculated a table of their elements; from which it was manifest that they were not comprehended in the zodiac, some of them making an angle of upwards of 80° with the ecliptic.

305 Dr Halley predicts a comet's return.

306 Periodical times of different comets determined.

By computations founded on these elements, the Doctor concluded that the comet of 1682 was the same which had appeared in 1607 and 1531; that it had a period of 75 or 76 years; and he ventured to foretel that it would return about the year 1758. The comet which appeared in 1661 was supposed to be the same with that of 1532, and to have a period of 129 years; and from the equality of periods, and similitude of appearances, it was concluded that the great comet of 1680 was the same which had appeared in 1106 in the time of Henry I. in the consulate of Lampadius and Orestes about the year 531, and in the year 44 B. C. before Julius Cæsar was murdered; and hence concluded that its period was 575 years. Mr Dunthorne, however, has endeavoured to show from a MS. in Pembroke-hall library, that the comet of 1106 could not be the same with that of 1680: but M. de la Lande thinks the four appearances related by Dr Halley stronger proofs than a single observation, which might be very faulty.

Since the time of Dr Halley other astronomers have calculated the elements of 25 other comets; all of which, excepting one of three which appeared in 1759, and which differs but little from that of 1531, 1607, and 1682, and is therefore accounted the same, differ very much from each other; so that we cannot help concluding them all to be different, and that the number of these bodies is very great. "It is not, however, unlikely (says Dr Long), from the immense interval between the orbit of Saturn and the nearest fixed stars, that many of them have not descended into the planetary

307 Why comets may sometimes be invisible even in their perihelion.

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planetary regions since they have been looked upon as celestial bodies, and observed accordingly: besides, it may often happen, that a body may finish its whole period without being observed by us, on account of the unfavourable situation of the earth in her orbit when the comet is in its perihelion. Thus, if the comet be either behind or before the sun, or nearly so, it must be above our horizon in the day time, and consequently invisible, except the sun should at that time be in a total eclipse; for then the comet might be seen near the sun, as well as the stars and planets are: and this case is said to have happened; for Seneca relates from Possidonius, that a comet was seen when the sun was eclipsed, which had before been invisible by being near that luminary."

308 Why more are seen in the hemisphere towards the sun than in the opposite.

A greater number of comets are seen in the hemisphere towards the sun than in the opposite; the reason of which will easily appear from fig. 116. wherein S represents the sun, E the earth, ABCD the sphere of the fixed stars: and because comets either do not reflect light enough to be visible, or emit tails conspicuous enough to attract our notice, till they come within the planetary regions, commonly a good way within the sphere of Jupiter, let KLMN be a sphere concentric to the sun, at such a distance from him, that no comet can be seen by us till it come within that distance; though E draw the plane BD perpendicular to SE, which will divide the sphere CLMN into two hemispheres, one of which, BCD, is toward the sun, the other, DAB, opposite. Now it is manifest, that the spherical portion LMN, which is in the hemisphere BCD towards the sun, is larger than the portion NKL in the hemisphere opposite to him: and consequently a greater number of comets will appear in the hemisphere BCD than in that marked DAB.

309 Great differences in the eccentricities of the orbits of comets.

Though the orbits of all comets are very eccentric ellipses, there are vast differences amongst them; excepting Mercury, there are no great differences among the planets, either as to the eccentricity of their orbits, or the inclination of their planes; but the planes of some comets are almost perpendicular to others, and some of their ellipses are much wider than others. The narrowest ellipsis of any comet hitherto observed was that of 1680. There is also a much greater inequality in the motion of the comets than of the planets; the velocity of the former being incomparably greater in their perihelion than in their aphelion: but the planets are but very little accelerated.

310 Opinions concerning their substance.

Astronomers are now generally agreed, that comets are opaque bodies, enlightened by the sun. Hevelius, in a large work, wherein he gives the opinion of various authors on the subject, mentions some who were of the same sentiments with himself, that comets were so far transparent as to let the light of the sun pass through them, which formed their tails. Sir Isaac Newton was of opinion, that they are quite opaque; and in confirmation of this, he observes, that if a comet be seen in two parts of its orbit, at equal distances from the earth, but at unequal distances from the sun, it always shines brightest in that nearest the sun. They are of very different magnitudes, which may be conjectured from their apparent diameter and brightness. Thus the head of a comet, when of the same brightness and apparent diameter with Saturn, may be supposed to be nearly about the same magnitude with that planet; though this must be attended with some uncertainty, as we know not whether the heads of comets reflect the sun's light in the same manner the planets do. Their distance may be known from their parallax, in the manner related in a subsequent section.

311 Distances, diameters, &c. of some comets computed.

In this manner he found the distance of the comet of 1577 to be about 210 semidiameters of the earth, or about 840,000 miles distant from us, its apparent diameter being seven minutes; whence he concluded, that the true diameter of the comet was to that of the earth as 3 to 14. "But (says Dr Long) it was the hemisphere of the comet which was then measured." Hevelius, from the parallax and apparent diameter of the head of the comet in 1652, computed its diameter to be to that of the earth as 52 to 100. By the same method he found the diameter of the head of the comet of 1664 to be at one time 12 semidiameters of the earth, and at another not much more than 5. "That the head of the comet must appear less the farther it is from the earth (says Dr Long) is obvious; but besides this apparent change, there is also a real one in the dimensions of the head of the same comet; for, when near the sun, the atmosphere is diminished by the heat raising more of it into the tail; whereas, at a greater distance, the tail is diminished and the head enlarged." Hevelius computed the diameter of the nucleus of the comets of 1661 and 1665 to be only about a tenth part of that of the earth; and Cysatus makes the true diameter of the comet of 1618 to be about the same size. Some comets, however, from their apparent magnitude and distance, have been supposed much larger than the moon, or even equal in magnitude to some of the primary planets; and some

312 Eclipses occasioned by comets.

have imagined, that by an interposition of these bodies betwixt the earth and sun, we might account for those darknesses which cannot be derived from any interposition of the moon. Such are those mentioned by Herodotus, lib. vii. cap. 37. and lib. ix. cap. 70.; likewise the eclipse mentioned by Dion, which happened a little before the death of Augustus; and it is observable that Seneca saw a comet that year. Some have even attempted to account in this manner for the darkness which happened at our Saviour's crucifixion; and indeed it is certain, that were a comet in its perigee to come between the earth and sun, and to be moving the same way with the earth, it must cause a darkness much more intense, as well as of more considerable duration, than what would take place in any lunar eclipse.

313 Conjectures concerning their tails.

Various conjectures have been formed respecting the tails of comets; though it is acknowledged by all, that they depend on the sun somehow or other; and for this plain reason, that they are always turned from him; but in what manner this is accomplished, we cannot easily determine. Appian, Tycho Brahe, and others, thought the tail was formed by the sun's rays transmitted through the nucleus of the comet, which they fancied transparent, and was there refracted as in a lens of glass, so as to form a beam of light behind the comet: but this cannot be the case, as well because the figure of a comet's tail does not answer to such a refraction, as that such refracted light would not be seen by a spectator placed sideways to it, unless it fell upon some substance sufficiently dense to cause a

314 Opinion of Descartes.

reflection. Descartes and his followers were of opinion, that the tail of a comet was owing to the refraction

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tion of its head: but if this were the case, the planets and principal fixed stars must have tails also; for the rays from them pass through the same medium as the light from the comets. Sir Isaac Newton was of opinion, that the tail of a comet is a very thin vapour which the head sends out by reason of its heat: that it ascends from the sun just as smoke does from the earth: that as the ascent of smoke is caused by the rarefaction of the air wherein it is entangled, causing such air to ascend and carry the smoke up with it; so the sun's rays acting upon the coma or atmosphere of the comet, do by rarefaction and refraction heat the same: that this heated atmosphere heats, and by heating rarefies, the ether that is involved therein; and that the specific gravity with which such ether tends to the sun, is so diminished by its rarefaction, that it will now ascend from him by its relative lightness, and carry with it the reflecting particles whereof the tail is composed. Though the immensely large tails of some comets seem to require a great quantity of matter to produce them, this is no objection to the foregoing solution: for every day's experience shows what a great quantity of smoke is produced from a very little wood or coal; and Newton has demonstrated, that a cubic inch of air equally rarefied with that at the distance of a semidiameter from the earth's surface, would fill all the planetary regions to the orbit of Saturn and beyond. Mairan entertained a very different opinion. He supposed the tails of the comets to be formed out of the luminous matter whereof the sun's atmosphere consists. This he supposes to extend as far as the orbit of the earth, and to furnish matter for the aurora borealis. M. de la Lande is for joining the two last opinions together. Part of the matter which forms the tails of comets he supposes to arise from their own atmosphere rarefied by heat and pushed forward by the force of the light streaming from the sun; and also that a comet passing through the sun's atmosphere is drenched therein, and carries away some of it. Mr Rowning objects to Newton's account, that it can hardly be supposed the thin vapour of the tail should go before the more solid body of the comet, when the motion thereof is sometimes so extremely swift, as that of some of the comets is said to be, after the rate, as Sir Isaac Newton calculated the motion of the comet of 1680 to be, of no less than 880,000 miles an hour. He therefore supposes the atmosphere of the comet to extend every way round it as far as the tail reaches; and that the part of it which makes the tail is distinguished from the rest, so as to fall thick upon that part of the atmosphere which goes before the comet in its progress along its elliptic orbit. The greatest objection to this is the immense magnitude of the atmospheres; as it must now be supposed to account for the vast lengths of the tails of some comets, which have been said to measure above 80 millions of miles.

The many discoveries which, since the time of Newton, Halley, and other celebrated mathematicians, have been made in electricity, having brought in a new element unknown to former ages, and which shows a vast power through every part of the creation with which we are acquainted, it became natural to imagine that it must extend also into those higher regions which are altogether inaccessible to man. The similarity of the tails of comets to the Aurora Borealis, which is commonly looked upon to be an electrical phenomenon, therefore suggested an opinion, at present far from being generally disbelieved, that the tails of comets are streams of electric matter. An hypothesis of this kind was published by Dr Hamilton of Dublin in a small treatise, entitled, *Conjectures on the Nature of the Aurora Borealis, and on the Tails of Comets*. His hypothesis is, that the comets are of use to bring back the electric fluid to the planets, which is continually discharged from the higher regions of their atmospheres. Having given at length the above-mentioned opinion of Sir Isaac, "We find (says he) in this account, that Sir Isaac ascribes the ascent of comets tails to their being rarer and lighter, and moving round the sun more swiftly than the solar atmosphere, with which he supposes them to be surrounded whilst in the neighbourhood of the sun; he says also, that whatever position (in respect to each other) the head and tail of a comet then receive, they will keep the same afterwards most freely; and in another place he observes, 'That the celestial spaces must be entirely void of any power of resisting, since not only the solid bodies of the planets and comets, but even the exceeding thin vapours of which comets tails are formed, move through those spaces with immense velocity, and yet with the greatest freedom.' I cannot help thinking that this account is liable to many difficulties and objections, and that it seems not very consistent with itself or with the phenomena.

315 Dr Hamilton of Dublin's opinion.

"I do not know that we have any proof of the existence of a solar atmosphere of any considerable extent, nor are we anywhere taught how to guess at the limits of it. It is evident that the existence of such an atmosphere cannot be proved merely by the ascent of comets tails from the sun, as that phenomenon may possibly arise from some other cause. However, let us suppose, for the present, that the ascent of comets tails is owing to an atmosphere surrounding the sun; and see how the effects arising from thence will agree with the phenomena. When a comet comes into the solar atmosphere, and is then descending almost directly to the sun, if the vapours which compose the tail are raised up from it by the superior density and weight of that atmosphere, they must rise into those parts that the comet has left, and therefore at that time they may appear in a direction opposite to the sun. But as soon as the comet comes near the sun, and moves in a direction nearly at right angles with the direction of its tail, the vapours which then arise, partaking of the great velocity of the comet, and being specifically lighter than the medium in which they move, and being vastly expanded through it, must necessarily suffer a resistance immensely greater than what the small and dense body of the comet meets with, and consequently cannot possibly keep up with it, but must be left behind, or, as it were, driven backwards by the resistance of that medium into a line directed towards the parts which the comet has left, and therefore can no longer appear in a direction opposite to the sun. And, in like manner, when a comet passes its perihelion, and begins to ascend from the sun, it certainly ought to appear ever after with its tail behind it, or in a direction pointed towards the sun; for if the tail of the comet be specifically lighter than the medium in which it moves with so great velocity, it must be just as impossible

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possible it should move foremost, as it is that a torch moved swiftly through the air should project its flame and smoke before it. Since therefore we find that the tail of a comet, even when it is ascending from the sun, moves foremost, and appears in a direction nearly opposite to the sun, I think we must conclude that the comet and its tail do not move in a medium heavier and denser than the matter of which the tail consists, and consequently that the constant ascent of the tail from the sun must be owing to some other cause. For that the solar atmosphere should have density and weight sufficient to raise up the vapours of a comet from the sun, and yet not be able to give any sensible resistance to these vapours in their rapid progress through it, are two things inconsistent with each other: And therefore, since the tail of a comet is found to move as freely as the body does, we ought rather to conclude, that the celestial spaces are void of all resisting matter, than that they are filled with a solar atmosphere, be it ever so rare.

"But there is, I think, a further consideration, which will show that the received opinion, as to the ascent of comets tails, is not agreeable to the phenomena, and may at the same time lead us to some knowledge of the matter of which these tails consist; which I suspect is of a very different nature from what it has been hitherto supposed to be. Sir Isaac says, the vapours of which the tail of a comet consists, grow hot by reflecting the rays of the sun, and thereby warm and rarefy the medium which surrounds them; which must therefore ascend from the sun, and carry with it the reflecting particles of which the tail is formed; for he always speaks of the tail as shining by reflected light. But one would rather imagine, from the phenomena, that the matter which forms a comet's tail has not the least sensible power of reflecting the rays of light. For it appears from Sir Isaac's observation, which I have quoted already, that the light of the smallest stars, coming to us through the immense thickness of a comet's tail, does not suffer the least diminution. And yet, if the tail can reflect the light of the sun so copiously as it must do if its great splendour be owing to such reflection, it must undoubtedly have the same effect on the light of the stars; that is, it must reflect back the light which comes from the stars behind it, and by so doing must intercept them from our sight, considering its vast thickness, and how exceedingly slender a ray is that comes from a small star; or if it did not intercept their whole light, it must at least increase their twinkling. But we do not find that it has even this small effect; for those stars that appear through the tail are not observed to twinkle more than others in their neighbourhood. Since therefore this fact is supported by observations, what can be a plainer proof that the matter of a comet's tail has no power of reflecting the rays of light? and consequently, that it must be a self-shining substance. But the same thing will further appear, from considering that bodies reflect and refract light by one and the same power; and therefore if comets tails want the power of refracting the rays of light, they must also want the power of reflecting them. Now, that they want this refracting power appears from hence: If that great column of transparent matter which forms a comet's tail, and moves either in a vacuum or in some medium of a different density from its own, had any power of refracting a ray of light coming through it from a star to us, that ray must be turned far out of its way in passing over the great distance between the comet and the earth; and therefore we should very sensibly perceive the smallest refraction that the light of the stars might suffer in passing through a comet's tail. The consequence of such a refraction must be very remarkable: the stars that lie near the tail would, in some cases, appear double; for they would appear in their proper places by their direct rays, and we should see their images behind the tail, by means of their rays which it might refract to our eyes; and those stars that were really behind the tail would disappear in some situations, their rays being turned aside from us by refraction. In short, it is easy to imagine what strange alterations would be made in the apparent places of the fixed stars by the tails of comets, if they had a power of refracting their light, which could not fail to be taken notice of if any such ever happened. But since astronomers have not mentioned any such apparent changes of place among the stars, I take it for granted that the stars seen through all parts of a comet's tail appear in their proper places, and with their usual colours; and consequently I infer, that the rays of light suffer no refraction in passing through a comet's tail. And thence I conclude (as before), that the matter of a comet's tail has not the power of refracting or reflecting the rays of light, and must therefore be a lucid or self-shining substance."

316 Sir Isaac's account defended.

But whatever probability the Doctor's conjecture concerning the materials whereof the tails are formed may have in it, his criticism on Sir Isaac Newton's account of them seems not to be just: for that great philosopher supposes the comets to have an atmosphere peculiar to themselves; and consequently in their nearest approaches to the sun, both comet and atmosphere are immersed in the atmosphere of that luminary. In this case, the atmosphere of the comet being prodigiously heated on the side next to the sun, and consequently the equilibrium in it broken, the denser parts will continually pour in from the regions farthest from the sun; for the same reason, the more rarefied part which is before will continually fly off opposite to the sun, being displaced by that which comes from behind; for though we must suppose the comet and its atmosphere to be heated on all sides to an extreme degree, yet still that part which is farthest from the sun will be less hot, and consequently more dense, than what is nearest to his body. The consequence of this is, that there must be a constant stream of dense atmosphere descending towards the sun, and another stream of rarefied vapours and atmosphere ascending on the contrary side; just as in a common fire there is a constant stream of dense air ascending, which pushes up another of rarefied air, flame, and smoke. The resistance of a solar atmosphere may indeed be very well supposed to occasion the curvature observable in the tails of comets, and their being better defined in the fore part than behind; and this appearance we think Dr Hamilton's hypothesis is incapable of solving. We grant, that there is the utmost probability that the tails of comets are streams of electric matter; but they who advance a theory of any kind ought to solve every phenomenon, otherwise their theory is insufficient. It was incumbent

317 Dr Hamilton's hypothesis insufficient.

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cumbent on Dr Hamilton, therefore to have explained how this stream of electric matter comes to be bent into a curve; and also why it is better defined and brighter on the outer side of the arch than on the inner. This indeed he attempts in the following manner: "But that this curvature was not owing to any resisting matter appears from hence, that the tail must be bent into a curve, though it met with no resistance; for it could not be a right line, unless all its particles were projected in parallel directions, and with the same velocity, and unless the comet moved uniformly in a right line. But the comet moves in a curve, and each part of the tail is projected in a direction opposite to the sun, and at the same time partakes of the motion of the comet; so that the different parts of the tail must move on in lines which diverge from each other; and a line drawn from the head of a comet to the extremity of the tail, will be parallel to a line drawn from the sun to the place where the comet was when that part of the tail began to ascend, as Sir Isaac observes: and so all the chords or lines drawn from the head of the comet to the intermediate parts of the tail, will be respectively parallel to lines drawn from the sun to the places where the comet was when these parts of the tail began to ascend. And, therefore, since these chords of the tail will be of different lengths, and parallel to different lines, they must make different angles with a great circle passing through the sun and comet; and consequently a line passing through their extremities will be a curve.

"It is observed, that the convex side of the tail which is turned from the sun is better defined, and shines a little brighter, than the concave side. Sir Isaac accounts for this, by saying, that the vapour on the convex side is fresher (that is, has ascended later) than that on the concave side; and yet I cannot see how the particles on the convex side can be thought to have ascended later than those on the concave side which may be nearer to the head of the comet. I think it rather looks as if the tail, in its rapid motion, met with some slight resistance just sufficient to cause a small condensation in that side of it which moves foremost, and which would occasion it to appear a little brighter and better defined than the other side; which slight resistance may arise from that subtile ether which is supposed to be dispersed through the celestial regions, or from this very electric matter dispersed in the same manner, if it be different from the ether."

On the last part of this observation we must remark, that though a slight resistance in the ethereal medium would have served Sir Isaac Newton's turn, it will by no means serve Dr Hamilton's; for though a stream of water or air may be easily destroyed or broken by resistance, yet a stream of electric matter seems to set every obstacle at defiance. If a sharp needle is placed on the conductor of an electric machine, and the machine set in motion, we will perceive a small stream of electric matter issuing from the point; but though we blow against this stream of fire with the utmost violence, it is impossible either to move it, or to brighten it on the side against which we blow. If the celestial spaces then are full of a subtile ether capable of thus affecting a stream of electric matter, we may be sure that it also will resist very violently: and we are then as much difficulted to account for the projectile motion continuing amidst such violent resistance; for if the ether resists the tail of the comet, it is impossible to prove that it doth not resist the head also.

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318 Electric matter not always passive.

This objection may appear to some to be but weakly founded, as we perceive the electric fluid to be endowed with such extreme subtility, and to yield to the impression of solid bodies with such facility, that we easily imagine it to be of a very passive nature in all cases. But it is certain, that this fluid only shows itself passive where it passes from one body into another, which it seems very much inclined to do of itself. It will also be found, on proper examination of all the phenomena, that the only way we can manage the electric fluid at all is by allowing it to direct its own motions. In all cases where we ourselves attempt to assume the government of it, it shows itself the most untractable and stubborn being in nature. But these things come more properly under the article ELECTRICITY, where they are fully considered. Here it is sufficient to observe, that a stream of electric matter resists air, and from the phenomena of electric repulsion we are sure that one stream of electric matter resists another: from which we may be also certain, that if a stream of electric matter moves in an aerial fluid, such fluid will resist it; and we can only judge of the degree of resistance it meets with in the heavens from what we observe on earth. Here we see the most violent blast of air has no effect upon a stream of electric fluid: in the celestial regions, either air or some other fluid has an effect upon it according to Dr Hamilton. The resistance of that fluid, therefore, must be greater than that of the most violent blast of air we can imagine.

As to the Doctor's method of accounting for the curvature of the comet's tail, it might do very well on Sir Isaac Newton's principles, but cannot do so on his. There is no comparison between the celerity with which rarefied vapour ascends in our atmosphere, and that whereby the electric fluid is discharged. The velocity of the latter seems to equal that of light; of consequence, supposing the velocity of the comet to be equal to that of the earth in its annual course, and its tail equal in length to the distance of the sun from the earth, the curvature of the tail could only be to a straight line as the velocity of the comet in its orbit is to the velocity of light, which according to the calculations of Dr Bradley, is as 10,201 to 1. The apparent curvature of such a comet's tail, therefore, would at this rate only be $\frac{1}{10201}$ part of its visible length, and this would always be imperceptible to us. The velocity of comets is indeed sometimes inconceivably great. 319 Prodigious velocity of a comet observed by Mr Brydone.
Mr Brydone observed one at Palermo, in July 1770, which in 24 hours described an arch in the heavens upwards of 50 degrees in length; according to which he supposes, that if it was as far distant as the sun, it must have moved at the rate of upwards of 60 millions of miles in a day. But this comet was attended with no tail, so that we cannot be certain whether the curvature of the tails of these bodies corresponds with their velocity or not.

320 Vehement heat of the comet of 1680.

The near approach of some comets to the sun subjects them to intense and inconceivable degrees of heat. Newton calculated that the heat of the comet of 1680 must have been near 2000 times as great as that of red-hot iron. The calculation is founded upon this principle,

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principle, that the heat of the sun falling upon any body at different distances is reciprocally as the squares of those distances; but it may be observed, that the effect of the heat of the sun upon all bodies near our earth depends very much on the constitution of those bodies, and of the air that surrounds them. "The comet in question (says Dr Long) certainly acquired a prodigious heat: but I cannot think it came up to what the calculation makes it: the effect of the strongest burning-glass that has ever been made use of was the vitrification of most bodies placed in its focus. What would be the effect of a still greater heat we can only conjecture; it would perhaps so disunite the parts as to make them fly off every way in atoms. This comet, according to Halley, in passing through its southern node, came within the length of the sun's semidiameter of the orbit of the earth. Had the earth then been in the part of her orbit nearest to that node, their mutual gravitation must have caused a change in the plane of the orbit of the earth, and in the length of our year: he adds, that if so large a body, with so rapid a motion as that of this comet, were to strike against the earth, a thing by no means impossible, the shock might reduce this beautiful frame to its original chaos."

We must not conclude this account without observing that Whiston, who, from Flamstead's measure of its apparent diameter, concluded the nucleus of the comet to be about ten times as big as the moon, or equal to a fourth part of the earth, attributes the universal deluge in the time of Noah to the near approach thereof. His opinion was, that the earth passing through the atmosphere of the comet, attracted therefrom great part of the water of the flood; that the nearness of the comet raised a great tide in the subterraneous waters, so that the outer crust of the earth was changed from a spherical to an oval figure; that this could not be done without making fissures and cracks in it, through which the waters forced themselves, by the hollow of the earth being changed into a less capacious form; that along with the water thus squeezed up on the surface of the earth, much slime or mud would rise; which, together with the grosser part of the comet's atmosphere, would, after the subsiding of the water, partly into the fissures and partly into the lower parts of the earth to form the sea, cover all over, to a considerable depth, the antediluvian earth. Thus he accounts for trees and bones of animals being found at a very great depth in the earth. He also held that, before the fall, the earth revolved round the sun in the plane of the ecliptic, keeping always the same points of its surface towards the same fixed stars. By this means, as every meridian would come to the sun but once in every revolution, a day and a year were then the same: but that a comet striking obliquely upon some part of the earth gave it the diurnal rotation: that the antediluvian year consisted of 360 days: but that the additional matter deposited upon the earth from the atmosphere of the comet at the flood, so retarded the revolution thereof round the sun, that it is not now performed in less than 365 days and about a quarter. The same comet he thought would probably, coming near the earth when heated in an intense degree in its perihelion, be the instrumental cause of that great catastrophe, the general conflagration, foretold in the sacred writings and from ancient tradition.

These conjectures lead us to speak somewhat more particularly concerning the nature of comets, and the purposes they may possibly answer in the creation. Hevelius, in order to account for the various appearances of the nucleus already related, supposed that they were composed of several masses compacted together, with a transparent fluid interspersed, but the apparent changes in the nucleus may be only on the surface: comets may be subject to spots as the planets are; and the vastly different degrees of heat they go through may occasion great and sudden changes, not only in their surfaces, but even in their internal frame and texture. Newton places all these apparent changes to the atmosphere that environs them; which must be very dense near their surfaces, and have clouds floating therein. It was his opinion, that the changes mentioned may all be in the clouds, not in the nucleus. This last indeed he looked upon to be a body of extreme solidity, in order to sustain such an intense heat as the comets are sometimes destined to undergo; and that, notwithstanding their running out into the immense regions of space, where they were exposed to the most intense degrees of cold, they would hardly be cooled again on their return to the sun. Indeed, according to his calculation, the comet of 1680 must be for ever in a state of violent ignition. He hath computed that a globe of red-hot iron of the same dimensions with the earth, would scarce be cool in 50,000 years. If then the comet be supposed to cool 100 times faster than red-hot iron, as its heat was 2000 times greater, it must require upwards of a million of years to cool it. In the short period of 575 years, therefore, its heat will be in a manner scarce diminished; and, of consequence, in its next and every succeeding revolution, it must acquire an increase of heat: so that, since the creation, having received a proportional addition in every succeeding revolution, it must now be in a state of ignition very little inferior to that of the sun itself. Sir Isaac Newton hath farther concluded, that this comet must be considerably retarded in every succeeding revolution by the atmosphere of the sun within which it enters; and thus must continually come nearer and nearer his body, till at last it falls into it. This, he thinks, may be one use of the comets, to furnish fuel for the sun, which otherwise would be in danger of wasting from the continual emission of its light.

221 Conjectures of Hevelius, &c. concerning the nature of comets.

He adds, that for the conservation of the water and moisture of the planets, comets seem absolutely requisite; from whose condensed vapours and exhalation all the moisture which is spent in vegetation and putrefaction, and turned into dry earth, &c. may be resupplied and recruited; for all vegetables grow and increase wholly from fluids; and again, as to their greatest part, turn by putrefaction into earth; an earthy slime being perpetually precipitated to the bottom of putrefying liquors. Hence the quantity of dry earth must continually increase, and the moisture of the globe decrease, and be quite evaporated, if it have not a continual supply from some part or other of the universe. "And I suspect (adds our great author), that the spirit which makes the finest, subtilest, and best

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part of our air, and which is absolutely requisite for the life and being of all things, comes principally from the comets."

322 Mr Brydone's conjectures concerning comets without tails.

Mr Brydone observes, that the comets without tails seem to be of a very different species from those which have tails: To the latter, he says, they appear to bear a much less resemblance than they do even to planets. He tells us, that comets with tails have seldom been visible but on their recess from the sun: that they are kindled up, and receive their alarming appearance, in their near approach to this glorious luminary; but that those without tails are seldom or ever seen but on their way to the sun; and he does not recollect any whose return has been tolerably well ascertained. "I remember indeed (says he), a few years ago, a small one, that was said to have been discovered by a telescope after it had passed the sun, but never more became visible to the naked eye. This assertion is easily made, and nobody can contradict it; but it does not at all appear probable that it should have been so much less luminous after it had passed the sun than before it approached him: and I will own to you, when I have heard that the return of these comets had escaped the eyes of the most acute astronomers, I have been tempted to think that they did not return at all, but were absorbed in the body of the sun, which their violent motion towards him seemed to indicate." He then attempts to account for the continual emission of the sun's light without waste, by supposing that there are numberless bodies throughout the universe that are attracted into the body of the sun, which serve to supply the waste of light, and which for some time remain obscure and occasion spots on his surface, till at last they are perfectly dissolved and become bright like the rest. This hypothesis may account for the dark spots becoming as bright, or even brighter than the rest of the disk, but will by no means account for the brighter spots becoming dark. Of this comet, too, Mr Brydone remarks, that it was evidently surrounded by an atmosphere which refracted the light of the fixed stars, and seemed to cause them to change their places as the comet came near them.

323 Mr Cole's hypothesis.

A very strange opinion we find set forth in a book entitled "Observations and Conjectures on the Nature and Properties of Light, and on the Theory of Comets, by William Cole." This gentleman supposes that the comets belong to no particular system; but were originally projected in such directions, as would successively expose them to the attraction of different centres, and thus they would describe various curves of the parabolic and the hyperbolic kind. This treatise is written in answer to some objections thrown out in Mr Brydone's Tour, against the motions of the comets by means of the two forces of gravitation and projection, which were thought sufficient for that purpose by Sir Isaac Newton: of which we shall treat as fully as our limits will allow in the next section.

324 Of the periodical times, &c. of the comets.

The analogy between the periodical times of the planets and their distances from the sun, discovered by Kepler, takes place also in the comets. In consequence of this, the mean distance of a comet from the sun may be found by comparing its period with the time of the earth's revolution round the sun. Thus the period of the comet that appeared in 1531, 1607, 1682, and 1759, being about 76 years, its mean distance from the sun may be found by this proportion: As 1, the square of one year, the earth's periodical time, is to 5776 the square of 76, the comet's periodical time; so is 1,000,000 the cube of 100 the earth's mean distance from the sun, to 5,776,000,000 the cube of the comet's mean distance. The cube root of this last number is 1794; the mean distance itself in such parts as the mean distance of the earth from the sun contains 100. If the perihelion distance of this comet, 58 be taken from 3588 double the mean distance, we shall have the aphelion distance, 3530 of such parts as the distance of the earth contains 100; which is a little more than 35 times the distance of the earth from the sun. By a like method, the aphelion distance of the comet of 1680 comes out 138 times the mean distance of the earth from the sun, supposing its period to be 575 years: so that this comet, in its aphelion, goes more than 14 times the distance from the sun that Saturn does. Euler computes the orbit of this comet from three of Flamstead's observations taken near together, compared with a fourth taken at some distance from the other three, and from thence concludes the period to be a little more than 170 years. "It seems something surprising (says Dr Long), that, from the same observations which were used by Newton and Halley, he should bring out a period so very different from what these great men have determined: but it is the less to be wondered at, if we consider how small a portion of the comet's orbit lay between the most distant places used in this computation, or indeed that could be had for that purpose; so small, that the form of the ellipsis cannot be found with precision by this method, except the comet's places were more exactly verified than is possible to be done: and that he does not pretend to confirm his determination of the period by pointing out and comparing together any former appearances of this comet; a method which Newton recommended as the only one whereby the periodical times and transverse diameters of the orbits of the comets can be determined with accuracy."

The period of the comet in 1744 is much longer than even that of 1680. Mr Betts, in attempting to compute the transverse axis of its orbit, found it come out so near infinite, that, though the orbit showed itself in this manner to be a very long one, he found it impossible to calculate it without some observations made after its perihelion. Halley, after he had finished his 325 Dr Halley calculates the return of comets.
tables of comets, found such a similitude in the elements of those of 1531, 1607, and 1682, that he was induced to believe them to be returns of the same comet in an elliptic orbit: but as there was such a difference in their periodical times and inclinations of their orbits as seemed to make against this opinion; and as the observations of the first of them in 1531 by Appian, and the second in 1607 by Kepler, were not exact enough to determine so nice a point when he first published his synopsis in 1705; he only mentioned this as a thing probable, and recommended it to posterity to watch for an appearance of the same in 1758. Afterwards, looking over the catalogue of ancient comets, and finding three others at equal instruments with those now mentioned, he grew more positive in his opinion; and knowing a method of calculating with ease a motion in an elliptic orbit, how eccentric soever it might be, instead of the parabolic orbit which he had given

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given for the comet of 1682, he set about adapting the plan of that orbit to an ellipsis of a given space and magnitude, having the sun in one of its foci, so as to tally with the observations of that comet made by Flamstead with great accuracy, by the help of a very large sextant. He likewise corrected the places of the comet of 1531 from Appian, and those of the comet 1607 from Kepler and Longomontanus, by rectifying the places of the stars they had made use of, and found those places agree as well with the motion in such an ellipsis as could be expected from the manner of observing of these astronomers, and the imperfections of their instruments. The greatest objection to this theory was some difference in the inclination of the orbits, and that there was above a year's difference between the two periods. The comet of 1531 was in its perihelion August 24.; that of 1607, October 16, and that of 1682, September 4.: so that the first of these periods was more than 76, the latter not quite 75 years. To obviate this, he reminds his readers of an observation made by him of the periodical revolution of Saturn having at one time been about 13 days longer than at another time; occasioned, as he supposed, by the near approach of Saturn and Jupiter, and the mutual attraction and gravitation of these two planets: and observes, that in the summer of the year 1681, the comet in its descent was for some time so near Jupiter, that its gravitation towards that planet was one-fiftieth part of its gravitation towards the sun. This, he concluded, would cause a change in the inclination of its orbit, and also in the velocity of its motion: for by continuing longer near the planet Jupiter on the side most remote from the sun, its velocity would be more increased by the joint forces of both those bodies, than it would be diminished by them acting contrarywise, when on the side next the sun where its motion was swiftest. The projectile motion being thus increased, its orbit would be enlarged, and its period lengthened; so that he thought it probable it would not return till after a longer period than 76 years, about the end of the year 1758, or beginning of 1759.

316 Why the periodical return of comets may happen at unequal intervals.

As Halley expressed his opinion modestly, though clearly enough, that this comet would appear again about the end of 1758, or the beginning of the following year, M. de la Lande pretends he must have been at a loss to know whether the period he foretold would have been of 75 or of 76 years; that he did not give a decisive prediction, as if it had been the result of calculation; and that, by considering the affair in so loose a manner as Halley did, there was a good deal of room for objecting to his reasoning. After these reflections, he is very large in his commendation of the performance of Clairault; who, he says, not only calculated strictly the effect of the attraction of Jupiter in 1681 and 1683, when the comet was again near Jupiter, but did not neglect the attraction of that planet when the comet was most distant; that he considered the uninterrupted attractions of Jupiter and Saturn upon the sun and upon the comet, but chiefly the attractions of Jupiter upon the sun, whereby that luminary was a little displaced, and gave different elements to the orbit of the comet. By this method he found the comet would be in its perihelion about the middle of April; but that, on account of some small quantities necessarily neglected in the method of approximation made use of by him, Mr Clairault desired to be indulged one month; and that the comet came just 30 days before the time he had fixed for its appearance.

That comets may have their motion disturbed by the planets, especially by the two largest, Jupiter and Saturn, appears by an instance just now mentioned. They may also affect one another by their mutual gravitation when out of the planetary regions; but of this we can take no account, nor can we estimate the resistance of the ether through which they pass; and yet both these causes may have some influence on the inclination of their orbits and the length of their periods.

Chap. V. *Of the Motions of the Satellites.*

THE moon is the satellite which moves round the earth, and as her apparent and real motions are the same, we have already given an account of her elliptical orbit and irregularities.

Jupiter is attended by four satellites. If we represent the semidiameters of Jupiter's equator by unity, then the mean distances of the satellites from Jupiter, will be represented by the following numbers.

327 Orbits and distances of Jupiter's satellites.

First satellite	5.697300 semidiameters.
Second satellite	9.065898
Third satellite	14.461628
Fourth satellite	25.436000

The durations of their revolutions are respectively,

First satellite	1.769137787069931 days.
Second satellite	3.551181016734509
Third satellite	7.154552807541524
Fourth satellite	16.689019396008634

If we compare the distances of these satellites with their periodic times, we observe the same relation pointed out by Kepler between the distances of the planets from the sun and the duration of their revolutions: for the squares of the periodic times of the satellites are proportional to the cubes of their distance from Jupiter's centre.

The frequent eclipses of these satellites have enabled astronomers to ascertain their motion, with much more precision than could have been attained merely by observing their distances from Jupiter. The following points have been ascertained.

The orbit of the first satellite is circular, at least its eccentricity is insensible; it coincides nearly with Jupiter's equator, which is inclined to the orbit of the planet at an angle of 3.9999°.

The ellipticity of the orbit of the second satellite is also insensible; its inclination to Jupiter's orbit varies, as does also the position of its nodes. These irregularities are represented pretty well, by supposing the inclination of the orbit to the equator of Jupiter 1750.968", and that its nodes move retrograde in that plane in a period of 30 years. 328 Irregularities in their motions.

A small eccentricity is observed in the orbit of the third satellite. The extremity of its longer axis next Jupiter, called the *perijove*, has a direct motion. The eccentricity of the orbit has been observed to vary considerably. The equation of the centre was at its maximum about the end of the 17th century; it then amounted

mounted to about 862″; it gradually diminished, and in the year 1775 it was at its minimum, and amounted only to about 229.7″. The inclination of the orbit of this satellite to that of Jupiter, and the position of its nodes, are variable. These different variations are represented pretty nearly, by supposing the orbit inclined to that of Jupiter, at an angle of about 726″, and giving to the nodes a retrograde motion in the plane of the equator, completed in the period of 137 years.

The orbit of the fourth satellite is very sensibly elliptical. Its perijove has a direct motion, amounting to about 2112″. This orbit is inclined to that of Jupiter, at an angle of about 147′. It is in consequence of this inclination, that the fourth satellite often passes behind the planet relatively to the sun without being eclipsed. From the first discovery of this planet, till the year 1760, the inclination of its orbit appeared constant: but it has sensibly increased since that period.

Besides all these variations, the satellites of Jupiter are subjected to several irregularities, which disturb their elliptical motion, and render their theory very complicated. These irregularities are most conspicuous in the three first satellites.

Their mean motions are such, that the mean motion of the first satellite, together with twice the mean motion of the third, is nearly equal to thrice the mean motion of the second. The same relation holds in their synodical motions. The mean longitude both synodical and sidereal of the first three satellites, seen from the centre of Jupiter, is such that the longitude of the first, minus thrice that of the second, plus twice that of the third, is nearly equal to the semicircumference. This relation is so very near the truth, that one is tempted to consider it as rigorous, and to ascribe the supposed errors to the imperfection of observations. It will hold at least for a long time to come, and shews us that the three satellites cannot be eclipsed at once.

The periods and laws of the principal irregularities of these satellites are the same in all. The irregularity of the first advances or retards its eclipses 20″ of time at its maximum. If we compare the changes on this inequality, with the relative positions of the two first satellites, we find that it disappears when these two satellites, seen from the centre of Jupiter, are in opposition at the same time; that it increases gradually, and acquires its maximum when the first satellite, at the instant of opposition, is 45° more advanced than the second; that it vanishes when the first is 90° before the second. Beyond that point it becomes negative and retards the eclipses, and increases till the two satellites are 135 degrees from each other, when it acquires its negative maximum. Then it diminishes and disappears when they are 180° distant. In the second half of the circumference the very same laws are observed as in the first. From these phenomena it has been concluded, that there exists in the motion of the first satellite round Jupiter, an inequality amounting to 1733.6″ at its maximum, and proportional to the sine of twice the excess of the mean longitude of the first satellite above that of the second; which excess is equal to the difference between the mean synodical longitudes of the two satellites. The period of this inequality does not amount to 4 days. How comes it then, it will be asked, to change into a period of 437.75 days, with respect to the eclipses of the first satellite? Let us suppose, that the first and second satellites set out together from their mean opposition to the sun. During every revolution of the first satellite, in consequence of its mean synodical motion, it will be in mean opposition. Suppose a fictitious star, whose angular motion is owing to the excess of the mean synodical motion of the first satellite, over that of the second, then twice the difference of the mean synodical motions of the two satellites will in the eclipses of the first be equal to a multiple of the circumference together with the motion of the fictitious star. Of course the sine of this last motion will be proportional to the inequality of the first satellite in its eclipses, and may represent that inequality. Its period is equal to the duration of the revolution of the fictitious star, which according to the mean motion of the two satellites is 437.75 days. Thus it is determined with more precision than by direct observation.

The irregularity of the second satellite follows a law similar to that of the first; but its sign is always contrary. It accelerates or retards the eclipses 932″ in time when at its maximum. When compared with the position of the two satellites, we perceive that it disappears when they are in opposition to the sun at the same time: that it retards the time of the eclipses more and more, till the two satellites are distant from each other 90° at the time when they take place; then the retardation diminishes and vanishes altogether, when the two satellites are 180° from each other at the time of the eclipses. It then accelerates the eclipses in the other half of the circumference precisely as it had retarded them before. From these observations it has been concluded that there exists in the motion of the second satellite an irregularity of 3647″ at its maximum proportional, (*but with a contrary sign*) to the sign of the excess of the mean longitude of the first satellite above that of the second, which excess is equal to the difference of the mean synodical motions of the two satellites.

If the two satellites set out together from their mean opposition to the sun; the second satellite will be in mean opposition every time that it completes a synodical revolution. If we suppose, as before, a star whose angular motion is equal to the excess of the mean synodical movement of the first satellite, or twice that of the second, then the difference of the two synodical movements of the two satellites will, at the eclipses of the second, equal a multiple of the circumference together with the motion of the fictitious star. Of course the inequality of the second during its eclipse will be proportional to the sine of the angular motion of that fictitious star. Hence the reason that the period and law of that irregularity are the same as in the irregularity of the first satellite.

If the third satellite produces in the motion of the second an inequality resembling that which the second seems to produce in the motion of the first, that is to say, proportional to the sine of twice the difference of the mean longitudes of the second and third satellite; that new inequality will coincide with that which is due to the first satellite. For in consequence of the relation which the mean longitude of the three first satellites have to each other, the difference of the mean longitudes of the two first satellites is equal to the semicircumference

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cumference together with twice the difference of the mean longitudes of the second and third satellites, so that the sine of the first difference is the same as the sine of double the second difference, but with a contrary sign. The inequality produced by the third satellite in the motion of the second, will therefore have the same sign, and will follow the same law as the inequality observed in that motion. It is, therefore, very probable that this inequality is the result of two inequalities depending on the first and third satellite. If in the course of ages, the preceding relation between the mean longitudes of these three satellites should cease to exist, these two inequalities, at present compounded, would separate, and their respective values might be discovered.

The inequality relative to the third satellite in its eclipses, compared with the respective positions of the second and third, offers the same relations with the inequality of the second compared with the respective situations of the two first. There exists then in the motion of the third satellite, an inequality which at its maximum amounts to 268″. If we suppose a star whose angular motion is equal to the excess of the mean synodical motion of the second satellite, above twice the mean synodical motion of the third, the inequality of the third satellite will in its eclipses be proportional to the motion of this fictitious star. But in consequence of the relation which exists between the mean longitude of the three satellites, the sine of this motion is the same (except its sign), with that of the motion of the first fictitious star which we formerly considered. Therefore the inequality of the third satellite in its eclipses has the same period, and follows the same laws, with the inequalities of the two first satellites: such are the laws of the principal irregularities of the three first satellites of Jupiter.

329 **Satellites of Saturn.**

Let us now consider the satellites of Saturn, which are seven in number. The satellites of Saturn have not as yet proved so useful to astronomy or geography as those of Jupiter; principally because they cannot be seen unless very powerful telescopes be used. Five of those satellites were discovered in the year 1685, by Cassini and Huygens, who used telescopes consisting of two simple lenses, but upwards of 100 feet in length; and those were called 1st, 2d, 3d, &c. reckoning from the planet. Two others were discovered by Dr Herschel in the years 1787 and 1788, and these are smaller and nearer to the planet, on which account they ought to have been called the first and second, at the same time that the other five ought to have been called 3d, 4th, 5th, 6th, and 7th; but, imagining that this might create some confusion in the reading of old astronomical books, the five old satellites have been suffered to retain their numerical names, and the two new satellites are now called the 6th and the 7th; so that the 7th is the nearest to the planet, then comes the 6th, then the 1st; and this is followed by the 2d, 3d, 4th, and 5th.

The inclinations of the orbits of the 1st, 2d, 3d, and 4th satellites, to the ecliptic, are from 30° to 31°. That of the 5th is from 17° to 18°. Of all the satellites of the solar system, none, except the 5th of Saturn, has been observed to have any spots, from the motion of which the rotation of the satellite round its own axis might be determined. Then the 5th satellite of Saturn, as Dr Herschel has discovered, turns round its own axis; and it is remarkable, that, like our moon, it revolves round its axis exactly in the same time that it revolves round its primary.

The following table states the particulars which have been ascertained with respect to the satellites of Saturn.

The SATELLITES of SATURN.

Satellites.	Periods.				Dist. in semi-dia. of Saturn.	Dist. in miles.	App. diam. of orbits.	
	d.	h.	m.	s.			′	″
Seventh	0	22	40	46	$2\frac{5}{6}$	107,000	0	57
Sixth	1	8	53	9	$3\frac{5}{9}$	135,000	1	14
First	1	21	18	27	$4\frac{3}{8}$	170,000	1	27
Second	2	17	41	22	$5\frac{1}{8}$	217,000	1	52
Third	4	12	25	12	8	303,000	2	36
Fourth	15	22	41	13	18	704,000	6	18
Fifth	79	7	48	0	54	2,050,000	17	4

330 **Satellites of Herschel.**

The planet Herschel, with its six satellites, have been entirely discovered by Dr Herschel. The planet itself may be seen with almost any telescope; but its satellites cannot be perceived without the most powerful instruments, and the concurrence of all other favourable circumstances. One of these satellites Dr Herschel found to revolve round its primary in 8d. 17h. 1m. 19 sec.; the period of another he found to be 13d. 11h. 5m. 1.5 sec. The apparent distance of the former from the planet is 33″; that of the second 44″$\frac{2}{9}$. Their orbits are nearly perpendicular to the plane of the ecliptic.

The other four satellites were discovered a considerable time after, and of course Dr Herschel has had less time to make observations upon them. They are altogether very minute objects; so that the following particulars must be considered as being not accurate but probable. "Admitting the distance of the interior satellite to be 25″.5, its periodical revolution will be 5d. 21h. 25m.

"If the intermediate satellite be placed at an equal distance between the two old satellites, or at 38″.57, its period will be 10d. 23h. 4m. The nearest exterior satellite is about double the distance of the farthest old one; its periodical time will therefore be about 38d. 1h. 49m. The most distant satellite is full four times as far from the planet as the old second satellite; it will therefore take at least 107d. 16h. 14m. to complete one revolution. All these satellites perform their revolutions in their orbits contrary to the order of the signs; that is, their real motion is retrograde."

PART

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Theory of Universal Gravitation.

PART IV. OF THE THEORY OF UNIVERSAL GRAVITATION.

HAVING in the last two parts of this treatise given an account of the apparent and real motions of the heavenly bodies, it only remains for us to compare these motions with the laws established by mathematicians, in order to ascertain the forces that animate the solar system, and to acquire notions of the general principle of gravitation on which they depend. To develope this part of the subject properly, three particulars claim our attention. We must in the first place lay down the laws of motion as established by mathematicians; in the second place, we must apply these laws to the heavenly bodies, which will furnish us with the theory of gravitation; and, in the third place, we must apply this theory to the planetary system, and demonstrate that the whole motions of the heavenly bodies are explicable by that theory, and merely cases of it. These particulars shall be the subject of the three following chapters.

CHAP. I. *Of the Laws of Motion.*

THE laws of motion, by which all matter is regulated, and to which it is subject notwithstanding the variety of phenomena which it continually exhibits, constitute the first principles of mechanical philosophy. They will claim a separate place hereafter in this work, under the title of DYNAMICS; but some notions of them are requisite in order to understand the theory of gravitation. We shall satisfy ourselves in this place with the following short sketch.

331 Motion. A body appears to us to *move* when it changes its situation with respect to other bodies which we consider as at rest. Thus in a vessel sailing down a river, bodies are said to be in motion when they correspond successively to different parts of the vessel. But this motion is merely relative. The vessel itself is moving along the surface of the river, which turns round the axis of the earth, while the centre of the earth itself is carried round the sun, and the sun with all its attendant planets is moving through space. This renders it necessary to refer the motion of a body to the parts of *space*, which is considered as boundless, immoveable, and penetrable. A body then is said to be in motion when it corresponds successively to different parts of space.

332 Moving forces. Matter, as far as we know, is equally indifferent to motion or rest. When in motion it moves for ever unless stopt by some cause, and when at rest it remains so, unless put in motion by some cause. The cause which puts matter in motion is called a *force*. The *nature* of *moving forces* is altogether unknown, but we can measure their effects.

333 Composition of forces. Whenever a force acts upon matter it puts it in motion, if no other force prevent this effect; the straight line which the body describes, is called the *direction* of the force. Two forces may act upon matter at the same time. If their direction be the same, they increase the motion; if their direction be opposite they destroy each other; and the motion is nothing if the two forces be equal; it is merely the excess of the one force above the other if the motions be unequal. If the directions of the two forces make with each other any angle whatever, the resulting motion will be in a direction between the two. And it has been demonstrated, that if lines be taken to represent the direction and amount of the forces, if these lines be converted into a parallelogram by drawing parallels to them; the diagonal of that parallelogram will represent the direction and quantity of the resulting motion. This is called the composition of forces.

For two forces thus acting together, we may substitute their result, and *vice versa*. Hence we may decompose a force into two others, parallel to two axes situated in the same plane, and perpendicular to each other.

Thus finding that a body A, fig. 117. has moved from A to C, we may imagine either that the body has been impelled by a single force in the direction of AC, and proportionate to the length of AC, or that it has been impelled by two forces at once, viz. by one in the direction of AD, and proportionate to the length of AD; and by another force in the direction of AB or DC, and proportionate to AB or DC. Therefore, if two sides of any triangle (as AD and DC) represent both the quantities and the directions of two forces acting from a given point, then the third side (as AC) of the triangle will represent both the quantity and the direction of a third force, which acting from the same point, will be equivalent to the other two, and *vice versa*.

Thus also in fig. 118. finding that the body A has moved along the line AF from A to F in a certain time; we may imagine, 1st, that the body has been impelled by a single force in the direction and quantity represented by AF; or 2dly, that it has been impelled by two forces, viz. the one represented by AD, and the other represented by AE; or thirdly, that it has been impelled by three forces, viz. those represented by AD, AB, and AC; or lastly, that it has been impelled by any other number of forces in any directions; provided all these forces be equivalent to the single force which is represented by AF.

This supposition of a body having been impelled by two or more forces to perform a certain course; or, on the contrary, the supposition that a body has been impelled by a single force, when the body is actually known to have been impelled by several forces, which are, however, equivalent to that single force; has been called the composition and resolution of forces.

The knowledge of these principles gives mathematicians an easy method of obtaining the result of any number of forces whatever acting on a body. For every particular force may be resolved into three others, parallel to three axes given in position, and perpendicular to each other. It is obvious, that all the forces parallel to the same axis are equivalent to a single force, equal to the sum of all those which act in one direction, diminished by the sum of those which act 334 Resolution of forces.

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act in the opposite direction. Thus the body will be acted on by three forces perpendicular to each other: if the direction of these forces be represented by the sides of a parallelopiped, the resulting force will be represented by the diagonal of that parallelopiped.

The indifference of a material body to motion or rest, and its perseverance in either state when put into it, is called the *vis inertiæ* of matter. This property is considered as the first law of motion. Hence, whenever the state of a body changes, we ascribe the change to the action of some cause: hence the motion of a body when not altered by the action of some new force, must be uniform and in a straight line.

335 Velocity.

In such uniform motions the space passed over is proportional to the time: but the time employed to describe a given space will be longer or shorter according to the greatness of the moving force. This difference in the time of traversing the same space gives us the notion of *velocity*, which in uniform motions is the ratio between the space and the time employed in traversing it. As space and time are heterogeneous quantities, they cannot indeed be compared together; it is the ratio between the numbers representing each that constitutes velocity. A unity of time, a second for instance, is chosen, and in like manner a unity of space, as a foot. Thus, if one body move over 20 feet in one second, and another only 10, then the velocity of the first is double that of the second; for the ratio between 20 and 1 is twice as great as the ratio of 10 to 1. When the space, time, and velocity, are represented by numbers, we have the space equal to the velocity multiplied by the time, and the time equal to the space divided by the time.

The force by which a body is moved is proportional to the velocity, and therefore is measured by the velocity. This has been disputed by some philosophers, but has been sufficiently established. We shall consider it, therefore, as a matter of fact, referring the reader for a discussion of the subject to the article DYNAMICS.

336 Accelerating forces.

When a body is put in motion by forces which not only act at first, but which continue to act uniformly, it will describe a curve line, the nature of which depends upon the forces which occasion the motion. *Gravitation* is an instance of a force which acts in this manner. Let us consider it a little. It appears to act in the same manner in a body at rest and in motion. A body abandoned to its action acquires a very small velocity the first instant; the second instant it acquires a new velocity equal to what it had the first instant; and thus its velocity increases every instant in proportion to the time. Suppose a right-angled triangle, one of the sides of which represents the time, and the other the velocity. The fluxion of the surface of the triangle being equal to the fluxion of the time multiplied by that of the velocity, will represent the fluxion of the space. Hence the whole triangle will represent the space described in a given time. But the triangle increasing as the square of either of its sides, it is obvious, that in the accelerated motion produced by gravitation, the velocities increase with the times, and the heights from which a body falls from rest increase as the squares of the times or of the velocities. Hence, if we denote by 1 the space through which a body falls the first second, it will fall 4 in 2″, 9 in 3″, and so on; so that every second it will describe spaces increasing as the odd numbers 1, 3, 5, 7, &c. This important point will perhaps be rendered more intelligible by the following diagram.

Let AB, fig. 119. represent the time during which a body is descending, and let BC represent the velocity acquired at the end of that time. Complete the triangle ABC, and the parallelogram ABCD. Also suppose the time to be divided into innumerable particles *ei*, *im*, *mp*, *po*, &c. and draw *ef*, *ik*, *mn*, &c. all parallel to the base BC. Then, since the velocity of the descending body has been gradually increasing from the commencement of the motion, and BC represents the ultimate velocity; therefore the parallel lines *ef*, *ik*, *mn*, &c. will represent the velocities at the ends of the respective times A*e*, A*i*, A*m*, &c. Moreover, since the velocity during an indefinitely small particle of time may be considered as uniform; therefore the right line *ef* will be as the velocity of the body in the indefinitely small particle of time *ei*; *ik* will be as the velocity in the particle of time *im*, and so forth. Now the space passed over in any time with any velocity is as the velocity multiplied by the time; viz. as the rectangle under that time and velocity; hence the space passed over in the time *ei* with the velocity *ef*, will be as the rectangle *if*; the space passed over in the time *im* with the velocity *ik*, will be as the rectangle *mk*; the space passed over in the time *mp* with the velocity *mn*, will be as the rectangle *pn*, and so on. Therefore the space passed over in the sum of all those times, will be as the sum of all those rectangles. But since the particles of time are infinitely small, the sum of all the rectangles will be equal to the triangle ABC. Now since the space passed over by a moving body in the time AB with a uniform velocity BC, is as the rectangle ABCD, (viz. as the time multiplied by the velocity) and this rectangle is equal to twice the triangle ABC (Eucl. p. 31. B. I.) therefore the space passed over in a given time by a body falling from rest, is equal to half the space passed over in the same time with an uniform velocity, equal to that which is acquired by the descending body at the end of its fall.

Since the space run over by a falling body in the time represented by AB, fig. 120. with the velocity BC is as the triangle ABC, and the space run over in any other time AD, and velocity DE, is represented by the triangle ADE; those spaces must be as the squares of the times AB AD; for the similar triangles ABC, and ADE, are as the squares of their homologous sides, viz. ABC is to ADE as the square of AB is to the square of AD, (Eucl. p. 29. B. VI.).

When a body is placed upon an inclined plane, the force of gravity which urges that body downwards, acts with a power so much less, than if the body descended freely and perpendicularly downwards, as the elevation of the plane is less than its length.

The space which is described by a body descending freely from rest towards the earth, is to the space which it will describe upon the surface of an inclined plane in the same time as the length of the plane is to its elevation, or as radius is to the sine of the plane's inclination to the horizon.

If upon the elevation BC, fig. 121. of the plane BD, as as a diameter, the semicircle BEGC be described, the part BE of the inclined plane, which is cut off by the semicircle, is that part of the plane over which a body will descend, in the same time that another body will descend freely and perpendicularly along the diameter of the circle, viz. from B to C, which is the altitude of the plane, or sine of its inclination to the horizon.

The time of a body's descending along the whole length of an inclined plane, is to the time of its descending freely and perpendicularly along the altitude of the plane, as the length of the plane is to its altitude; or as the whole force of gravity is to that part of it which acts upon the plane.

A body by descending from a certain height to the same horizontal line, will acquire the same velocity whether the descent be made perpendicularly or obliquely, over an inclined plane, or over many successive inclined planes, or lastly over a curve surface.

From these propositions, which have been sufficiently established by mathematicians, it follows, that in the circle ABC (fig. 122), a body will fall along the diameter from A to B, or along the chords CB, DB, in exactly the same line by the action of gravity.

When a body is projected in any line whatever not perpendicular to the earth's surface, it does not continue in that line, but continually deviates from it, describing a curve, of which the primary line of direction is a tangent. The motion of the body relative to this line is uniform. But if vertical lines be drawn from this tangent to the curve, it will be perceived that its velocity is uniformly accelerated in the direction of these verticals. They are proportional to the squares of the corresponding parts of the tangent. This property shows us that the curve in which the body projected moves is a parabola.

337 Of the pendulum.

The oscillations of the pendulum are regulated likewise by the same law of gravitation. The fundamental proportions respecting pendulums are the following:

If a pendulum be moved to any distance from its natural and perpendicular direction, and there be let go, it will descend towards the perpendicular; then it will ascend on the opposite side nearly as far from the perpendicular, as the place whence it began to descend; after which it will again descend towards the perpendicular, and thus it will keep moving backwards and forwards for a considerable time; and it would continue to move in that manner for ever, were it not for the resistance of the air, and the friction at the point of suspension, which always prevent its ascending to the same height as that from which it lastly began to descend.

The velocity of a pendulum in its lowest point is as the chord of the arch which it has described in its descent.

The very small vibrations of the same pendulum are performed in times nearly equal; but the vibrations through longer and unequal arches are performed in times sensibly different.

As the diameter of a circle is to its circumference, so is the time of a heavy body's descent from rest through half the length of a pendulum to the time of one of the smallest vibrations of that pendulum.

It is from these propositions, and the experiments made with pendulums, that the space described by a body falling from rest by the action of gravity has been ascertained.

The late Mr John Whitehurst, an ingenious member of the Royal Society, seems to have contrived and performed the least exceptionable experiments relatively on this subject. The result of his experiments shews, that the length of the pendulum which vibrates seconds in London, at 113 feet above the level of the sea, in the temperature of 60° of Fahrenheit's thermometer, and when the barometer is at 30 inches, is 39,1196 inches; whence it follows that the space which is passed over by bodies descending perpendicularly, in the first second of time, is 16,087 feet. This length of a second pendulum is certainly not mathematically exact, yet it may be considered as such for all common purposes; for it is not likely to differ from the truth by more than $\frac{1}{1000}$th part of an inch.

By these propositions, also, the variations of gravity in different parts of the earth's surface and on the tops of mountains has been ascertained. Newton also has shown, by means of the pendulum, that gravity does not depend upon the surface nor figure of a body.

338 Of central forces.

The motion of bodies round a centre affords another well known instance of a constant force. As the motion of matter left to itself is uniform and rectilinear, it is obvious that a body moving in the circumference of a curve, must have a continual tendency to fly off at a tangent. This tendency is called a *centrifugal force*, while every force directed towards a centre is called a *central* or *centripetal force*. In circular motions the central force is equal, and directly contrary, to the centrifugal force. It tends constantly, to bring the body towards the centre, and in a very short interval of time, its effect is measured by the versed sine of the small arch described.

Let A (fig. 123.) be the centre of a force. Let a body in B be moving in the direction of the straight line BC, in which line it would continue to move if undisturbed; but being attracted by the centripetal force towards A, the body must necessarily depart from this line BC; and being drawn into the curve line BD, must pass between the lines AB and BC. It is evident, therefore, that the body in B being gradually turned off from the straight line BC, it will at first be convex towards that line, and concave towards A. And that the curve will always continue to have this concavity towards A, may thus appear: In the line BC, near to B, take any point, as E, from which the line EFG may be so drawn as to touch the curve line BD in some point, as F. Now, when the body is come to F, if the centripetal power were immediately to be suspended, the body would no longer continue to move in a curve line, but, being left to itself, would forthwith reassume a straight course, and that straight course would be in the line FG; for that line is in the direction of the body's motion of the point F. But the centripetal force continuing its energy, the body will be gradually drawn from this line FG so as to keep in the line FD, and make that line, near the point F, to be concave towards the point A; and in this manner the body may be followed in its course throughout the line BD, and every part of that line be shown to be concave towards the point A.

Again, the point A (fig. 124.) being the centre of a centripetal force, let a body at B set out in the direction

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rection of the straight line BC, perpendicular to the line AB. It will be easily conceived, that there is no other point in the line BC so near to A as the point B; that AB is the shortest of all the lines which can be drawn from A to any part of the line BC; all others, as AD or AE, being longer than AB. Hence it follows, that the body setting out from it, if it moved in the line BC, would recede more and more from the point A. Now, as the operation of a centripetal force is to draw a body towards the centre of that force, if such a force act upon a resting body, it must necessarily put that body so into motion as to cause it move towards the centre of the force: if the body were of itself moving towards that centre, it would accelerate that motion, and cause it to move faster down; but if the body were in such a motion that it would of itself recede from the centre, it is not necessary that the action of a centripetal power should make it immediately approach the centre from which it would otherwise have receded; the centripetal force is not without effect if it cause the body to recede more slowly from that centre than otherwise it would have done. Thus, the smallest centripetal power, if it act on the body, will force it out of the line BC, and cause it to pass in a bent line between BC and the point A, as has been already explained. When the body, for instance, has advanced to the line AD, the effect of the centripetal force discovers itself by having removed the body out of the line BC, and brought it to cross the line AD somewhere between A and D, suppose at F. Now, AD being longer than AB, AF may also be longer than AB. The centripetal power may indeed be so strong, that AF shall be shorter than AB; or it may be so evenly balanced with the progressive motion of the body that AF and AB shall be just equal; in which case the body would describe a circle about the centre A: this centre of the force being also the centre of the circle.

If now the body, instead of setting out in the line BC perpendicular to AB, had set out in another line BG more inclined towards the line AB, moving in the curve line BH; then, as the body, if it were to continue its motion in the line BG, would for some time approach the centre A, the centripetal force would cause it to make greater advances towards that centre: But if the body were to set out in the line BI, reclined the other way from the perpendicular BC, and were to be drawn by the centripetal force into the curve line BK; the body, notwithstanding any centripetal force, would for some time recede from the centre; since some part at least of the curve line BK lies between the line BI and the perpendicular BC.

Let us next suppose a centripetal power directed toward the point A (fig. 109.), to act on a body in B, which is moving in the direction of the straight line BC, the line BC reclining off from AB. If from A the straight lines AD, AE, AF, are drawn to the line CB, prolonged beyond B to G, it appears that AD is inclined to the line GC more obliquely than AB, AE more obliquely than AD, and AF than AE; or, to speak more correctly, the angle under ADG is less than that under ABG, that under AEG is less than ADG, and AFG less than AEG. Now suppose the body to move in the curve line BHIK, it is likewise evident that the line BHIK being concave towards A and convex towards BC, it is more and more turned off from that line: so that in the point H, the line AK will be more obliquely inclined to the curve line BHIK than the same line AHD is inclined to BC at the point D; at the point I the inclination of the line AI to the curve line will be more different from the inclination of the same line AIE to the line BC at the point IE; and in the points K and F the difference of inclination will be still greater; and in both, the inclination at the curve will be less oblique than at the straight line BC. But the straight line AB is less obliquely inclined to BG than AD is inclined towards DG: therefore, although the line AH be less obliquely inclined towards the curve HB than the same line AHD is inclined towards DG, yet it is possible, that the inclination at H may be more oblique than the inclination at B. The inclination at H may indeed be less oblique than the other, or they may be both the same. This depends upon the degree of strength wherewith the centripetal force exerts itself during the passage of the body from B to H: and in like manner the inclinations at I and K depend entirely on the degree of strength wherewith the centripetal force acts on the body in its passage from H to K: if the centripetal force be weak enough, the lines AH and AI drawn from the centre A to the body at H and at I, shall be more obliquely inclined to the curve than the line AB is inclined towards BG. The centripetal force may be of such a strength as to render all these inclinations equal; or if stronger, the inclination at I and K will be less oblique than at B; and Sir Isaac Newton has particularly shown, that if the centripetal power decreases after a certain manner without the increase of distance, a body may describe such a curve line, that all the lines drawn from the centre to the body shall be equally inclined to that curve line.

339 Revolution of a body round a centre explained.

We must further remark, that if the centripetal power, while the body increases its distance from the centre, retain sufficient strength to make the lines drawn from the centre to the body to become at length less oblique to the curve: then, if this diminution of the obliquity continue, till at last the line drawn from the centre to the body shall cease to be obliquely inclined to the curve, and become perpendicular thereto; from this instant the body shall no longer recede from the centre, but in its following motion shall again descend, and describe a curve in all respects like that which it has described already, provided the centripetal power, everywhere at the same distance from the body, acts with the same strength. This return of the body may be proved by the following proposition: That if the body in any place, suppose at I, were to be stopped, and thrown directly backward with the velocity wherewith it was moving forward in that point I, then the body, by the action of the centripetal force upon it, would move back again over the path IHB, in which it had before advanced forward, and would arrive again at the point B in the same space of time as was taken up in its passage from B to I; the velocity of the body at its return from the point B being the same as that wherewith it first set out from that point.

The truth of this proposition may be illustrated in the following manner. Suppose, in fig. 110. that a body

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body were carried after the following manner through the bent figure ABCDEF, composed of the straight lines AB, BC, CD, DE, EF: let the body then first be supposed to receive an impulse to some point within the concavity of the figure, as G. Now, as this body, when once moving in the straight line AB, will continue to move on in this line as long as it shall be left to itself; but being disturbed at the point B by the impulse given it, it will be turned out of this line AB into some other straight line, wherein it will afterwards continue to move as long as it shall be left to itself; therefore, let this impulse have strength sufficient to turn the body into the line BC; then let the body move on undisturbed from B to C: but at C let it receive another impulse pointed also towards G, and of sufficient strength to turn the body into the line CD; at D let a third impulse turn it into the line DE; and at E let another turn it into EF. Now, if the body, while moving on in the line EF, be stopped and turned back again with the same velocity with which it was moving forward, then by the repetition of the former impulse at E, the body will be turned into the line ED, and move in it from E to D with the same velocity as that wherewith it was moving forward in this line: then by a repetition of the impulse at D, when the body shall have returned to that point, it will be turned into the line DC; and by the repetition of the former impulses at C and at B, the body will be brought back again into the line BA, with the velocity wherewith it first moved in that line.

To illustrate this still farther, let DE and FE be continued beyond E. In DE thus continued, take at pleasure the length EH, and let HI be so drawn as to be equidistant from the line GE; then, from the second law of motion, it follows, that after the impulse on the body on E, it will move through the space EI in the same time it would have employed in moving from E to H with the velocity it had in the line DE. In FE prolonged, take EK equal to EI, and draw KL equidistant from GE. Then because the body is thrown back in the line FE, with the same velocity with which it went forward in that line, if, when the body was turned to E, it were permitted to go straight on, it would pass through EK in the same time as it took up in passing through EI, when it went forward in the line EF. But if, at the body's return to the point E, such an impulse directed toward the point D were to be given it as was sufficient to turn it into the line DE, it is plain that this impulse must be equal to that which originally turned the body out of the line DE into EF; and that the velocity with which the body will return into the line ED is the same as that wherewith it moved before through this line from D to E. Because EK is equal to EI, and KL and HI being each equidistant from GE, are by consequence equidistant from each other; it follows, that the two triangular figures IEH and KEL, are altogether like and equal to each other. EK therefore being equal to EI, and EL equal to KH, and KL equal to HL, it is plain, that the body, after its return to E, being turned out of the line FE into ED by an impulse acting upon it in E after the manner above mentioned, it will receive such a velocity by this impulse as will carry it through EL in the same time it would have taken to go through EK, if it had passed through it undisturbed. It has already been observed, that the time in which the body would pass over EK, with the velocity wherewith it returns, is equal to the time it took up in going forward from E to I; that is, to the time in which it would have gone through EH with the velocity wherewith it moved from D to E; therefore the time in which the body will pass from E to L, after its return into the line ED, is the same as would have been taken up by the body in passing through the line EH with the velocity wherewith it first moved in the line DE. Since, therefore, EL and EH are equal, the body returns into the line DE with the velocity which it had before in that line.—Again, we may affirm, that the second impulse in E is equal to the first; for, as the impulse in E, whereby the body was turned out of the line DE into the line EF, is of such strength, that if the body had been at rest when this impulse had acted upon it, it would have communicated as much motion to it, as would have been sufficient to carry it through a length equal to HI, in the time wherein the body would have passed from E to H, or in the time wherein it passed from E to I. In the same manner, on the return of the body, the impulse in E, whereby it is turned out of the line FE into ED, is of such strength, that if it had acted on the body at rest, it would have caused it move through a length equal to KL in the same time as the body would employ in passing through EK with the velocity wherewith it returns in the line FE: therefore the second impulse, had it acted on the body at rest, would have caused it to move through a length equal to KL, in the same space of time as would have been taken up by the body in passing through a length equal to HI were the first impulse to act on the body while at rest; that is, the effects of the first and second impulse on the body when at rest would be the same; for KL and HI are equal: consequently the second impulse is equal to the first. Thus, if the body be returned through FE with the velocity wherewith it moved forward, it has been shown how, by the repetition of the impulse which acted on it in E, the body will return again into the line DE with the velocity which it had before in that line. By the same method of reasoning it may be proved, that when the body is returned back to D, the impulse which before acted on that point will throw the body into the line DC with the velocity which it first had in that line; and the other impulses being successively repeated, the body will at length be brought back again into the line BA with the velocity wherewith it set out in that line.—Thus these impulses, by acting over again in an inverted order all their operations on the body, bring it back again through the path in which it had proceeded forward; and this obtains equally whatever be the number of straight lines whereof this curve figure is composed. Now, by a method of reasoning of which Sir Isaac Newton made much use, and which he introduced into geometry, thereby greatly enriching that science, we might make a transition from this figure, composed of a number of straight lines, to a figure of one continued curvature, and from a number of separate impulses repeated at distinct intervals to a continued centripetal force, and show that because what has been here advanced holds universally true whatever be the number

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ber of straight lines whereof the curve figure ACF is composed, and however frequently the impulses at the angles of this figure are repeated; therefore the same will still remain true although this figure should be converted into one of a continued curvature; and these distinct impulses should be changed into a continual centripetal force.

This being allowed, suppose the body in K to have the line AK no longer obliquely inclined to its motion. In this case, if the body be turned back in the manner we have been considering, it must be directed back perpendicularly to AK: but if it had proceeded forward, it would likewise have moved in a direction perpendicular to AK: consequently, whether it move from this point K backward or forward, it must describe the same kind of course. Therefore, since by being turned back it will go over again the line KIHB, if it be permitted to go forward, the line KL, which it shall describe, will be altogether similar to the line KHB.

In like manner we may determine the nature of the motion, if the line wherein the body sets out be inclined, as in fig. 127. down toward the line BA drawn between the body and the centre. If the centripetal power so much increases in strength as the body approaches, that it can bend the path in which the body moves to that degree as to cause all the lines, AH, AI, AK, to remain no less oblique to the motion of the body than AB is oblique to BC, the body shall continually more and more approach the centre. But if the centripetal power increases in so much less a degree as to permit the line drawn from the centre to the body, as it accompanies the body in its motion, at length to become more and more erect to the curve wherein the body moves, and in the end, suppose at K, to become perpendicular to it; from that time the body shall rise again. This is evident from what has been said above; because, for the very same reason, here also, the body will proceed from the point K to describe a line altogether similar to that in which it has moved from B to K. Thus it happens as in the pendulum, which, all the time it approaches a perpendicular position towards the horizon, descends more and more; but as soon as it is come into that situation, it immediately rises again by the same degrees as it descended before: so here the body more and more approaches the centre all the time it is moving from B to K; but thenceforward it rises from the centre again by the same degrees as it approached before.

If, as in fig. 127. the line BC be perpendicular to AB; then, as has already been observed, the centripetal power may be so balanced with the progressive motion of the body, that it may keep moving round the centre A constantly at the same distance; as the body does when whirled about any point to which it is tied by a string. If the centripetal power be too weak to produce this effect, the motion of the body will presently become oblique to the line drawn from itself to the centre; but if it be stronger, the body must constantly keep moving in a curve to which a line drawn from it to the body is perpendicular.

If the centripetal power change with the change of distance, in such a manner that the body, after its motion has become oblique to the line drawn from itself to the centre, shall again become perpendicular thereto; then the body shall, in its subsequent motion, return again to the distance of AB, and from that distance take a course similar to the former: and thus, if the body move in a space void of all resistance, which has been all along supposed, it will continue in a perpetual motion about the centre, descending and ascending from it alternately. If the body, setting out from B (fig. 126.) in the line BC perpendicular to AB, describe the line BDE, which in D shall be oblique to the line AD, but in E shall again become erect to AE, drawn from the body in E to the centre A; then from this point E the body shall describe the line EFG entirely similar to BDE, and at G shall be at the same distance as it was at B; and the line AG shall be erect to the body's motion. Therefore the body shall proceed to describe from G the line GHI altogether similar to the line GFE, and at I it will have the same distance from the centre as it had at E; and also have the line AI erect to its motion: so that its subsequent motion must be in the line IKL similar to IKG, and the distance AL equal to AG. Thus the body will go on in a perpetual round without ceasing, alternately enlarging and contracting its distance from the centre.

If it so happen that the point E fall upon the line BA, continued beyond A; then the point G will fall upon B, I on E, and L also on B; so that the body will in this case describe a simple curve line round the centre A, like the line BDEF in fig. 126. in which it will revolve from P to E, and from E to B, without end. If AE in fig 126. should happen to be perpendicular to AB, in this case also a simple line will be described; for the point G will fall on the line BA prolonged beyond A; the point I on the line AE prolonged beyond A; and the point L on B; so that the body will describe a line like the curve line BEGI in fig. 128. in which the opposite points B and G are equally distant from A; and the opposite points E and L are also equally distant from the same point A. In other cases the body will have a course of a more complicated nature.

Thus it must be apparent how a body, while it is constantly attracted towards the centre, may notwithstanding by its progressive motion keep itself from falling down to the centre, describing about it an endless circuit, sometimes approaching and sometimes receding from it. Hitherto, however, we have supposed, that the centripetal power is everywhere of equal strength at the same distance from the centre: and this is indeed the case with that power which keeps the planets in their orbits; but a body may be kept on in a perpetual circuit round a centre, although the centripetal power be kept moving in any curve line whatever, that shall have its concavity turned everywhere towards the centre of the force. To illustrate this, we shall in the first place propose the case of a body moving in the incurvated figure ABCDE (fig. 129.), which is composed of the straight lines, AB, BC, CD, DE, and AE; the motion being carried on in the following manner. Let the body first move in the line AB with any uniform velocity. When it is arrived at the point B, let it receive an impulse directed towards any point F taken within the figure; and let the impulse be of such a strength as to turn the body out of the line AB into the line BC: The body after this impulse, while

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while left to itself, will continue moving in the line BC. At C let the body receive another impulse directed towards the same point F, of such strength as to turn it from the line CB into CD. At D, let the body, by another impulse, directed likewise towards the point F, be turned out of the line CD into DE. At E, let another impulse, directed likewise towards the point F, turn the body from the line DE into EA: and thus the body will, by means of these impulses, be carried through the whole figure ABCDE.

Again, when the body is come to the point A, if it there receive another impulse directed like the rest to the point F, and of such a degree of strength as to turn it into the line AB, wherein it first moved; the body will then return into this line with the same velocity it had originally. To understand this, let AB be prolonged beyond B at pleasure, suppose to G; and from G let GH be drawn; which, if produced, should always continue equidistant from BF, i. e. let GH be drawn parallel to BF, in the time, then, in which the body would have moved from B to G, had it not received a new impulse in B; by the means of that impulse it will have acquired a velocity which will carry it from B to H. After the same manner, if CI be taken equal to BH, and IK be drawn parallel to CF, the body will have moved from C to K, with the velocity which it has in the line CD, in the same time it would have employed in moving from C to I with the velocity it had in the line BC. Therefore, since CI and BH are equal, the body will move through CK in the same time as it would have taken up in moving from B to G with the velocity wherewith it moved through the line AB. Again, DL being taken equal to CK, and LM drawn parallel to DF, the body will for the same reason as before, move through DM with the velocity which it has in the line DE, in the same time it would employ in moving through BG with its original velocity. Lastly, if EN be taken equal to DM, and NO be drawn parallel to EF; likewise, if AP be taken equal to EO, and PQ be drawn parallel to AF; then the body, with the velocity wherewith it runs into the line AB, will pass through AQ in the time it would have employed in passing through BG with its original velocity. Now as all this follows directly from what has been delivered concerning oblique impulses impressed upon bodies in motion; so we must here observe farther, that it can be proved by geometry, that AQ will always be equal to BG; which, being granted, it follows, that the body has returned into the line AB with the same velocity which it had when it first moved in that line; for the velocity with which it returns into the line AB will carry it over the line AQ in the same time as would have been taken up in its passing over an equal line BG with the original velocity.

340 A body may be moved in any curvilinear direction by means of centripetal force.

The conclusion naturally deduced from the above reasoning is, that by means of a centripetal and projectile force, a body may be carried round any fixed point as a curve figure which shall be concave towards it, as that marked ABC, fig. 130. and when it is returned to that point from whence it set out, it shall recover again the velocity with which it departed from that point. It is not indeed always necessary that it should return again into its first course, for the curve line may have some such figure as ABCDBE in fig. 131. In this curve line, if the body set out from B in the direction BF, and moved through the line BCD till it returned to B; here the body would not enter again into the line BCD, because the two parts BD and BC of the curve line make an angle at the point B: so that the centripetal power, which at the point B would turn the body from the line BF into the curve, will not be able to turn it into the line BC from the direction in which it returns to the point B. A forcible impulse must be given the body in the point B to produce that effect. If, at the point B, whence the body sets out, the curve line return into itself, as in fig. 130. then the body, upon its arrival again at B, may return into its former course, and thus make an endless circuit about the centre.

341 Calculation of the force requisite to carry a body in any curve line.

The force requisite to carry a body in any curve line proposed, is to be deduced from the curvature which the figure has in any part of it. Sir Isaac Newton has laid down the following proposition as a foundation for discovering this, viz. that if a line be drawn from some fixed point to the body, and remaining by one extreme united to that point, it be carried round along with the body; then if the power whereby the body is kept in its course be always pointed to this fixed point as a centre, this line will move over equal spaces in equal portions of time. Suppose a body were moving through the curve line ABCD (fig. 132.), and passed over the arches AB, BC, CD in equal portions of time; then if a point, as E, can be found, from whence the line EA being drawn to the body in accompanying it in its motion, it shall make the spaces EAB, EBC, and ECD, over which it passes, equal where the times are equal; then is the body kept in this line by a power always pointed to E as a centre. To prove this, suppose a body set out from the point A, fig. 133, to move in a straight line AB; and after it had moved for some time in that line, it were to receive an impulse directed to some point, as C. Let it receive that impulse at D, and thereby be turned into the line DE; and let the body after this impulse, take the same time in passing from D to E that is employed in passing from A to D. Then the straight lines CA, CD, and CE being drawn, the triangular spaces CAD and CDE are proved to be equal in the following manner. Let EF be drawn parallel to CD. Then it follows, from the second law of motion, that since the body was moving in the line AB when it received the impulse in the direction DC, it will have moved after that impulse through the line DE in the same time as it would have moved through DF, provided it had received no disturbance in D. But the time of the body's moving from D to E is supposed to be equal to the time of its moving through AD; therefore the time which the body would have employed in moving through DF, had it not been disturbed in D, is equal to the time wherein it moved through AD: consequently DF is equal in length to AD; for if the body had gone on to move through the line AB without interruption, it would have moved through all the parts of it with the same velocity, and have passed over equal parts of that line in equal portions of time. Now CF being drawn, since AD and DF are equal, the triangular space CDF is equal to the triangular space CAD. Further, the line EF being parallel to CD, it follows from the 37th proposition of Euclid's first book, that the triangle

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angle CED is equal to the triangle CFD: therefore the triangle CED is equal to the triangle CAD.

In like manner, if the body receive at E another impulse directed toward the point C, and be turned by that impulse into the line EG; if it move afterwards from E to G, in the same space of time as was taken up by its motion from D to E, or from A to D; then CG being drawn, the triangle CEG is equal to CDE. A third impulse at G, directed as the two former to C, whereby the body shall be turned into the line GH, will have also the like effect with the rest. If the body move over GH in the same time as it took up in moving over EG, the triangle CGH will be equal to the triangle CEG. Lastly, if the body at H be turned by a fresh impulse directed towards C into the line HI, and at I by another impulse directed also to C be turned into the line IK; and if the body move over each of the lines HI and IK in the same time as it employed in moving over each of the preceding lines AD, DE, EG, and GH: then each of the triangles CHI and CIK will be equal to each of the preceding. Likewise, as the time in which the body moves over ADE is equal to the time of its moving over EGH, and to the time of its moving over HIK; the space CADE will be equal to the space CEGH and to the space CHIK. In the same manner, as the time in which the body moved over ADEG is equal to the time of its moving over GHIK, so the space CADEG will be equal to the space CGHIK. From this principle Sir Isaac Newton demonstrates the above-mentioned proposition, by making the transition from this incurvated figure composed of straight lines, to a figure of continued curvation; and by showing, that since equal spaces are described in equal times in this present figure composed of straight lines, the same relation between the spaces described, and the times of their description, will also have place in a figure of one continued curvature. He also deduces from this proposition the reverse of it; and proves, that whenever equal spaces are continually described, the body is acted upon by a centripetal force directed to the centre at which the spaces terminate.

342 Comparison of the centrifugal force with gravitation.

As the effect of a central force in a very small interval of time is measured by the versed sine of the small arch described, we may easily compare the centrifugal force produced by the rotation of the earth with gravitation. At the equator, a body in consequence of the rotation of the earth describes an arch of 15″ of the circumference of the earth, in 1″ of time. The radius of the equator is about 19634778 French feet; the versed sine of which is 0.0389704 feet. At the equator a body falls 11.23585 French feet in a second. The centrifugal force is to gravity as 0.0389704 to 1123585, or nearly as 1 to 288.3. The centrifugal force diminishes gravity, and bodies only fall in consequence of the excess of the last above the first. If the whole force whose effect would be evident, were there no rotation, be called *gravity;* then at the equator the centrifugal force is about $\frac{1}{289}$ of gravity. If the earth revolved 17 times faster than it does, the arch described in a second would be 17 times greater, and its versed sine 289 times longer; the centrifugal force would then be equal to gravity, and at the equator, bodies would cease to have any weight.

In general the expression of a uniformly accelerating force, acting constantly towards the same point, is equal to twice the space which it causes the body to describe, divided by the square of the time. Every accelerating force may be supposed constant for a very small interval of time, and acting in the same direction. The space described by a body moving in a circle in consequence of the central force, is the versed sine of the small arch described; and this versed sine is very nearly equal to the square of the arch divided by radius. The expression of the accelerating force is then the square of the arch described, divided by the square of the time, and by radius. The arch divided by the time gives the velocity. Hence the centripetal and centrifugal forces are equal to the square of the velocity divided by radius.

We have seen that gravity is equal to the square of the acquired velocity divided by twice the space gone through. Of course the centrifugal force is equal to gravity, if the velocity of the revolving body be that which it would acquire by falling from a height equal to half the radius of the circumference described. The velocities of different revolving bodies are as the circumferences which they describe divided by the time of their revolution. These circumstances are as their radii. The squares of the velocity of course are as the squares of the radii divided by the squares of the times. Hence centrifugal forces are to each other as the radii of the circumferences described divided by the squares of the times of the revolutions. Hence in different parallels of latitude, the centrifugal forces produced by the rotation of the earth are proportional to the radii of these parallels.

These remarks will give the reader an idea of the laws of motion. For a more particular investigation he must have recourse to those articles that treat particularly of Dynamics.

Chap. II. *Of Universal Gravitation.*

The principles of dynamics being understood, let us make use of them to examine the motions of the heavenly bodies, in order to detect the general laws which produce and regulate these motions.

343 Planets revolve round the sun.

We have seen that the planets and comets move in ellipses round the sun, and that the areas described by their radii vectors are proportional to the time. The principles of dynamics laid down in the last chapter, inform us that this could not happen unless each of these bodies were constantly acted on by a force turning them from the straight line in the direction of the centre of these radii vectors. Hence it follows, that the planets are constantly acted upon by a force which urges them towards the sun as a centre.

344 in consequence of a force residing in the sun.

Let us suppose that the planets revolve round the sun in circles, which is not very far from the truth. In that case, the squares of their velocities are proportional to the squares of the radii of their orbits, divided by the squares of the times of their revolution. But by the laws of Kepler, the squares of the times are as the cubes of the radii of the orbits of the planet, or of the distance. Therefore, the squares of the velocity are reciprocally as these radii. Perhaps this reasoning will be better understood by employing symbols. Let $t=$ the

the time, $v=$ the velocity, and $r=$ the radius, we have $v^2 \doteqdot \frac{r^2}{t^2}$. But $t^2 \doteqdot r^3$, therefore, substituting r^3 in the first formula, we have $v^2 \doteqdot \frac{r^2}{r^3}$, but $\frac{r^2}{r^3} = \frac{1}{r}$, therefore we have $v^2 \doteqdot \frac{1}{r}$, or v^2 always reciprocally proportional to r. We have seen formerly that the central forces of different bodies revolving in a circle, are as the squares of the velocity divided by the radii of their orbits. Therefore, the tendency of the planets to the sun, then, are reciprocally as the squares of the radii of their orbits, or their distance from the sun. This will be better understood if we express it by symbols. We have $v^2 \doteqdot \frac{1}{r}$. Let c denote the central force, $c \doteqdot \frac{v^2}{r}$; for v^2 substitute its equivalent $\frac{1}{r}$, and we have $c \doteqdot \frac{1}{r^2}$.

It is true that the orbits of the planets are not exactly circular; but as the law of the squares of the times, proportional to the cubes of the distances, is independent of the eccentricity of the planetary orbits, it is natural to suppose, that it would exist, even though the eccentricity were destroyed. The law, therefore, that the tendency to the sun is inversely as the square of the distance, is clearly indicated by this ratio.

345 **This force inversely as the square of the distance.** Analogy leads us to suppose, that this law, which extends from one planet to another, holds also with respect to the same planet in all its different distances from the sun. That this is actually the case, follows with certainty from the elliptical orbits of the planets. When the planet is in its perihelion, its velocity is a maximum, and its tendency to separate from the sun in consequence of this velocity overcoming the tendency towards the sun, the radius vector increases in length, and forms obtuse angles with the direction of the planet. Hence it opposes, and of course, tends to diminish the velocity, till the planet reaches its aphelion. Then the radius vector becomes perpendicular to the curve, the velocity is at its minimum; and the tendency to separate from the sun being less than the tendency towards the sun, the planet approaches towards it, describing the second part of its elliptical orbit. In that part, the tendency to the sun increases the velocity of the planet, as in the former part it had diminished it: the planet accordingly comes to its perihelion with a maximum of velocity. Now the curvature of the ellipse being the same at the perihelion and aphelion, the radii of the equicurve circles will be the same, and, of course, the centrifugal forces in these two points will be to each other as the squares of the velocity. The sectors described in the same times being equal, the velocities at the aphelion and perihelion are reciprocally as the corresponding distances of the planet from the sun. Of course, the squares of the velocities are reciprocally as the squares of these distances, or at the perihelion and aphelion the centrifugal forces are equal to the tendency of the planet towards the sun. Therefore this tendency is inversely as the square of the distance of the planet from the sun.

346 **Tendency the same in all the planets.** We see then, in general, that all the planets tend towards the sun, with a force inversely as the square of their distance. Newton demonstrated, that this force would cause them, if projected with a given velocity, to describe ellipses round the sun as a centre. He demonstrated farther, that this tendency is the same in all the planets, varying only according to their distances. Hence it follows, that if they were all at rest, and placed at the same distance from the sun, they would all, in consequence of this tendency, *fall* into the sun at the same instant; the same result must be applied also to the comets, for in them also the squares of the times are undoubtedly proportional to the cubes of their distance from the sun.

347 **and satellites.** The satellites tend equally to the sun with the planets around which they revolve. Were not the moon under the influence of this tendency, instead of describing a circle round the earth, it would soon abandon it altogether. Unless the satellites of Jupiter and the moon tended towards the sun, irregularities would be perceptible in their orbits, which they do not exhibit. The planets, comets, and satellites, then, all tend to the sun in consequence of the action of the same force. While the satellites move round their planet, the entire system of planet and satellites is carried round the sun, and retained in their orbits by the same force. Of course, the motion of the satellites round the planet, is merely the same as if the planet were altogether at rest, and not acted upon by any foreign body.

348 **Hence the sun's centre attracts all bodies.** Thus we have been led, without assuming any hypothesis, by the necessary consequence of the laws of the celestial movements, to consider the centre of the sun as the focus of a *force*, which extends itself indefinitely through space, diminishing inversely as the squares of the distance, and which *attracts* all bodies within the sphere of its activity. Each of Kepler's laws points out a property of this attractive force. The law of the areas proportional to the times, informs us, that the force is directed towards the sun; the elliptical figure of the planets proves to us, that its intensity diminishes as the square of the distance augments; and the law of the squares of the times proportional to the cubes of the distance, informs us, that the tendency, or *gravitation* of all the planets to the sun is the same, provided the distances were the same. We may call this force *solar attraction*, supposing, for the sake of a distinct conception, that it is a *force* residing in the sun.

349 **Satellites tend to their primaries.** The tendency or gravitation of the satellites towards their planets is a necessary consequence of the areas described by their radii vectors being proportional to the times; that this gravitation is inversely as the square of their distance, is indicated by the ellipticity of their orbits. This ellipticity, indeed, being scarcely apparent in most of the satellites of Jupiter, Saturn, and Herschel, would leave some uncertainty, did not the third law, namely, the squares of the times being inversely as the cubes of their distance, demonstrate, that from one satellite to another, the tendency to the planet is inversely as the square of the distance.

350 **Moon's tendency the same with gravitation.** This proof, indeed, is wanting with respect to our moon; but the defect may be supplied by the following considerations. *Gravity*, or the weight by which a body tends towards the earth, extends itself to the top of the highest mountains, and the very trifling diminution which it experiences at that height, cannot permit us to doubt, that it would still be sensible at a considerably

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considerably greater distance from the earth's centre. Is it not natural to extend it as far as the moon, and to suppose that the force which retains that satellite in its orbit, is its *gravitation* towards the earth, just as it is the solar attraction which retains the planets in their orbits? The forces at least seem to be of the same nature; they both act upon every particle of bodies, and cause them to move at the same rate; for the solar attraction acts equally upon all bodies placed at the same distance from the sun, just as gravitation causes all bodies to fall from the same height with the same velocity. A body projected horizontally, falls upon the earth at some distance after describing a curve sensibly parabolic. It would fall at a greater distance, if the force of projection were more considerable; and, if projected with a certain velocity, it would not fall back at all, but revolve round the earth like a satellite. To make it move in the orbit of the moon, it would be necessary only to give it the same height and the same projecting force. But what demonstrates the identity of gravitation and of the force which retains the moon in its orbit is, that if we suppose gravity to diminish inversely as the square of the distance from the centre of the earth, at the distance of the moon it will be precisely equal to the moon's tendency to the earth.

Let A in fig. 134. represent the earth, B the moon, BCD the moon's orbit; which differs little from a circle of which A is the centre. If the moon in B were left to itself to move with the velocity it has in the point B, it would leave the orbit, and proceed straight forward in the line BE which touches the orbit in B. Suppose the moon would upon this condition move from B to E in the space of one minute of time: By

351 Her motion particularly explained.

the action of the earth upon the moon, whereby it is retained in its orbit, the moon will really be found at the end of this minute in the point F, from whence a straight line drawn to A shall make the space BFA in the circle equal to the triangular space BEA; so that the moon in the time wherein it would have moved from B to E, if left to itself, has been impelled towards the earth from E to F. And when the time of the moon's passing from B to F is small, as here it is only one minute, the distance between E and F scarce differs from the space through which the moon would descend in the same time if it were to fall directly down from B toward A without any other motion. AB, the distance of the moon from the earth, is about 60 of the semidiameters of the latter; and the moon completes her revolution round the earth in about 27 days 7 hours and 43 minutes: therefore the space EF will here be found by computation to be about $16\frac{1}{12}$ feet. Consequently, if the power by which the moon is retained in its orbit be near the surface of the earth greater than at the distance of the moon in the duplicate proportion of that distance, the number of feet a body would descend near the surface of the earth, by

352 Calculation of the velocity of falling bodies.

the action of this power upon it, in one minute would be equal to the number $16\frac{1}{12}$ multiplied twice into the number 60; that is, to 58050. But how fast bodies fall near the surface of the earth may be known by the pendulum; and by the exactest experiments, they are found to descend the space of $16\frac{1}{12}$ feet in one second; and the spaces described by falling bodies being in the duplicate proportion of the times of their fall, the number of feet a body would describe in its fall near the surface of the earth in one minute of time will be equal to $16\frac{1}{12}$ twice multiplied by 60; the same as would be caused by the power which acts upon the moon.

353 Earth and moon move about their common centre of gravity.

In this computation the earth is supposed to be at rest: but it would have been more exact to have supposed it to move, as well as the moon, about their common centre of gravity; as will be easily understood from what has been already said concerning the motion of the sun and primary planets about their common centre of gravity. The action of the sun upon the moon is also here neglected; and Sir Isaac Newton shows, if you take in both these considerations, the present computation will best agree to a somewhat greater distance of the moon and earth, viz. to $60\frac{1}{2}$ semidiameters of the latter, which distance is more conformable to astronomical observations: and these computations afford an additional proof that the action of the earth observes the same proportion to the distance which is here contended for.

We see then that the force which retains the moon in its orbit is *gravitation*, or that force which causes heavy bodies to fall to the ground. This comparison between gravity and the lunar tendency to the earth shows us, that, in our calculations, we ought to measure distance from the centre of gravity of the sun and of the planets; for this is obviously the case with the earth, and its tendency to the sun is precisely the same with that of the other planets.

354 Planets react upon the sun.

The sun and the planets which have satellites, possessing, as we have seen, an attracting force inversely as the square of the distance, one is tempted to give the same property to the other planets also. The sphericity common to all these bodies, indicates clearly, that their particles are retained round their centre of gravity, by a force which at equal distances attracts them equally to that centre. But this important point is not left to analogical reasoning. We have seen, that if the planets and comets were placed at equal distances from the sun, their gravitation towards it would be proportional to their masses. But it may be considered as a general matter of fact, to which there is no exception, that action and reaction are equal and contrary. Of course all these bodies react upon the sun, and *attract* it in proportion to their mass, and consequently possess an attractive force proportional to their mass, and inversely as the square of their distance. The satellites also, in consequence of the same principle, attract the planets and the sun according to the same law. This attracting force is then common to all the heavenly bodies.

This force does not disturb the elliptical motion of the plants round the sun, when we consider only their mutual action. For the relative movement of a system of bodies does not change by giving them a common motion. Neither is the elliptical motion of the satellites disturbed by the revolution of the planets round the sun, for the very same reason.

The attractive force does not belong to these bodies only as wholes; but it belongs to every particle of matter of which each of them is composed. If the sun acted only upon the centre of the earth, without attracting every one of the particles of which it is composed individually, there would result *tides* incomparably greater, and very different from those that we observe.

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observe. Besides, every body on the earth gravitates towards its centre, in proportion to its mass. It reacts of course upon the earth, and attracts it in the same ratio. Unless that were the case, or if any part of the earth, however small, did not attract the other part as it is attracted by it, the centre of gravity of the earth would be moved in space, in consequence of gravitation; which is impossible.

355 General law of gravitation.

All these phenomena, compared with the laws of motion, lead us to this grand conclusion: *All the particles of matter mutually attract each other, in proportion to their masses, and inversely as the squares of their distances.* This is called *universal gravitation*, and was the discovery which crowned the happy industry, the consummate skill, and the unrivalled sagacity of Newton.

In universal gravitation, we readily perceive a cause of the irregularities and disturbances perceptible in the planetary motions. For as the planets and comets act upon each other, they ought to deviate a little from that exact ellipticity, which they would follow if they obeyed only the action of the sun. The satellites, disturbed equally by their mutual attraction, and by that of the sun, must deviate also from these laws. We see also, that the particles of which each heavenly body is composed, provided they be at liberty to move, ought to form themselves into a sphere, and that the result of their mutual action at the surface of this sphere ought to produce all the phenomena of gravity. We see also, that the rotation of the heavenly bodies round an axis ought to alter this sphericity somewhat by flattening them at the poles, and that the result of their mutual action not passing exactly through their centres of gravity, ought to produce in their axis of rotation motions similar to those which we perceive. We see also, that the particles of the ocean, unequally attracted by the sun and moon, ought to have an oscillation similar to the tides. But it will be necessary to consider the effects of gravitation more particularly; in order to show that it is established in the completest manner by all the phenomena. This shall be the subject of the next chapter.

Chap. III. *Of the Effects of Gravitation.*

We shall in this chapter consider, in the first place, several points which could only be ascertained by the assistance of gravitation, and afterwards examine the several subjects hinted at towards the conclusion of the last chapter.

Sect. I. *Of the Masses of the Planets.*

It would appear, at first view, impossible to ascertain the respective masses of the sun and planets, and to calculate the velocity with which heavy bodies fall towards each when at a given distance from their centres; yet these points may be determined from the theory of gravitation without much difficulty.

356 Calculation of the densities of the planets.

It follows from the theorems relative to centrifugal forces, given in the first chapter of this part, that the gravitation of a satellite towards its planet is to the gravitation of the earth towards the sun, as the mean distance of the satellite from its primary, divided by the square of the time of its sidereal revolution, or the mean distance of the earth from the sun divided by the square of a sidereal year. To bring these gravitations to the same distance from the bodies which produce them, we must multiply them respectively by the squares of the radii of the orbits which are described: and, as at equal distances the masses are proportional to the attractions, the mass of the earth is to that of the sun as the cube of the mean radius of the orbit of the satellite, divided by the square of the time of its sidereal motion, is to the cube of the mean distance of the earth from the sun, divided by the square of the sidereal year.

Let us apply this result to Jupiter. The mean distance of his 4th satellite subtends an angle of 1530″.86 decimal seconds. Seen at the mean distance of the earth from the sun, it would appear under an angle of 7964″.75 decimal seconds. The radius of the circle contains 636619″.8 decimal seconds. Therefore the mean radii of the orbit of Jupiter's 4th satellite and of the earth's orbit are to each other as these two numbers. The time of the sidereal revolution of the 4th satellite is 16.6890 days; the sidereal year is 365.2564 days. These data give us $\frac{1}{1066.08}$ for the mass of Jupiter, that of the sun being represented by 1. It is necessary to add unity to the denominator of this fraction, because the force which retains Jupiter in his orbit is the sum of the attractions of Jupiter and the sun. The mass of Jupiter is then $\frac{1}{1067.08}$. The mass of Saturn and Herschel may be calculated in the same manner. That of the earth is best determined by the following method:

If we take the mean distance of the earth from the sun for unity, the arch described by the earth in a second of time will be the ratio of the circumference to the radius divided by the number of seconds in a sidereal year. If we divide the square of that arch by the diameter, we obtain $\frac{1479565}{10^{20}}$ for its versed sine, which is the deflection of the earth towards the sun in a second. But on that parallel of the earth's surface the square of the sine of whose latitude is $\frac{1}{3}$, a body falls in a second $16\frac{1}{9}$ feet. To reduce this attraction to the mean distance of the earth from the sun, we must divide the number by the feet contained in that distance; but the radius of the earth at the above-mentioned parallel is 19614648 French feet. If we divide this number by the tangent of the solar parallax, we obtain the mean radius of the earth's orbit expressed in feet. The effect of the attraction of the earth at a distance equal to the mean radius of its orbit, is equal to $\frac{16\frac{1}{9}}{19614648}$ multiplied by the cube of the tangent of the solar parallax $= \frac{1479560.5}{10^{20}}$. Hence the masses of the sun and earth are to each other as the numbers 1479560.5 and 4.486113; therefore the mass of the earth is $\frac{1}{329809}$, that of the sun being unity.

M. de la Place calculated the masses of Mars and Venus from the secular diminution of the obliquity of the ecliptic, and from the mean acceleration of the moon's motion. The mass of Mercury he obtained from its volume, supposing the densities of that planet and

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and of the earth reciprocally as their mean distance from the sun, a rule which holds, with respect to the earth, Jupiter, and Saturn. The following table exhibits the masses of the different planets, that of the sun

357 being unity:

Table of the masses.

Mercury	$\frac{1}{2025810}$
Venus	$\frac{1}{383137}$
Earth	$\frac{1}{329809}$
Mars	$\frac{1}{1846082}$
Jupiter	$\frac{1}{1067.09}$
Saturn	$\frac{1}{3359.40}$
Herschel	$\frac{1}{19504}$

The densities of bodies are proportional to their masses divided by their bulks; and, when bodies are nearly spherical, their bulks are as the cubes of their semidiameters, of course the densities in that case are as the masses divided by the cubes of the semidiameters. For greater exactness, we must take that semidiameter of a planet which corresponds to the parallel, the square of the sine of which is equal to $\frac{1}{3}$, and which is equal to the third of the sum of the radius of the pole, and twice the radius of the equator. This method gives us the densities of the principal planets as follows, that of the sun being unity:

358 Of their densities.

Earth	3.93933
Jupiter	0.86014
Saturn	0.49512
Herschel	1.13757

359 Of gravity at their surfaces.

To have the intensity of gravitation at the surface of the sun and planets, let us consider, that, if Jupiter and the earth were exactly spherical, and destitute of their rotatory motion, gravitation at their equators would be proportional to the masses of these bodies divided by the squares of their diameters. But at the mean distance of the sun from the earth, the diameters of the equators of Jupiter and of the earth are to each other as the numbers 626.26 and 54.5. If then we represent the weight of a body at the earth's equator by 1, the same body, if transported to the equator of Jupiter, would weigh 2.509. But the difference of the centrifugal forces on the surface of the earth and Jupiter renders it necessary to diminish this last number by about $\frac{1}{9}$. The same body at the surface of the sun would weigh 27.65.

Sect. II. *Of the Perturbations in the Elliptical Orbit of the Planets.*

If the planets were influenced only by the sun, they would describe ellipses round that luminary: but they act upon one another, and from these various attractions there result disturbances in their elliptical motions, discoverable by observation, and which it is necessary to determine, in order to be able to construct accurate tables of the planetary motions. The rigorous solution of this problem is above the reach of the mathematical analysis; mathematicians have been obliged to satisfy themselves with approximations.

360 Secular and periodical inequalities.

The disturbances in the elliptical motions of the planets may be divided into two classes. The first class affects the elements of the elliptical motion: they increase very slowly, and have been called *secular* inequalities. The other class depends upon the configuration of the planets, either with respect to each other, or with respect to their nodes and perihelions, and are renewed every time that the relative situation of the planets becomes the same. They are called *periodical* inequalities, to distinguish them from the *secular*, whose periods are much longer and altogether independent of the mutual configuration of the planets. Before proceeding farther, we beg leave to introduce the following quotation from Dr Pemberton, because it will convey some notion of these disturbances in a very familiar manner to our readers.

361 Motion of the aphelion accounted for.

"The only inequalities which have been observed common to all the planets are, the motion of the aphelion and the nodes. The transverse axis of each orbit does not remain always fixed, but moves about the sun with a very slow progressive motion; nor do the planets keep constantly in the same planes, but change them and the lines by which these planes intersect each other by insensible degrees. The first of these inequalities, which is the motion of the aphelion, may be accounted for, by supposing the gravitation of the planets towards the sun to differ a little farther from the forementioned reciprocal duplicate proportion of the distances; but the second, which is the motion of the nodes, cannot be accounted for by any power directed towards the sun; for no such power can give it any lateral impulse to divert it from the plane of its motion into any new plane, but of necessity must be derived from some other centre. Where that power is lodged, remains to be discovered. Now it is proved, as shall afterwards be explained, that the three primary planets, Saturn, Jupiter, and the Earth, which have satellites revolving about them, are endowed with a power of causing bodies, in particular those satellites, to gravitate towards them with a force which is reciprocally in the duplicate proportion of their distances; and the planets are, in all respects in which they come under our consideration, so similar and alike, that there is no reason to question but they have all the same property, though it be sufficient for the present purpose to have it proved of Jupiter and Saturn only; for these planets contain much greater quantities of matter than the rest, and proportionally exceed the others in power. But the influence of these two planets being allowed, it is evident how the planets come to shift their places continually; for each of the planets moving in a different plane, the action of Jupiter and Saturn upon the rest will be oblique to the planes of their motion, and therefore will gradually draw them into new ones. The same action of these two planets upon the rest will likewise cause a progressive motion of the aphelion; so that there will be no necessity for having recourse to the other cause for this motion, which was before hinted at, viz. the gravitation of the planets toward the sun differing from the exact duplicate proportion

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portion of their distances. And, in the last place, the action of Jupiter and Saturn upon each other will produce in their motions the same inequalities as their joint action produces upon the rest. All this is effected in the same manner as the sun produces the same kind of inequalities and many others in the motion of the moon and other secondary planets; and therefore will be best apprehended by what is said afterwards. Those other irregularities in the motion of the secondary planets have place likewise here, but are too minute to be observable, because they are produced and rectified alternately, for the most part in the time of a single revolution; whereas the motion of the aphelion and nodes, which increase continually, become sensible after a long series of years. Yet some of these other inequalities are discernible in Jupiter and Saturn; in Saturn chiefly: for when Jupiter, who moves faster than Saturn, approaches to a conjunction with him, his action upon the latter will a little retard the motion of that planet; and by the reciprocal action of Saturn, he will himself be accelerated. After conjunction, Jupiter will again accelerate Saturn, and be likewise retarded in the same degree as before the first was retarded and the latter accelerated. Whatever inequalities besides are produced in the motion of Saturn by the action of Jupiter upon that planet, will be sufficiently rectified by placing the focus of Saturn's ellipsis, which should otherwise be the sun, in the common centre of gravity of the sun and Jupiter. And all the inequalities of Jupiter's motions, caused by the action of Saturn upon him, are much less considerable than the irregularities of Saturn's motion. This one principle, therefore, of the planets having a power as well as the sun to cause bodies gravitate towards them, which is proved by the motion of the secondary planets to obtain in fact, explains all the irregularities relating to the planetary motions ever observed by astronomers (c).

362 Jupiter and Saturn influence each other's motions.

363 Method of correcting the planetary motions.

"Sir Isaac Newton after this proceeds to make an improvement in astronomy, by applying this theory to the farther correction of their motions. For as we have here observed the planets to possess a principle of gravitation as well as the sun; so it will be explained at large hereafter, that the third law of motion, which makes action and reaction equal, is to be applied in this case, and that the sun does not only attract each planet, but is also itself attracted by them; the force wherewith the planet is acted on, bearing to the force wherewith the sun itself is acted upon at the same time, the proportion which the quantity of matter in the sun bears to the quantity of matter in the planet. From the action of the sun and planet being thus mutual, Sir Isaac Newton proves that the sun and planet will describe about their common centre of gravity similar ellipses; and then, that the transverse axis of the ellipsis, which would be described about the sun at rest in the same time, the same proportion as the quantity of solid matter in the sun and planet together bears to the first of two mean proportionals between this quantity and the quantity of matter in the sun only.

364 Sun moves round the common centre of gravity of him and the planets.

"It will be asked, perhaps, how this correction can be admitted, when the cause of the motions of the planets was before found, by supposing them to be the centre of the power which acted upon them? for, according to the present correction, this power appears rather to be directed to the common centre of gravity. But whereas the sun was at first concluded to be the centre to which the power acting on the planets was directed, because the spaces described in equal times round the sun were found to be equal; so Sir Isaac Newton proves, that if the sun and planet move round their common centre of gravity, yet, to an eye placed in the planet, the spaces which will appear to be described about the sun will have the same relation to the times of their description as the real spaces would if the sun were at rest. I further asserted, that, supposing the planets to move round the sun at rest, and to be attracted by a power which should everywhere act with degrees of strength reciprocally in the duplicate proportions of their distances; then the periods of the planets must observe the same relations to their distances as astronomers have found them to do. But here it must not be supposed, that the observations of astronomers absolutely agree without any the least difference: and the present correction will not cause a deviation from any one astronomer's observations so much as they differ from one another; for in Jupiter, where this correction is greatest, it hardly amounts to the 3000th part of the whole axis.

"Upon this head, I think it not improper to mention a reflection made by our excellent author upon these small inequalities in the planets motions, which contains in it a very strong philosophical argument against the eternity of the world. It is this, that these inequalities must continually increase by slow degrees, till they render at length the present frame of nature unfit for the purposes it now serves. And a more convincing proof cannot be desired against the present constitution's having existed from eternity than this, that a certain period of years will bring it to an end. I am aware, that this thought of our author has been represented even as impious, and as no less than casting a reflection upon the wisdom of the Author of nature for framing a perishable work. But I think so bold an assertion ought to have been made with singular caution: for if this remark upon the increasing irregularities in the heavenly motions be true in fact, as it really is, the imputation must return upon the assertor, that this does not detract from the divine wisdom. Certainly we cannot pretend to know all the omniscient Creator's purposes in making this world, and therefore cannot pretend to determine how long he designed it should last; and it is sufficient if it endure the time designed by the Author. The body of every animal shows

365 Argument against the eternity of the world.

(c) Professor J. Robison, however, informs us in his paper on the *Georgium Sidus* (Edinburgh Philosophical Transactions, Vol. I.), That *all* the irregularities in the planetary motions *cannot* be accounted for from the laws of gravitation; for which reason he was obliged to suppose the existence of planets beyond the orbit of Saturn, even before the discovery of the *Georgium Sidus*. M. de la Lande also has observed some unaccountable inequalities in the motion of Saturn for more than 30 years past.

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shows the unlimited wisdom of the Author, no less, nay, in many respects more, than the larger frame of nature: and yet we see they are all designed to last but a small space of time."

366 Deflection of the planets towards each other.

Sir Isaac Newton had no sooner discovered the universality and reciprocity of the deflections of the planets and the sun, than he also suspected that they were continually deflected towards each other. He immediately obtained a general notion of what should be the more general results of such a mutual action. They may be conceived in this way.

Let S (fig. 135.) represent the sun, E the earth, and I Jupiter, describing concentric orbits round the centre of the system. Make $IS : EA = EI^2 : SI^2$. Then, if

367 General result of such mutual action.

IS be taken to represent the deflection of the sun towards Jupiter, EA will represent the deflection of the Earth to Jupiter. Draw EB equal and parallel to SI, and complete the parallelogram EBAD. ED will represent the disturbing force of Jupiter. It may be resolvent into EF perpendicular to ES, and EG in the direction of SE. By the first of these the earth's angular motion round the sun is affected, and by the second its deflection towards him is diminished or increased.

In consequence of this first part of the disturbing force, the angular motion is increased, while the earth approaches from quadrature to conjunction with Jupiter (which is the case represented in the figure), and is diminished from the time that Jupiter is in opposition till the earth is again in quadrature, westward of his opposition. The earth is then accelerated till Jupiter is in conjunction with the sun; after which it is retarded till the earth is again in quadrature.

The earth's tendency to the sun is diminished while Jupiter is in the neighbourhood of his opposition or conjunction, and increased while he is in the neighbourhood of his stationary positions. Jupiter being about 1000 times less than the sun, and 5 times more remote, IS must be considered as representing $\frac{1}{25000}$th of the earth's deflection to the sun, and the forces ED and EG are to be measured on this scale.

In consequence of this change in the earth's tendency to the sun, the aphelion sometimes advances by the diminution, and sometimes retreats by the augmentation. It advances when Jupiter chances to be in opposition when the earth is in its aphelion; because this diminution of its deflection towards the sun makes it later before its path is brought from forming an obtuse angle with the *radius vector*, to form a right angle with it. Because the earth's tendency to the sun is, on the whole, more diminished by the disturbing force of Jupiter than it is increased, the aphelion of the earth's orbit advances on the whole.

In like manner the aphelia of the inferior planets advance by the disturbing forces of the superior: but the aphelion of a superior planet retreats; for these reasons, and because Jupiter and Saturn are larger and more powerful than the inferior planets, the aphelia of them all advance while that of Saturn retreats.

In consequence of the same disturbing forces, the node of the disturbed planet retreats on the orbit of the disturbing planet; therefore they all retreat on the ecliptic, except that of Jupiter, which advances by retreating on the orbit of Saturn, from which it suffers the greatest disturbance. This is owing to the particular position of the nodes and the inclinations of the orbits.

The inclination of a planetary orbit increases while the planet approaches the node, and diminishes while the planet retires from it.

368 A peculiarity explained in the motions of Jupiter and Saturn.

M. de la Place has completed this deduction of the planetary inequalities, by explaining a peculiarity in the motions of Jupiter and Saturn, which has long employed the attention of astronomers. The accelerations and retardations of the planetary motions depend, as has been shown, on their configurations, or the relative quarters of the heavens in which they are. Those of Mercury, Venus, the Earth, and Mars, arising from their mutual deflections, and their more remarkable deflections to the great planets Jupiter and Saturn, nearly compensate each other, and no traces of them remain after a few revolutions: but the positions of the aphelia of Saturn and Jupiter are such, that the retardations of Saturn sensibly exceed the accelerations, and the anomalistic period of Saturn increases almost a day every century; on the contrary, that of Jupiter diminishes. M. de la Place shows, that this proceeds from the position of the aphelia, and the almost perfect commensurability of their revolutions; five revolutions of Jupiter making 21,675 days, while two revolutions of Saturn make 21,538 differing only 137 days.

Supposing the relation to be exact, the theory shows, that the mutual actions of these planets must produce mutual accelerations and retardations of their mean motions, and ascertains the periods and limits of the secular equations thence arising. These periods include several centuries. Again, because this relation is not precise, but the odd days nearly divide the periods already found, there must arise an equation of this secular equation, of which the period is immensely longer, and the maximum very minute. He shews that this retardation of Saturn is now at its maximum, and is diminishing again, and will, in the course of years, change to an acceleration.

This investigation of the small inequalities is the most intricate problem in mechanical philosophy, and has been completed only by very slow degrees, by the arduous efforts of the greatest mathematicians, of whom M. de la Grange is the most eminent. Some of his general results are very remarkable.

He demonstrates, that since the planets move in one direction, in orbits nearly circular, no mutual disturbances make any permanent change in the mean distances and mean periods of the planets, and that the periodic changes are confined within very narrow limits. 369

369 Oscillation of the planetary system.

The orbits can never deviate sensibly from circles. None of them ever has been or will be a comet moving in a very eccentric orbit. The ecliptic will never coincide with the equator, nor change its inclination above two degrees. In short, the solar planetary system oscillates, as it were, round a medium state, from which it never swerves very far.

This theory of the planetary inequalities, founded on the universal law of mutual deflection, has given to our tables a precision, and a coincidence with observation, that surpasses all expectation, and insures the legitimacy of the theory. The inequalities are most sensible in the motions of Jupiter and Saturn; and these present themselves in such a complicated state, and their periods are so long, that ages were necessary for discovering them

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by mere observation. In this respect, therefore, the theory has outstripped the observations on which it is founded. It is very remarkable, that the periods which the Indians assign to these two planets, and which appeared so inaccurate that they hurt the credit of the science of those ancient astronomers, are now found precisely such as must have obtained about three thousand years before the Christian era; and thus they give an authenticity to that ancient astronomy. The periods which any nation of astronomers assign to those two planets would afford no contemptible mean for determining the age in which it was observed.

370 Authenticity of the Indian astronomy.

The following circumstance pointed out by La Place is remarkable: Suppose Jupiter and Saturn in conjunction in the first degree of Aries; twenty years after, the conjunction will happen in Sagittarius; and after other twenty years, in Leo. It will continue in these three signs for 200 years. In the year 200 it will happen in Taurus, Capricornus, and Virgo; in the next 200 years, it will happen in Gemini, Aquarius, and Libra; and in the next 200 years, it will happen in Cancer, Pisces, and Scorpio: then all begins again in Aries. It is probable that these remarkable periods of the oppositions of Jupiter and Saturn, progressive for 40 years, and oscillating during 160 more, occasioned the astrological division of the heavens into the four *trigons*, of fire, air, earth, and water. These relations of the signs, which compose a trigon, point out the repetitions of the chief irregularities of the solar system.

371 Origin of the astrological division of the heavens.

M. de la Place observes (in 1796), that the planet Herschel gives evident marks of the action of the rest; and that when these are computed and taken into the account of its bygone motions, they put it beyond doubt that it was seen by Flamstead in 1690, by Mayer in 1756, and by Monnier in 1769.

SECT. III. *Of the Disturbances in the Elliptical Motion of the Comets.*

Before the time of Sir Isaac Newton it was supposed that they moved in straight lines: and Descartes, finding that such a motion would interfere with his vortices, removed them entirely out of the solar system. Sir Isaac Newton, however, distinctly proves from astronomical observation, that the comets pass through the planetary regions, and are generally invisible at a greater distance than that of Jupiter. Hence, finding that they were evidently within the sphere of the sun's action, he concludes, that they must necessarily move about the sun as the planets do; and he proves, that the power of the sun being reciprocally in the duplicate proportion of the distance, every body acted upon by him must either fall directly down, or move about him in one of the conic sections; viz. either the ellipsis, parabola, or hyperbola. If a body which descends towards the sun as low as the orbit of any planet, move with a swifter motion than the planet, it will describe an orbit of a more oblong figure than that of the planet, and have at least a longer axis. The velocity of the body may be so great, that it shall move in a parabola, so that having once passed the sun, it shall ascend for ever without returning, though the sun will still continue in the focus of that parabola; and with a velocity still greater, they will move in an hyperbola. It is, however, most probable, that the comets move in very eccentric ellipses, such as is represented in fig. 136. where S represents the sun, C the comet, and ABDE its orbit; wherein the distance of S and D far exceeds that of S and A. Hence those bodies are sometimes found at a moderate distance from the sun, and appear within the planetary regions; at other times they ascend to vast distances, far beyond the orbit of Saturn, and thus become invisible.

372 Comets generally invisible until they come nearer than Jupiter.

That the comets do move in this manner is proved by our author from computations built upon the observations made by many astronomers. These computations were made by Sir Isaac Newton himself upon the comet which appeared toward the latter end of the year 1680 and beginning of 1681, and the same were prosecuted more at large by Dr Halley upon this and other comets. They depend on this principle, that the eccentricity of the orbits of the comets is so great, that if they are really elliptical, yet that part of them which comes under our view approaches so near to a parabola that they may be taken for such without any sensible error, as in the foregoing figure the parabola FAG, in the lower part of it about A, differs very little from the ellipsis DEAB; on which foundation Sir Isaac teaches a method of finding the parabola in which any comet moves, by three observations made upon it in that part of its orbit where it agrees nearest with a parabola: and this theory is confirmed by astronomical observations; for the places of the comets may thus be computed as exactly as those of the primary planets. Our author afterwards shows how to make use of any small deviation from the parabola which may be observed, to determine whether the orbits of the comets be elliptical or not; and thus to know whether or not the same comet returns at different seasons. On examining by this rule the comet of 1680, he found its orbit to agree more exactly with an ellipsis than a parabola, though the ellipsis be so very eccentric, that it cannot perform its revolution in 500 years. On this Dr Halley observed, that mention is made in history of a comet with a similar large tail, which appeared three several times before. The first was before the death of Julius Cæsar; and each appearance happened at the interval of 575 years, the last coinciding with the year 1680. He therefore calculated the motion of this comet to be in such an eccentric orbit, that it could not return in less than 575 years: which computation agrees yet more perfectly with the observations made on this comet than any parabolic orbit will do. To compare together different appearances of the same comet, is indeed the only method of discovering with certainty the form of its orbit; for it is impossible to discover the form of one so exceedingly eccentric from observations taken in a small part of it. Sir Isaac Newton therefore proposes to compare the orbits, on the supposition that they are parabolical, of such comets as appear at different times; for if we find the same orbit described by a comet at different times, in all probability it will be the same comet that describes it. Here he remarks from Dr Halley, that the same orbit very nearly agrees to two appearances of a comet about the space of 75 years distance; so that if these two appearances were really of the same comet, the transverse axis of its orbit would be 18 times that of the axis of the earth's orbit; and therefore, when at its greatest distance from the sun, this comet would be removed not less than 35 times the mean distance of the earth from the same luminary.

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375 They are affected by the planets. The comets may be considerably affected by the planets. The very important phenomenon of the return of the comet of 1682, which was to decide whether they were revolving planets describing ellipses, or bodies which come but once into the planetary regions, and then retire for ever, caused the astronomers to consider this matter with great care. Halley had shown, in a rough way, that this comet must have been considerably affected by Jupiter. Their motion near the aphelion must be very slow, so that a very small change of velocity or direction, while in the planetary regions, must considerably affect their periods. Halley thought that the action of Jupiter might change it half a year. M. Clairaut, by considering the disturbing forces of Jupiter and Saturn through the whole revolution, showed that the period then running would exceed the former nearly two years (618 days), and assigned the middle of April 1759 for the time of its perihelion. It really passed its perihelion on the 12th of March. This was a wonderful precision, when we reflect that the comet had been seen but a very few days in its former apparitions.

A comet observed by Mr Prosperin and others in 1771 has greatly puzzled the astronomers. Its motions appear to have been extremely irregular, and it certainly came so near Jupiter, that his momentary influence was at least equal to the sun's. It has not been recognised since that time, although there is a great probability that it is continually among the planets.

376 Consequence of a comet and planet meeting. It is by no means impossible, that, in the course of ages, a comet may actually meet one of the planets. The effect of such a concourse must be dreadful; a change of the axis of diurnal rotation must result from it, and the sea must desert its former bed and overflow the new equatorial regions. The shock and the deluge must destroy all the works of man, and most of the race. The remainder, reduced to misery, must long struggle for existence, and all remembrance of former arts and events must be lost, and every thing must be invented anew. There are not wanting traces of such devastations in this globe: strata and things are now found on mountain tops which were certainly at the bottom of the ocean in former times; remains of tropical animals and plants are now dug up in the circumpolar regions.

SECT. IV. *Of the Irregularities in the Moon's Motion.*

The moon is acted on at once by the sun and the earth: but her motion round the earth is only disturbed by the difference of the sun's action on these two bodies. If the sun were at an infinite distance it would act upon them both equally and in a parallel direction; of course, their relative motion would not be disturbed. But its distance, though very great, when compared with that of the moon, cannot be considered as infinite. The moon is alternately nearer and farther from the sun than the earth, and the straight line which joins the centre of the sun and moon forms angles more or less acute with the radius vector of the earth. Of course the sun acts unequally, and in different directions, upon the earth and moon; and from that diversity of action, there ought to result irregularities in the lunar motions, depending on the respective situation of the sun and moon.

Some of these inequalities, however, would take place, though the moon if undisturbed by the sun had moved in a circle concentrical to the earth, and in the plane of the earth's motion; others depend on the elliptical figure and oblique situation of the moon's orbit. One of the former is, that the moon does not describe equal spaces in equal times, but is continually accelerated as she passes from the quarter to the new or full, and is retarded again by the like degrees in returning from the new and full to the next quarter: but here we consider not so much the absolute as the apparent motions of the moon with respect to us. These two may be distinguished in the following manner: Let S in fig. 137. represent the sun, A the earth moving in its orbit BC, DEFG the moon's orbit, and H the place of the moon in her orbit. Suppose the earth to have moved from A to I. Because it has been shown that the moon partakes of all the progressive motion of the earth, and likewise that the sun attracts both the earth and moon equally when they are at the same distance from it, or that the mean action of the sun upon the moon is equal to its action upon the earth; we must therefore consider the earth as carrying about with it the moon's orbit: so that when the earth is removed from A to I, the moon's orbit shall likewise be removed from its former situation into that denoted by KLMN. But now the earth being in I, if the moon were found in O, so that OI should be parallel to HA, though the moon would really have moved from H to O, yet it would not have appeared to a spectator upon the earth to have moved at all, because the earth has moved as much as itself; so that the moon would still appear in the same place with respect to the fixed stars. But if the moon be observed in P, it will then appear to have moved, its apparent motion being measured by the angle under OIP. And if the angle under PIS be less than the angle under HAS, the moon will have approached nearer its conjunction with the sun. Now, to explain particularly the inequality of the moon's motion already mentioned, let S in fig. 138. represent the sun, A the earth, BCDE the moon's orbit, C the place of the moon when in the latter quarter. Here it will be nearly at the same distance from the sun as the earth is. In this case, therefore, they will be both equally attracted, the earth in the direction AS, and the moon in that of CS. Whence, as the earth, in moving round the sun, is continually descending towards it, so the moon in this situation must in any equal portion of time descend as much; and therefore the position of the line AC in respect of AS, and the change which the moon's motion produces in the angle CAS, will not be altered by the sun: but as soon as the moon is advanced from the quarter towards the new or conjunction, suppose to G, the action of the sun upon it will have a different effect. Were the sun's action upon the moon here to be applied in the direction GH parallel to AS, if its action on the moon were equal to its action on the earth, no change would be wrought by the sun on the apparent motion of the moon round the earth. But the moon receiving a greater impulse in G than the earth receives in A, were the sun to act in the direction GH, yet it would accelerate the description of the space DAG, and cause the angle under DAG to decrease faster than it otherwise would. The sun's action will have this effect upon account of the obli-

377 Inequalities of the moon's motion explained.

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quity of its direction to that in which the earth attracts the moon. For the moon by this means is drawn by two forces oblique to one another; one drawing from G towards A, the other from G towards H; therefore the moon must necessarily be impelled toward D. Again, because the sun does not act in the direction GH parallel to SA, but in the direction GS oblique to it, the sun's action on the moon will, by reason of this obliquity, farther contribute to the moon's acceleration. Suppose the earth, in any short space of time, would have moved from A to I, if not attracted by the sun, the point I being in the straight line CE, which touches the earth's orbit in A. Suppose the moon in the same time would have moved in her orbit from G to K, and besides have partook of all the progressive motion of the earth. Then, if KL be drawn parallel to AI, and taken equal to it, the moon, if not attracted to the sun, would be found in L. But the earth, by the sun's action, is removed from I. Suppose it were moved down to M in the line IMN parallel to SA, and if the moon were attracted but as much, and in the same direction as the earth is here supposed to be attracted, so as to have descended during the same time in the line LO parallel also to AS, down as far as P, till LP were equal to IM, the angle under PMN would be equal to that under LIN; that is, the moon will appear advanced as much farther forward than if neither it nor the earth had been subject to the sun's action. But this is on the supposition that the actions of the sun upon the earth and moon are equal; whereas the moon being acted upon more than the earth, did the sun's action draw the moon in the line LO parallel to AS, it would draw it down so far as to make LP greater than IM, whereby the angle under PMN will be rendered greater than that under LIN. But, moreover, as the sun draws the earth in a direction oblique to IN, the earth will be found in its orbit somewhat short of the point M. However, the moon is attracted by the sun still more out of the line LO than the earth is out of the line IN; therefore this obliquity of the sun's action will yet farther diminish the angle under PMN. Thus the moon at the point G receives an impulse from the sun whereby her motion is accelerated; and the sun producing this effect in every place between the quarter and the conjunction, the moon will move from the quarter with a motion continually more and more accelerated; and therefore, by acquiring from time to time an additional degree of velocity in its orbit, the spaces which are described in equal times by the line drawn from the earth to the moon will not be everywhere equal, but those toward the conjunction will be greater than those toward the quarter. But in the moon's passage from the conjunction D to the next quarter, the sun's action will again retard the moon, till, at the next quarter at E, it be restored to the first velocity which it had in C. When the moon moves from E to the full, or opposition to the sun in B, it is again accelerated; the deficiency of the sun's action on the moon from what it has upon the earth producing here the same effect as before the excess of its action.

Let us now consider the moon in Q as moving from F towards B. Here, if she were attracted by the sun in a direction parallel to AS, yet being acted on less than the earth, as the latter descends towards the sun, the moon will in some measure be left behind. Therefore, QF being drawn parallel to SB, a spectator on the earth would see the moon move as if attracted from the point Q in the direction QF, with a degree of force equal to that whereby the sun's action on the moon falls short of its action on the earth. But the obliquity of the sun's action has here also an effect. In the time the earth would have moved from A to I without the influence of the sun, let the moon have moved in its orbit from Q to R. Drawing, therefore, RT parallel and equal to AI, the moon, by the motion of its orbit, if not attracted by the sun, must be found in T: and therefore, if attracted in a direction parallel to SA, would be in the line TV parallel to AS; suppose in W. But the moon in Q being farther off the sun than the earth, it will be less attracted; that is TW will be less than IM; and if the line SM be prolonged towards X, the angle under XMW will be less than XIT. Thus, by the sun's action, the moon's passage from the quarter to the full would be accelerated, if the sun were to act on the earth and moon in a direction parallel to AS; and the obliquity of the sun's action will still increase this acceleration: For the action of the sun on the moon is oblique to the line SA the whole time of the moon's passage from Q to T, and will carry her out of the line TV towards the earth. Here we suppose the time of the moon's passage from Q to T so short, that it shall not pass beyond the line SA. The earth will also come a little short of the line IN, as was already mentioned; and from these causes the angle under XMW will be still farther lessened. The moon, in passing from the opposition B to the next quarter, will be retarded again by the same degrees as it was accelerated before its appulse to the opposition; and thus the moon, by the sun's action upon it, is twice accelerated and twice restored to its first velocity every circuit it makes round the earth; and this inequality of the moon's motion about the earth is called by astronomers its variation.

771 Effect of the sun's attraction in different parts of the moon's orbit.

The next effect of the sun upon the moon is, that it gives the orbits of the latter in the quarters a greater degree of curvature than it would receive from the earth alone: and, on the contrary, in the conjunction and opposition the orbit is less inflected. When the moon is in the conjunction with the sun at D, the latter attracting her more forcibly than it does the earth, the moon is by that means impelled less to the earth than otherwise it would be, and thus the orbit is less incurvated; for the power by which the moon is impelled towards the earth being that by which it is inflected from a rectilinear course, the less that power is, the less it will be inflected. Again, when the moon is in the opposition in B farther removed from the sun than the earth is, it follows, then, that though the earth and moon are both continually descending toward the sun, that is, are drawn by the sun towards itself out of the place they would otherwise move into, yet the moon descends with less velocity than the earth: insomuch that, in any given space of time from its passing the point of opposition, it will have less approached the earth than otherwise it would have done; that is, its orbit, in respect to the earth, will approach nearer to a straight line. Lastly, when the motion is in the quarter in F, and equally distant from the sun as the earth, it

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it was before observed, that they would both descend with equal velocity towards the sun, so as to make no change in the angle FAS; but the length of the line FA must necessarily be shortened. Therefore the moon, in moving from F toward the conjunction with the sun, will be impelled more toward the earth by the sun's action than it would have been by the earth alone, if neither the earth nor the moon had been acted upon by the sun: so that, by this additional impulse, the orbit is rendered more curve than it otherwise should be. The same effect will also be produced in the other quarter.

379 Moon comes nearest the earth when least attracted by it.

A third effect of the sun's action, and which follows from that just now explained, is, that though the moon undisturbed by the sun might move in a circle, having the earth for its centre, by the sun's action, if the earth were to be in the very middle or centre of the moon's orbit, yet the moon would be nearer the earth at the new and full than in the quarters. This may at first appear somewhat difficult to be understood, that the moon should come nearest to the earth when it is least attracted by it; yet, upon a little consideration, it will evidently appear to flow from that very cause, because her orbit, in the conjunction and opposition, is rendered less curve: for the less curve the orbit is, the less will the moon have descended from the place it would move into without the action of the earth. Now, if the moon were to move from any place without further disturbance from that action, since it would proceed on the line touching the orbit in that place, it would continually recede from the earth; and therefore, if the power of the earth upon the moon be sufficient to retain it at the same distance, this diminution of that power will cause the distance to increase, though in a less degree. But, on the other hand, in the quarters, the moon being pressed in a less degree towards the earth than by the earth's single action, will be made to approach it: so that, in passing from the conjunction or opposition to the quarters, the moon ascends from the earth; and in passing from the quarters to the opposition or conjunction, it descends again, becoming nearer in these last-mentioned places than in the other.

All the inequalities we have mentioned are different in degree as the sun is more or less distant from the earth; being greatest when the earth is in its perihelion, and smallest when it is in its aphelion: for in the quarters, the nearer the moon is to the sun, the greater is the addition to the earth's action upon it by the power of the sun; and, in the conjunction and opposition, the difference between the sun's action upon the earth and upon the moon is likewise so much the greater.

380 Cause of the dilatation of the moon's orbit.

This difference in the distance between the earth and the sun produces a further effect upon the moon's motion; causing her orbit to dilate when less remote from the sun, and become greater than when at a farther distance: For it is proved by Sir Isaac Newton, that the action of the sun by which it diminishes the earth's power over the moon in the conjunction or opposition, is about twice as great as the addition to the earth's action by the sun in the quarters; so that, upon the whole, the power of the earth on the moon is diminished by the sun, and therefore is most diminished when that action is strongest: but as the earth, by its approach to the sun, has its influence lessened, the moon, being less attracted, will gradually recede from the earth; and as the earth, in its recess from the sun, recovers by degrees its former power, the orbit of the moon must again contract. Two consequences follow from hence, viz. that the moon will be more remote from the earth when the latter is nearest the sun, and also will take up a longer time in performing its revolution through the dilated orbit than through the more contracted.

These irregularities would be produced, if the moon, without being acted upon unequally by the sun, should describe a perfect circle about the earth, and in the plane of its motion; but though neither of these circumstances take place, yet the above-mentioned inequalities occur, only with some little variation with regard to the degree of them; but some others are observed to take place, from the moon's motion being performed in the manner already described: For, as the moon describes an ellipsis, having the earth in one of its foci, this curve will be subjected to various changes, neither preserving constantly the same figure nor position; and because the plane of this ellipsis is not the same with that of the earth's orbit, it thence follows, that the former will continually change; so that neither the inclination of the two planes towards each other, nor the line in which they intersect, will remain for any length of time unaltered.

381 Action of the sun causes the plane of the moon's orbit to change.

As the moon does not move in the same plane with the earth, the sun is but seldom in the plane of her orbit, viz. only when the line made by the common intersection of the two planes, if produced, will pass through the sun. Thus, let S in fig. 139. denote the sun, T the earth, ATB the plane of the earth's orbit, CDEF the moon's orbit; the part CDE being raised above, and the part CFE depressed under the former. Here the line CE, in which the two planes intersect each other, being continued, passes through the sun in S. When this happens, the action of the sun is directed in the plane of the moon's orbit, and cannot draw her out of this plane, as will evidently appear from an inspection of the figure; but in other cases the obliquity of the sun's action to the plane of the orbit will cause this plane continually to change.

Let us now suppose, in the first place, the line in which the two planes intersect each other to be perpendicular to the line which joins the earth and sun. Let T, in fig. 140, 141, 142, 143. represent the earth; S the sun; the plane of the scheme the plane of the earth's orbit, in which both the sun and earth are placed. Let AC be perpendicular to ST, which joins the earth and sun; and let the line AC be that in which the plane of the moon's orbit intersects the orbit of the earth. On the centre T describe in the plane of the earth's motion the circle ABCD; and in the plane of the moon's orbit describe the circle AECF; one half of which, AEC, will be elevated above the plane of this scheme, and the other half, AFC, as much depressed below it. Suppose then the moon to set out from the point A in fig. 127. in the direction of the plane AEC. Here she will be continually drawn out of this plane by the action of the sun; for this plane AEC, if extended, will not pass through the sun, but above it; so that the sun, by drawing the moon directly toward itself, will force it continually

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continually more and more from that plane towards the plane of the earth's motion in which itself is, causing it to describe the line AKGHI, which will be convex to the plane AEC, and concave to the plane of the earth's motion. But here this power of the sun, which is said to draw the moon toward the plane of the earth's motion, must be understood principally of as much only of the sun's action upon the moon as it exceeds the action of the same upon the earth: For suppose the last-mentioned figure to be viewed by the eye placed in the plane of that scheme, and in the line CTA, on the side A, it will appear as the straight line DTB in fig. 126. and the plane AECF as another straight line FE, and the curve line AKGHI under the form of the line TKGHI. Now it is plain, that the earth and moon being both attracted by the sun, if the sun's action upon both was equally strong, the earth T, and with it the plane AECF, or the line FTE, would be carried towards the sun with as great velocity as the moon, and therefore the moon not drawn out of it by the sun's action, except only from the small obliquity of direction of this action upon the moon to that of the sun's action upon the earth, which arises from the moon being out of the plane of the earth's motion, and is not considerable: but the action of the sun upon the moon being greater than upon the earth all the time the moon is nearer to the sun than the earth is, it will be drawn from the plane AEC, or the line TE, by that excess, and made to describe the curve line AGI or TGI. But it is the custom of astronomers, instead of considering the moon as moving in such a curve line, to refer its motion continually to the plane which touches the true line wherein it moves at the point where at any time the moon is. Thus, when the moon is in the point A, its motion is considered as being in the plane AEC, in whose direction it then attempts to move; and when in the point K, fig. 144. its motion is referred to the plane which passes through the earth and touches the line AKGHI in the point K. Thus the moon, in passing from A to I, will continually change the plane of her motion in the manner we shall now more particularly explain.

Let the plane which touches the line AKI in the point K, fig. 141, intersect the plane of the earth's orbit in the line LTM. Then, because the line AKI is concave to the plane ABC, it falls wholly between that plane and the plane which touches it in K, so that the plane MKL will cut the plane AEC before it meets the plane of the earth's motion, suppose in the line YT, and the point A will fall between K and L. With a radius equal to TY or TL describe the semicircle LYM. Now, to a spectator on the earth, the moon when in A will appear to move in the circle AECF; and when in K, will appear to be moving in the semicircle LYM. The earth's motion is performed in the plane of this scheme; and to a spectator on the earth the sun will always appear to move in that plane. We may therefore refer the apparent motion of the sun to the circle ABCD described in this plane about the earth. But the points where this circle in

352 Nodes of the moon's orbit.

which the sun seems to move, intersecting the circle in which the moon is seen at any time to move, are called the nodes of the moon's orbit at that time. When the moon is seen moving in the circle AECD, the points A and C are the nodes of the orbit; when she appears in the semicircle LYM, then L and M are the nodes. It will now appear, from what has been said, that while the moon has moved from A to K, one of the nodes has been carried from A to L, and the other as much from C to M. But the motion from A to L and from C to M is backward in regard to the motion of the moon, which is the other way from A to K, and from thence toward C. Again, the angle which the plane wherein the moon at any time appears makes with the plane of the earth's motion, is called the inclination of the moon's orbit at that time: we shall now therefore proceed to show,

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that this inclination of the orbit, when the moon is in K, is less than when she was in A; or, that the plane LYM, which touches the line of the moon's motion in K, makes a less angle with a plane of the earth's motion, or with the circle ABCD, than the plane AEC makes with the same. The semicircle LYM intersects the semicircle AEC in Y, and the arch AY is less than LY, and both together less than half a circle. But it is demonstrated by spheric geometry, that when a triangle is made, as here, by three arches of circles AL, AY, and YL, the angle under YAB without the triangle is greater than the angle YLA within, if the two arches AY, YL, taken together, do not amount to a semicircle. If the two arches make a complete semicircle, the two angles will be equal; but if the two arches taken together exceed a semicircle, the inner angle YLA is greater than the other. Here then the two arches AL and LY together being less than a semicircle, the angle under ALY is less than the angle under BAE. But from the doctrine of the sphere it is also evident, that the angle under ALY is equal to that in which the plane of the circle LYKM, that is, the plane which touches the line AKGHI in K, is inclined to the plane of the earth's motion ABC; and the angle under BAE is equal to that in which the plane AEC is inclined to the same plane. Therefore the inclination of the former plane is less than that of the latter. Suppose, now, the moon to be advanced to the point G in fig. 142. and in this point to be distant from its node a quarter part of the whole circle; or, in other words, to be in the mid-way between its two nodes. In this case the nodes will have receded yet more, and the inclination of the orbit be still more diminished; for suppose the line AKGHI to be touched in the point G by a plane passing through the earth T, let the intersection of this plane with the plane of the earth's motion be the line WTO, and the line TP its intersection with the plane LKM. In this plane let the circle NGO be described with the semidiameter TP or NT cutting the other circle LKM in P. Now, the line AKGI is convex to the plane LKM which touches it in K; and therefore the plane NGO, which touches it in G, will intersect the other touching plane between G and K, that is, the point P will fall between these two points, and the plane continued to the plane of the earth's motion will pass beyond L; so that the points N and O, or the places of the nodes when the moon is in G, will be farther from A and C than L and M; that is, will have moved farther backward. Besides, the inclination of the plane NGO to the plane of the earth's motion ABC is less than the inclination of the plane LKM to the same; for here also the

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the two arches LP and NP, taken together, are less than a semicircle, each of them being less than a quadrant, as appears, because GN, the distance of the moon in G from its node N, is here supposed to be a quarter part of a circle. After the moon is passed beyond G, the case is altered; for then these arches will be greater than quarters of a circle; by which means the inclination will be again increased, though the nodes still go on to move the same way. Suppose the moon in H (fig. 143.), and that the plane which touches the line AKGI in H intersects the plane of the earth's motion in the line QTR, and the plane NGO in the line TV, and besides, that the circle QHR be described in that plane; then, for the same reason as before, the point V will fall between H and G, and the plane RVQ will pass beyond the last plane OVN, causing the points Q and K to fall farther from A and C than N and O. But the arches NV, VQ are each greater than the quarter of a circle: consequently the angle under BQV will be greater than that under BNV. Lastly, when the moon is by this attraction of the sun drawn at length into the plane of the earth's orbit, the node will have receded yet more, and the inclination be so much increased, as to become somewhat more than at first: for the line AKGHI being convex to all the planes which touch it, the part HI will wholly fall between the plane QVR and the plane ABC; so that the point I will fall between B and R; and, drawing ITW, the point W will be farther removed from A than Q. But it is evident, that the plane which passes through the earth T, and touches the line AGI in the point I, will cut the plane of the earth's motion ABCD in the line ITW, and be inclined to the same in the angle under HIB; so that the node which was first in A, after having passed into L, N, and Q, comes at last in the point W, as the node which was at first in C has passed from thence successively through the points M, O, and R, to I. But the angle HIB, which is now the inclination of the orbit to the plane of the ecliptic, is manifestly not less than the angle under ECB or EAB, but rather something greater. Thus the moon, while it passes from the plane of the earth's motion in the quarter, till it comes again into the same plane, has the nodes of its orbit continually moved backward, and the inclination of it at first diminished till it comes to G in fig. 128. which is near to its conjunction with the sun, but afterwards is increased again almost by the same degrees, till upon the moon's arrival again to the plane of the earth's motion, the inclination of the orbit is restored to something more than its first magnitude, though the difference is not very great, because the points I and C are not far distant from each other.

In like manner, if the moon had departed from the quarter at C, it should have described the curve line CXW in fig. 140. between the planes AH and ADC, which would be convex to the former planes and concave to the latter; so that here also the nodes would continually recede, and the inclination of the orbit gradually diminish more and more, till the moon arrived near its opposition to the sun in X; but from that time the inclination should again increase till it become a little greater than at first. This will easily appear by considering, that as the action of the sun upon the moon, by exceeding its action upon the earth, drew it out of the plane AEC towards the sun, while the moon passed from A to I; so during its passage from C to W, the moon being all that time farther from the sun than the earth, it will be attracted less; and the earth, together with the plane AECF, will as it were be drawn from the moon, in such a manner, that the path the moon describes shall appear from the earth as it did in the former case by the moon being drawn away.

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Motion of the nodes explained.

Such are the changes which the nodes and inclination of the moon's orbit undergo when the nodes are in the quarters; but when the nodes by their motion, and the motion of the sun together, come to be situated between the quarter and conjunction or opposition, their motion and the change made in the inclination of the orbit are somewhat different.—Let AGH, in fig. 145. be a circle described in the plane of the earth's motion, having the earth in T for its centre, A the point opposite to the sun, and G a fourth part of the circle distant from A. Let the nodes of the moon's orbit be situated in the line BTD, and B the node falling between A, the place where the moon would be in the full, and G the place where she would be in the quarter. Suppose BEDF to be the plane in which the moon attempts to move when it proceeds from the point B: then, because the moon in B is more distant from the sun than the earth, it will be less attracted by the sun, and will not descend towards the sun so fast as the earth, consequently it will quit the plane BEDF, which is supposed to accompany the earth, and describe the line BIK convex to it, till such time as it comes to the point K, where it will be in the quarter; but from thenceforth being more attracted than the earth, the moon will change its course, and the following part of the path it describes will be concave towards the plane BED or BGD, and continue concave to the plane BGD till it crosses that plane in L just as in the preceding case. Now, to show that the nodes, while the moon is passing from B to K, will proceed forward, or move the same way with the moon, and at the same time the inclination of the orbit will increase when the moon is in the point I, let the line MIN pass through the earth T, and touch the path of the moon in I, cutting the plane of the earth's motion in the line MTN, and the line BED, in TO. Because the line BIK is convex to the plane BED, which touches it in B, the plane NIM must cross the plane DEB before it meets the plane CGB; and therefore the point M will fall from G towards B; and the node of the moon's orbit being translated from B towards M is moved forward.

Again the angle under OMG, which the plane MON makes with the plane BGC, is greater than the angle OBG, which the plane BOD makes with the same. This appears from what has been already demonstrated, because the arches BO and OM are each of them less than the quarter of a circle; and therefore, taken both together, are less than a semicircle. But further, when the moon is come to the point K in its quarter, the nodes will be advanced yet farther forward, and the inclination of the orbit also more augmented. Hitherto we have referred the moon's motion to that plane, which, passing through the earth, touches the path of the moon in the point where the moon is, as we have already said that the custom of

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astronomers is. But in the point K no such plane can be found: on the contrary, seeing the line of the moon's motion on one side the point K is convex to the plane BED, and on the other side concave to the same, so that no plane can pass through the points T and K, but will cut the line BKL in that point; therefore instead of such a touching plane, we must make use of PKQ, which is equivalent, and with which the line BKL shall make a less angle than with any other plane; for this does as it were touch the line BK in the point K, since it cuts it in such a manner that no other plane can be drawn so as to pass between the line BK and the plane PKQ. But now it is evident, that the point P, or the node, is removed from M towards G, that is, has moved yet further forward; and it is likewise as manifest, that the angle under KPG, or the inclination of the moon's orbit in the point K, is greater than the angle under IMG, for the reason already given.

After the moon has passed the quarter, her plane being concave to the plane AGCH, the nodes will recede as before till she arrives at the point L; which shows, that considering the whole time of the moon's passing from B to L, at the end of that time the nodes shall be found to have receded, or to be placed more backward, when the moon is in L than when it was in B; for the moon takes a longer time in passing from K to L than in passing from B to K; and therefore the nodes continue to recede a longer time than they moved forwards; so that their recess must surmount their advance. In the same manner, while the moon is in its passage from K to L, the inclination of the orbit shall diminish till the moon come to the point in which it is one quarter part of a circle distant from its node, suppose in the point R; and from that time the inclination will again increase. Since, therefore, the inclination of the orbit increases while the moon is passing from B to K, and diminishes itself again only while the moon is passing from K to R, then augments again while the moon passes from B to L; it thence comes to be much more increased than diminished, and thus will be distinguishably greater when the moon comes to L than when it sets out from B. In like manner, when the moon is passing from L on the other side the plane AGCH, the node will advance forward as long as the moon is between the point L and the next quarter; but afterwards it will recede till the moon come to pass the plane AGCH again, in the point V between B and A: and because the time between the moon's passing from L to the next quarter is less than the time between that quarter and the moon's coming to the point V, the node will have receded more than it has advanced; so that the point V will be nearer to A than L is to C. So also the inclination of the orbit, when the moon is in V, will be greater than when she was in L; for this inclination increases all the time the moon is betwixt L and the next quarter, decreasing only when she is passing from this quarter to the mid-way between the two nodes, and from thence increases again during the whole passage through the other half of the way to the next node.

In this manner we see, that at every period of the moon the nodes will have receded, and thereby have approached towards a conjunction with the sun: but this will be much forwarded by the motion of the earth, or the apparent motion of the sun himself. In the last scheme the sun will appear to have moved from S towards W. Let us suppose it had appeared to have moved from S to W while the moon's node has receded from B to V; then drawing the line WTX, the arch VX will represent the distance of the line drawn between the nodes from the sun when the moon is in V; whereas the arch BA represented that distance when the moon was in B. This visible motion of the sun is much greater than that of the node; for the sun appears to revolve quite round in one year, while the node is near nineteen in making its revolution. We have also seen that when the moon was in the quadrature, the inclination of her orbit decreased till she came to the conjunction or opposition, according to the node it set out from; but that afterwards it again increased till it became at the next node rather greater than at the former. When the node is once removed from the quarter nearer to a conjunction with the sun, the inclination of the moon's orbit, when she comes into the node, is more sensibly greater than it was in the node preceding; the inclination of the orbit by this means more and more increasing till the nodes come into conjunction with the sun: at which time it has been shown that the latter has no power to change the plane of her orbit. As soon, however, as the nodes are got out of conjunction towards the other quarters, they begin to recede as before; but the inclination of the orbit in the appulse of the moon to each succeeding node is less than at the preceding, till the nodes come again into the quarters. This will appear as follows: Let A, in fig. 146. represent one of the moon's nodes placed between the point of opposition B and the quarter C. Let the plane ADE pass through the earth T, and touch the path of the moon in A. Let the line AFGH be the path of the moon in her passage from A to H, where she crosses again the plane of the earth's moon. This line will be convex towards the plane ADE, till the moon comes to G, where she is in the quarter; and after this, between G and H, the same line will be concave towards this plane. All the time this line is convex towards the plane ADE, the nodes will recede; and, on the contrary, move forward when the line is concave towards that plane. But the moon is longer in passing from A to G, and therefore the nodes go backward farther than they proceed; and therefore, on the whole, when the moon has arrived at H, the nodes will have receded, that is, the point H will fall between B and E. The inclination of the orbit will decrease till the moon is arrived at the point F in the middle between A and H. Through the passage between F and G the inclination will increase, but decrease again in the remaining part of the passage from G to H, and consequently at H must be less than at A. Similar effects, both with respect to the nodes and inclination of the orbit, will take place in the following passage of the moon on the other side of the plane ABEC from H, till it comes over that plane again in I.

Thus the inclination of the orbit is greatest when the line drawn between the moon's nodes will pass through the sun, and least when this line lies in the quarters; especially if the moon at the same time be in conjunction with the sun, or in the opposition. In the

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the first of these cases the nodes have no motion; in all others, the nodes will each month have receded: and this retrograde motion will be greatest when the nodes are in the quarters, for in that case they will have no progressive motion during the whole mouth; but in all other cases they at some times go forward, viz. whenever the moon is between either of the quarters and the node which is less distant from that quarter than the fourth part of a circle.

385 Irregularities arising from the moon's motion in an ellipsis.

We have now only to explain those irregularities of the lunar motion which arise from her motion in an ellipsis. From what has been already said it appears, that the earth acts on the moon in the reciprocal duplicate proportion of the distance; therefore the moon, if undisturbed by the sun, would move round the earth in a true ellipsis, and a line drawn from the earth to the sun would pass over equal spaces in equal times. We have, however, already shown, that this equality is disturbed by the sun, and likewise how the figure of the orbit is changed each month; that the moon is nearer the earth at the new and full, and more remote in the quarters than it would be without the sun. We must, however, pass by those monthly changes, and consider the effect which the sun will have in the different situations of the axis of the orbit in respect of that luminary. This action varies the force wherewith the moon is drawn towards the earth. In the quarters the force of the earth is directly increased by the sun, but diminished at the new and full; and in the intermediate places the influence of the earth is sometimes lessened, sometimes assisted, by the action of that luminary. In these intermediate places, however, between the quarters and the conjunction or opposition, the sun's action is so oblique to that of the earth on the moon, as to produce that alternate acceleration and retardation of her motion so often mentioned. But besides this effect, the power by which the moon attracts the earth towards itself, will not be at full liberty to act with the same force as if the sun acted not at all on the moon; and this effect of the sun's action, whereby it corroborates or weakens the action of the earth, is here only to be considered; and by means of this influence it comes to pass, that the power by which the moon is impelled towards the earth is not perfectly in the reciprocal duplicate proportion of the distance, and of consequence the moon will not describe a perfect ellipsis. One particular in which the lunar orbit will differ from a perfect elliptic figure, consists in the places where the motion of the moon is perpendicular to the line drawn from itself to the earth. In an ellipsis, after the moon should have set out in the direction perpendicular to this line, drawn from itself to the earth, and at its greatest distance from the earth, its motion would again become perpendicular to this line drawn between itself and the earth, and the moon be at its nearest distance from the earth, when it should have performed half its period: after having performed the other half period of its motion, it would again become perpendicular to the forementioned line, and the moon return to the place when it set out, and have recovered again its greatest distance. But the moon in its real motion, after setting out as before, sometimes makes more than half a revolution before its motion comes again to be perpendicular to the line drawn from itself to the earth, and the moon is at its nearest distance, and then performs more than another half of an entire revolution before its motion can a second time recover its perpendicular direction to the line drawn from the moon to the earth, and the former arrive again at its greatest distance from the earth. At other times the moon will descend to her nearest distance before she has made half a revolution, and recover again its greatest distance before she has made an entire revolution. The place where the moon is at its greatest distance is called

386 Apogeon and perigeon of the moon.

the *moon's apogeon*, and the place of her greatest distance her *perigeon;* and this change of place, where the moon comes successively to its greatest distance from the earth, is called the *motion of the apogeon*. The manner in which this motion of the apogeon is caused by the sun, comes now to be explained.

Sir Isaac Newton has shown, that if the moon were attracted towards the earth by a composition of two powers, one of which was reciprocally in the duplicate proportion of the distance from the earth, and the other reciprocally in the triplicate proportion of the same distance; then, though the line described by the moon would not be in reality an ellipsis, yet the moon's motion might be perfectly explained by an ellipsis whose

387 Motion in antecedence and consequence explained.

axis should be made to move round the earth: this motion being in consequence, as astronomers express themselves, that is, the same way as the moon itself moves, if the moon be attracted by the sum of the two powers; but the axis must move in antecedence, or the contrary way, if the moon be acted upon by the difference of these forces. We have already explained what is meant by duplicate proportion, namely, that if three magnitudes, as A, B, and C, are so related that the second B bears the same proportion to the third C as the first A bears to the second B; then the proportion of the first A to the third C is the duplicate of the

388 Triplicate proportion explained.

proportion of the first A to the second B. Now if a fourth magnitude as D be assumed, to which D shall bear the same proportion as A bears to B, and B to C; then the proportion of A to D is the triplicate of the proportion of A to B.

389 Motion of the moon's apogeon determined.

Let now T (fig. 147, 148.) denote the earth, and suppose the moon in the point A its apogeon or greatest distance from the earth, moving in the direction AF perpendicular to AB, and acted upon from the earth by two such forces as already mentioned. By that power alone, which is reciprocally in the duplicate proportion of the distance, if the moon set out with a proper degree of velocity, the ellipsis AMB may be described: but if the moon be acted upon by the sum of the forementioned powers, and her velocity in the point A be augmented in a certain proportion; or if that velocity be diminished in a certain proportion *, and the moon be acted upon by the difference of those powers; in both these cases the line AE, which shall be described by the moon, shall thus be determined. Let the point M be that into which the moon would have arrived in any given point of time, had it moved in the ellipsis AMB; draw MT and likewise CTD in such a manner that the angle ATM shall bear the same proportion to the angle under ATC, as the velocity with which the ellipsis must have been described bears to the difference between this velocity and that with which the moon must set out from the point A, in order to describe the path AE. Let the angle ATC be taken towards the moon, as in fig. 133.

* See Newton's Principia, book i. prop. 44. corol. 2.

if

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if the moon be attracted by the sum of the powers; but the contrary way (as in fig. 134.) if by their difference. Then let the line AB be moved into the position CD, and the ellipsis AMB into the situation CND, so that the point M be translated to L; then the point L shall fall upon the path of the moon AE. Now the angular motion of the line AT, whereby it is removed into the situation CT, represents the motion of the apogeon; by the means of which the motion of the moon might be fully explained by the ellipsis AMB, if the action of the sun upon it was directed to the centre of the earth, and reciprocally in the triplicate proportion of the moon's distance from it; but that not being so, the motion of the apogeon will not proceed in the regular manner now described. It is, however, to be observed here, that in the first of the two preceding cases, where the apogeon moves forward, the whole centripetal power increases faster, with the decrease of distance, than if the entire power were reciprocally in the duplicate proportion of the distance; because one part only is already in that proportion, and the other part, which is added to this to make up the whole power, increases faster with the decrease of distance. On the other hand, when the centripetal power is the difference between these two bodies, it increases less with the decrease of the distance, than if it were simply in the reciprocal duplicate proportion of the distance. Therefore, if we choose to explain the moon's motion by an ellipsis, which may be done without any sensible error, we may collect in general, that when the power by which the moon is attracted to the earth, by varying the distance, increases in a greater than the duplicate proportion of the distance diminished, a motion in consequence must be ascribed to the apogeon; but that when the attraction increases in a smaller proportion than that just mentioned, the apogeon must have given to it a motion in antecedence. It is then observed by Sir Isaac Newton, that the former of these cases obtains when the moon is in the conjunction and opposition, and the latter when she is in the quarters; so that in the former the apogeon moves according to the order of the signs; in the other, the contrary way. But, as has been already mentioned, the disturbance given to the action of the earth by the sun in the conjunction and opposition, being near twice as great as in the quarters, the apogeon will advance with a greater velocity than recede, and in the compass of a whole revolution of the moon will be carried in consequence.

390 **Inequality in the motion of the apogeon.**

Sir Isaac shows, in the next place, that when the line AB coincides with the line that joins the sun and earth, the progressive motion of the apogeon, when the moon is in conjunction or opposition, exceeds the retrograde, in the quadratures, more than in any other situation of the line AB. On the contrary, when the line AB makes right angles with that which joins the earth and sun, the retrograde motion will be more considerable, nay, is found so great as to exceed the progressive; so that in this case the apogeon, in the compass of an entire revolution of the moon, is carried in antecedence. Yet from the considerations already mentioned, the progressive motion exceeds the other; so that, on the whole, the motion of the apogeon is in consequence. The line AB also changes its situation with that which joins the earth and sun by such slow degrees, that the inequalities of the motion of the apogeon, arising from this last consideration, are much greater than what arise from the other.

391 **Occasions another inequality in the eccentricity of the moon's orbit.**

This unsteady motion of the apogeon gives rise to another inequality in the motion of the moon herself, so that it cannot at all times be explained by the same ellipsis. For whenever the apogeon moves in consequence, the motion of the luminary must be referred to an orbit more eccentric than what the moon would describe, if the whole power by which the moon was acted upon in its passing from the apogeon changed according to the reciprocal duplicate proportion of its distance from the earth, and by that means the moon did describe an immoveable ellipsis: and when the apogeon moves in antecedence, the moon's motion must be referred to an orbit less eccentric. In the former of the two figures last referred to, the true place of the moon L falls without the orbit AMB, to which its motion is referred: whence the orbit ALE truly described by the moon, is less incurvated in the point A than is the orbit AMB: therefore this orbit is more oblong, and differs farther from a circle than the ellipsis would, whose curvature in A were equal to that of the line ALB: that is, the proportion of the distance of the earth T from the centre of the ellipsis to its axis, will be greater in AMB than in the other; but that other is the ellipsis which the moon would describe, if the power acting upon it in the point A were altered in the reciprocal duplicate proportion of the distance; and consequently the moon being drawn more forcibly toward the earth, it will descend nearer to it. On the other hand, when the apogeon recedes, the power acting on the moon increases with the decrease of distance, in less than the duplicate proportion of the distance; and therefore the moon is less impelled towards the earth, and will not descend so low. Now, suppose, in the former of these figures, that the apogeon A is in the situation where it is approaching towards the conjunction or opposition of the sun; in this case its progressive motion will be more and more accelerated. Here suppose the moon, after having descended from A through the orbit AE as far as F, where it is come to its nearest distance from the earth, ascends again up the line FG. As the motion of the apogeon is here more and more accelerated, it is plain that the cause of its motion must also be on the increase: that is, the power by which the moon is drawn to the earth, will decrease with the increase of the moon's distance in her ascent from F, in a greater proportion than that wherewith it is increased with the decrease of distance in the moon's distance to it. Consequently the moon will ascend to a greater distance than AT from whence it is descended; therefore the proportion of the greatest distance of the moon to the least is increased. But farther, when the moon again descends, the power will increase yet farther with the decrease of distance than in the last ascent it increased with the augmentation of distance. The moon therefore must descend nearer to the earth than it did before, and the proportion of the greatest distance to the least be yet more increased. Thus, as long as the apogeon is advancing to the conjunction or opposition, the proportion of the greatest distance of the moon from the earth to the least will continually increase; and the elliptical orbit to which the moon's motion is referred will

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will become more and more eccentric. As soon, however, as the apogeon is past the conjunction or opposition with the sun, its progressive motion abates, and with it the proportion of the greatest distance of the moon from the earth to the least will also diminish: and when the apogeon becomes retrograde, the diminution of this proportion will be still farther continued, until the apogeon comes into the quarter; from thence this proportion, and the eccentricity of the orbit, will increase again. Thus the orbit of the moon is most eccentric when the apogeon is in conjunction with the sun, or in opposition to it, and least of all when the apogeon is in the quarters. These changes in the nodes, the inclination of the orbit to the plane of the earth's motion, in the apogeon and in the eccentricity, are varied like the other inequalities in the motion of the moon, by the different distance of the earth from the sun being greatest when their cause is greatest: that is, when the earth is nearest the sun.

392 Computation of the lunar inequalities.

Sir Isaac Newton has computed the very quantity of many of the moon's inequalities. That acceleration of the moon's motion which is called the *variation*, when greatest, removes the luminary out of the place in which it would otherwise be found, somewhat more than half a degree. If the moon, without disturbance from the sun, would have described a circle concentrical to the earth, his action will cause her approach nearer in the conjunction and opposition than in the quarters, nearly in the proportion of 69 to 70. It has already been mentioned, that the nodes perform their period in almost 19 years. This has been found by observation; and the computations of Sir Isaac assigned to them the same period. The inclination of the moon's orbit, when least, is an angle about one-eighteenth of that which constitutes a right angle; and the difference between the greatest and least inclination, is about one-eighteenth of the least inclination, according to our author's computation: which is also agreeable to the general observations of astronomers.

There is one empirical equation of the moon's motion which the comparison of ancient and modern eclipses obliges the astronomers to employ, without being able to deduce it, like the rest, *à priori*, from the theory of an universal force inversely proportional to the square of the distance. It has therefore been considered as a stumbling block in the Newtonian philosophy.

393 The secular equation of the moon's mean distance.

This is what is called *the secular equation of the moon's mean motion*. The mean motion is deduced from a comparison of distant observations. The time between them, being divided by the number of intervening revolutions, gives the average time of one revolution, or the mean lunar period. When the ancient Chaldean observations are compared with those of Hipparchus, we obtain a certain period; when those of Hipparchus are compared with some in the 9th century, we obtain a period somewhat shorter; when the last are compared with those of Tycho Brahe, we obtain one still shorter; and when Brahe's are compared with those of our day, we obtain the shortest period of all—and thus the moon's mean motion appears to accelerate continually; and the accelerations appear to be in the duplicate ratio of the times. The acceleration for the century which ended in 1700 is about 9 seconds of a degree; that is to say, the whole motion of the moon during the 17th century must be increased 9 seconds, in order to obtain its motion during the 18th; and as much must be taken from it, or added to the computed longitude, to obtain its motion during the 16th: and the double of this must be taken from the motion during the 16th, to obtain its motion during the 15th, &c. Or it will be sufficient to calculate the moon's mean longitude for any time past or to come by the secular motion which obtains in the present century, and then to add to this longitude the product of 9 seconds, multiplied by the square of the number of centuries which intervene. Thus having found the mean longitude for the year 1200, add 9 seconds, multiplied by 36, for six centuries. By this method we shall make our calculation agree with the most ancient and all intermediate observations. If we neglect this correction, we shall differ more than a degree from the Chaldean observation of the moon's place in the heavens.

The mathematicians having succeeded so completely in deducing all the observed inequalities of the planetary motions, from the single principle, that the deflecting forces diminished in the inverse duplicate ratio of the distances, were fretted by this exception, the reality of which they could not contest. Many opinions were formed about its cause. Some have attempted to deduce it from the action of the planets on the moon; others have deduced it from the oblate form of the earth, and the translation of the ocean by the tides; others have supposed it owing to the resistance of the ether in the celestial spaces; and others have imagined that the action of the deflecting force requires time for its propagation to a distance: But their deductions have been proved unsatisfactory, and have by no means the precision and evidence that have been attained in the other questions of physical astronomy. At last M. de la Place, of the Royal Academy of Sciences at Paris, has happily succeeded, and deduced the secular equation of the moon from the Newtonian law of planetary deflection. It is produced in the following manner.

394 Deduced from the Newtonian law of planetary deflection.

Suppose the moon revolving round the earth, undisturbed by any deflection toward the sun, and that the time of her revolution is exactly ascertained. Now let the influence of the sun be added. This diminishes her tendency to the earth in opposition and conjunction, and increases it in the quadratures: but the diminutions exceed the augmentations both in quantity and duration; and the excess is equivalent to $\frac{1}{179}$th of her tendency to the earth. Therefore this diminished tendency cannot retain the moon in the same orbit: she must retire farther from the earth, and describe an orbit which is less incurvated by $\frac{1}{179}$th part; and she must employ a longer time in a revolution. The period therefore which we observe, is not that which would have obtained had the moon been influenced by the earth alone. We should not have known that her natural period was increased, had the disturbing influence of the sun remained unchanged; but this varies in the inverse triplicate ratio of the earth's distance from the sun, and is therefore greater in our winter, when the earth is nearer to the sun. This is the source of the annual equation, by which the lunar period in January is made to exceed that in July nearly 24 minutes. The angular velocity of the moon is diminished in general $\frac{1}{179}$, and this numerical coefficient varies in the inverse ratio of the cube

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of the earth's distance from the sun. If we expand this inverse cube of the earth's distance into a series arranged according to the sines and cosines of the earth's mean motion, making the earth's mean distance unity, we shall find that the series contains a term equal to $\frac{3}{2}$ of the square of the eccentricity of the earth's orbit. Therefore the expression of the diminution of the moon's angular velocity contains a term equal to $\frac{1}{179}$ of this velocity multiplied by $\frac{3}{2}$ of the square of the earth's eccentricity; or equal to the product of the square of the eccentricity, multiplied by the moon's angular velocity, and divided by 119,33 ($\frac{2}{3}$ of 179). Did this eccentricity remain constant, this product would also be constant, and would still be confounded with the general diminution, making a constant part of it: but the eccentricity of the earth's orbit is known to diminish, and its diminution is the result of the universality of the Newtonian law of the planetary deflections. Although this diminution is exceedingly small, its effect on the lunar motion becomes sensible by accumulation in the course of ages. The eccentricity diminishing, the diminution of the moon's angular motion must also diminish, that is, the angular motion must increase.

During the 18th century, the square of the earth's eccentricity has diminished 0,00000015325, the mean distance from the sun being $=1$. This has increased the angular motion of the moon in that time 0,00000001285. As this augmentation is gradual, we must multiply the angular motion during the century by the half of this quantity, in order to obtain its accumulated effect. This will be found to be 9″ very nearly, which exceeds that deduced from a most careful comparison of the motion of the last two centuries, only by a fraction of a second.

As long as the diminution of the square of the eccentricity of the earth's orbit can be supposed proportional to the time, this effect will be as the squares of the times. When this theory is compared with observations, the coincidence is wonderful indeed. The effect on the moon's motion is periodical, as the change of the solar eccentricity is, and its period includes millions of years. Its effect on the moon's longitude will amount to several degrees before the secular acceleration change to a retardation.

Those who are not familiar with the disquisitions of modern analysis, may conceive this question in the following manner.

Let the length of a lunar period be computed for the earth's distance from the sun for every day of the year. Add them into one sum, and divide this by their number, the quotient will be the mean lunar period. This will be found to be greater than the arithmetical medium between the greatest and the least. Then suppose the eccentricity of the earth's orbit to be greater, and make the same computation. The average period will be found still greater, while the medium between the greatest and least periods will hardly differ from the former. Something very like this may be observed without any calculation, in a case very similar. The angular velocity of the sun is inversely as the square of his distance. Look into the solar tables, and the greatest diurnal motion will be found 3673″, and the least 3433″. The mean of these is 3553″, but the medium of the whole is 3548″. Now make a similar observation in tables of the motion of the planet Mars, whose eccentricity is much greater. We shall find that the medium between the greatest and least exceeds the true medium of all in a much greater proportion.

It has been supposed by some philosophers that the moon was originally a comet, which passing very near the earth, had been made to revolve round her by the force of attraction. But if we calculate ever so far backwards, we still find the moon revolving round the earth as the planets round the sun, which could not be the case if this opinion were true. Hence it follows, that neither the moon nor any of the satellites have ever been comets.

Sect. V. *Of Irregularities in the Satellites of Jupiter.*

The subserviency of the eclipses of Jupiter's satellites to geography and navigation had occasioned their motions to be very carefully observed, ever since these uses of them were first suggested by Galileo; and their theory is as far advanced as that of the primary planets. It has peculiar difficulties. Being very near to Jupiter, the great deviation of his figure from perfect sphericity makes the relation between their distances from his centre and their gravitations toward it vastly complicated. But this only excited the mathematicians so much the more to improve their analysis; and they saw, in this little system of Jupiter and his attendants, an epitome of the solar system, where the great rapidity of the motions must bring about in a short time every variety of configuration or relative position, and thus give us an example of those mutual disturbances of the primary planets, which require thousands of years for the discovery of their periods and limits. We have derived some very remarkable and useful pieces of information from this investigation; and have been led to the discovery of the eternal durability of the solar system, a thing which Newton greatly doubted of.

Mr Pound had observed long ago, that the irregularities of the three interior satellites were repeated in a period of 437 days; and this observation is found to be just to this day.

		Days.	H.	M.
247 revolutions of the	first occupy	437	3	44
123	second	437	3	42
61	third	437	3	36
26	fourth	435	14	16

This naturally led mathematicians to examine their motions, and see in what manner their relative positions or configurations, as they are called, corresponded to this period: and it is found, that the mean longitude of the first satellite, *minus* thrice the mean longitude of the second, *plus* twice the mean longitude of the third, always made 180 degrees. This requires that the mean motion of the first, added to twice that of the third, shall be equal to thrice the mean motion of the second. This correspondence of the mean motions is of itself a singular thing, and the odds against its probability seems infinitely great; and when we add to this the particular positions of the satellites in any one moment, which is necessary for the above constant relation of their longitudes, the improbability of the coincidence, as a thing quite fortuitous, becomes infinitely greater. Doubts were first entertained of the coincidence,

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coincidence, because it was not indeed accurate to a second. The result of the investigation is curious. When we follow out the consequences of mutual gravitation, we find, that although neither the primitive motions of projection, nor the points of the orbit from which the satellites were projected, were *precisely* such as suited these observed relations of their revolutions and their contemporaneous longitudes; yet if they differed from them only by very minute quantities, the mutual gravitations of the satellites would in time bring them into those positions, and those states of mean motion, that would induce the observed relations; and when they are once induced they will be continued for ever. There will indeed be a small equation, depending on the degree of unsuitableness of the first motions and positions; and this causes the whole system to oscillate, as it were, a little, and but a very little way on each side of this exact and permanent state. The permanency of these relations will not be destroyed by any secular equations arising from external causes; such as the action of the fourth satellite, or of the sun, or of a resisting medium; because their mutual actions will distribute this equation as it did the original error.

For a full discussion of this curious but difficult subject, we refer the reader to the dissertations of La Grange and La Place, and to the tables lately published by Delambre. These mathematicians have shown, that if the mass of Jupiter be represented by unity, that of his satellites will be represented by the following numbers.

First satellite	0.0000172011
Second satellite	0.0000237103
Third satellite	0.0000872128
Fourth satellite	0.0000544681

Sect. VI. *Of Saturn's Ring.*

395 Saturn's ring.

The most important addition (in a philosophical view) which has been made to astronomical science since the discovery of the aberration of light and the nutation of the earth's axis, is that of the rotation of Saturn's ring. The ring itself is an object quite peculiar; and when it was discovered that all the bodies which had any immediate connexion with a planet gravitated toward that planet, it became an interesting question to ascertain what was the nature of this ring? What supports this immense arch of heavy matter without its resting on the planet? What maintains it in perpetual concentricity with the body of Saturn, and keeps its surface in one invariable position?

The theory of universal gravitation tells us what things are possible in the solar system; and our conjectures about the nature of this ring must always be regulated by the circumstance of its gravitation to the planet. Philosophers had at first supposed it to be a luminous atmosphere, thrown out into that form by the great centrifugal force arising from a rotation: but its well-defined edge, and, in particular, its being two very narrow rings, extremely near each other, yet perfectly separate, rendered this opinion of its constitution more improbable.

396 Discovery of Dr Herschel relating to it.

Dr Herschel's discovery of brighter spots on its surface, and that those spots were permanent during the whole time of his observation, seem to make it more probable that the parts of the ring have a solid connexion. Mr Herschel has discovered, by the help of these spots, that the ring turns round its axis, and that this axis is also the axis of Saturn's rotation. The time of rotation is 10h. $32\frac{1}{4}'$. But the other circumstances are not narrated with the precision sufficient for an accurate comparison with the theory of gravity. He informs us, that the radii of the four edges of the ring are 590, 751, 774, 830, of a certain scale, and that the angle subtended by the ring at the mean distance from the earth is $46\frac{2}{7}''$. Therefore its elongation is $23\frac{1}{7}''$. The elongation of the second Cassinian satellite is 56″, and its revolution is 2d. 17h. 44′. This should give, by the third law of Kepler, 17h. 10′ for the revolution of the outer edge of the ring, or rather of an atom of that edge, in order that it may maintain itself in equilibrio. The same calculation applied to the outer edge of the inner ring gives about 13h. 36′; and we obtain 11h. 16′ for the inner edge of this ring. Such varieties are inconsistent with the permanent appearance of a spot. We may suppose the ring to be a luminous fluid or vapour, each particle of which maintains its situation by the law of planetary revolution. In such a state, it would consist of concentric strata, revolving more slowly as they were more remote from the planet, like the concentric strata of a vortex, and therefore having a relative motion incompatible with the permanency of any spot. Besides, the rotation observed by Herschel is too rapid even for the innermost part of the ring. We think therefore that it consists of cohering matter, and of considerable tenacity, at least equal to that of a very clammy fluid, such as melted glass.

We can tell the figure which a fluid ring must have, so that it may maintain its form by the mutual gravitation of its particles to each other, and their gravitation to the planet. Suppose it cut by a meridian. It may be in equilibrio if the section is an ellipse, of which the longer axis is directed to the centre of the planet, and very small in comparison with its distance from the centre of the planet, and having the revolution of its middle round Saturn, such as agree with the Keplerean law. These circumstances are not very consistent with the dimensions of Saturn's inner ring. The distance between the middle of its breadth and the centre of Saturn is 670, and its breadth is 161′, nearly one-fourth of the distance from the centre of Saturn. De la Place says, that the revolution of the inner ring observed by Herschel is very nearly that required by Kepler's law: but we cannot see the grounds of this assertion. The above comparison with the second Cassinian satellite shows the contrary. The elongation of that satellite is taken from Bradley's observations, as is also its periodic time. A ring of detached particles revolving in 10h. $32\frac{1}{4}'$ must be of much smaller diameter than even the inner edge of Saturn's ring. Indeed the quantity of matter in it might be such as to increase the gravitation considerably; but this would be seen by its disturbing the seventh and sixth satellites, which are exceedingly near it. We cannot help thinking, therefore, that it consists of matter which has very considerable tenacity. An equatorial zone of matter, tenacious like melted glass, and whirled briskly round, might be thrown off, and, retaining its great velocity, would stretch out while whirling, enlarging in diameter and diminishing in thickness or breadth, or both, till the centrifugal force was balanced by the united force of gravity 397 Its probable consistency.

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gravity and tenacity. We find the equilibrium will not be sensibly disturbed by considerable deviations, such as equal breadth, or even want of flatness. Such inequalities appear on the ring at that time of its disparition, when its edge is turned to the sun or to us. The appearances of its different sides are then considerably different.

Such a ring or rings must have an oscillatory motion round the centre of Saturn, in consequence of their mutual action, and the action of the sun, and their own irregularities: but there will be a certain position which they have a tendency to maintain, and to which they will be brought back, after deviating from it, by the ellipticity of Saturn, which is very great. The sun will occasion a nutation of Saturn's axis and a precession of his equinoxes, and this will drag along with it both the rings and the neighbouring satellites.

The atmosphere which surrounds a whirling planet cannot have all its parts circulating according to the third law of Kepler. The mutual attrition of the planet, and of the different strata, arising from their different velocities, must accelerate the slowly moving strata, and retard the rapid, till all acquire a velocity proportional to their distance from the axis of rotation; and this will be such that the momentum of rotation of the planet and its atmosphere remains always the same. It will swell out at the equator, and sink at the poles, till the centrifugal force at the equator balances the height of a superficial particle. The greatest ratio which the equatorial diameter can acquire to the polar axis is that of four to three, unless a cohesive force keeps the particles united, so that it constitutes a liquid, and not an elastic fluid like air; and an elastic fluid cannot form an atmosphere bounded in its dimensions, unless there be a certain rarity which takes away all elasticity. If the equator swells beyond the dimension which makes the gravitation balance the centrifugal force, it must immediately dissipate.

If we suppose that the atmosphere has extended to this limit, and then condenses by cold, or any chemical or other cause different from gravity, its rotation necessarily augments, preferring its former momentum,
398 and the limit will approach the axis; because a greater
and origin. velocity produces a greater centrifugal force, and requires a greater gravitation to balance it. Such an atmosphere may therefore desert, in succession, zones of its own matter in the plane of its equator, and *leave* them revolving in the form of rings. It is not unlikely that the rings of Saturn may have been furnished in this very way; and the zones, having acquired a common velocity in their different strata, will preserve it; and they are susceptible of irregularities arising from local causes at the time of their separation, which may afford permanent spots.

Sect. VII. *Of the Atmospheres of the Planets.*

By *atmosphere* is meant a rare, transparent, compressible, and elastic fluid surrounding a body. It is supposed that all the heavenly bodies possess atmospheres. The atmosphere of the earth is familiar to all its inhabitants. Observation points out the atmospheres of the sun and of Jupiter; but that of the other planets is scarcely perceptible.

The atmosphere becomes rarer in proportion to its distance from the body to which it belongs, in consequence of its elasticity, which causes it to dilate the more the less it is compressed. If its most remote parts were still possessed of elasticity, they would separate indefinitely, and the whole would be scattered through space. To prevent this effect, it is necessary that the elasticity should diminish at a greater rate than the compressing force, and that when it reaches a certain degree of rarity its elasticity should vanish altogether.

All the atmospherie strata must gradually acquire the same rotatory motion with the bodies to which they belong in consequence of the continual friction to which their different parts must be subjected, which will gradually accelerate or retard the different parts till a common motion is produced. In all these changes, and indeed in all those which the atmosphere undergoes, the sum of the products of the particles of the body and of its atmosphere multiplied by the areas described round their common centres of gravity by their radii vectors projected in the plane of the equator continue always the same, the times being the same. If we suppose then, by any cause whatever, the height of the atmosphere is diminished, and a portion of it condenses on the surface of the planet; the consequence will be, that the rotatory motion of the planet and of its atmosphere will be accelerated. For the radii vectors of the areas described by the particles of the primitive atmosphere becoming shorter, the sum of the products of all these particles by the corresponding areas cannot remain the same unless the rotatory motion augment.

At the upper surface of the atmosphere the fluid is retained only by its weight. Its figure is such that the direction resulting from the combination of the centrifugal forces and the attracting forces is perpendicular to it. It is flattened at the poles, and more convex at the equator. But this flattening has its limits. When a maximum the axis of the poles is to that at the equator as 2 to 3.

At the equator the atmosphere can only extend to the place where the centrifugal force and gravitation exactly balance each other; for if it pass that limit, it will be dissipated altogether. Hence it follows that the solar atmosphere does not extend as far as Mercury; consequently it is not the cause of the zodiacal light which appears to extend beyond even the earth's orbit.

The place where the centrifugal force and gravitation balance each other is so much the nearer a body the more rapid its rotatory motion is. If we suppose the atmosphere to extend to that limit, and then to condense by cooling, &c. at the surface of the planet, the rotatory motion will increase in rapidity in proportion to this condensation, and the limit of the height of the atmosphere will constantly approach the planet. The atmosphere would of course abandon successively zones of fluid in the plane of the equator, which would continue to circulate round the body. We have shown in the last section that Saturn's ring may owe its origin to this cause.

We may add also, that the action of another body may considerably change the constitution of this atmosphere. Thus, supposing that the moon had originally an atmosphere, the limit will be that distance from the moon where the centrifugal force, arising from the moon's rotation, added to the gravitation 399

399 Probable reason why we see no atmosphere about the moon.

tion to the earth, balances the gravitation to the moon. If the moon be $\frac{1}{39}$th of the earth, this limit will be about $\frac{1}{9}$th of the moon's distance from the earth. If at this distance the elasticity of the atmosphere is not annihilated by its rarefaction, it will be all taken off by the earth, and accumulate round it. This may be the reason why we see no atmosphere about the moon.

Sect. VII. *Of the Tides.*

400 Cause of the tides discovered by Kepler.

The cause of the tides was discovered by Kepler, who, in his *Introduction to the Physics of the Heavens*, thus explains it: "The orb of the attracting power which is in the moon, is extended as far as the earth; and draws the waters under the torrid zone, acting upon places where it is vertical, insensibly on confined seas and bays, but sensibly on the ocean, whose beds are large, and where the waters have the liberty of reciprocation, that is, of rising and falling." And in the 70th page of his *Lunar Astronomy*—"But the cause of the tides of the sea appears to be the bodies of the sun and moon drawing the waters of the sea." This hint being given, the immortal Sir Isaac Newton improved it, and wrote so amply on the subject, as to make the theory of the tides in a manner quite his own, by discovering the cause of their rising on the side of the earth opposite to the moon. For Kepler believed that the presence of the moon occasioned an impulse which caused another in her absence.

It has been already observed, that the power of gravity diminishes as the square of the distance increases; and therefore the waters at Z on the side of the earth

Fig. 149. ABCDEFGH next the moon M, are more attracted than the central parts of the earth O by the moon, and the central parts are more attracted by her than the waters on the opposite side of the earth at *n*: and therefore the distance between the earth's centre and the waters on its surface under and opposite to the moon will be increased. For, let there be three bodies at H, O, and D: if they are all equally attracted by the body M, they will all move equally fast towards it, their mutual distances from each other continuing the same. If the attraction of M is unequal, then that body which is most strongly attracted will move fastest, and this will increase its distance from the other body. Therefore, by the law of gravitation, M will attract H more strongly than it does O, by which the distance between H and O will be increased; and a spectator on O will perceive H rising higher toward Z. In like manner, O being more strongly attracted than D, it will move farther towards M than D does: consequently, the distance between O and D will be increased; and a spectator on O, not perceiving his own motion, will see D receding farther from him towards *n*; all effects and appearances being the same, whether D recedes from O, or O from D.

Suppose now there is a number of bodies, as A, B, C, D, E, F, G, H, placed round O, so as to form a flexible or fluid ring: then, as the whole is attracted towards M, the parts at H and D will have their distance from O increased; whilst the parts at B and F being nearly at the same distance from M as O is, these parts will not recede from one another; but rather, by the oblique attraction of M, they will approach nearer to O. Hence the fluid ring will form itself into an ellipse ZIBL *n* KFNZ, whose longer axis *n* OZ produced will pass through M, and its shorter axis BOF will terminate in B and F. Let the ring be filled with fluid particles, so as to form a sphere round O; then, as the whole moves towards M, the fluid sphere being lengthened at Z and *n*, will assume an oblong or oval form. If M is the moon, O the earth's centre, ABC DEFGH the sea covering the earth's surface, it is evident, by the above reasoning, that whilst the earth by its gravity falls towards the moon, the water directly below her at B will swell and rise gradually towards her; also the water at D will recede from the centre [strictly speaking, the centre recedes from D], and rise on the opposite side of the earth; whilst the water at B and F is depressed, and falls below the former level. Hence, as the earth turns round its axis from the moon to the moon again in $24\frac{1}{2}$ hours, there will be two tides of flood and two of ebb in that time, as we find by experience.

401 Why the tides are high at full moon.

As this explanation of the ebbing and flowing of the sea is deduced from the earth's constantly falling towards the moon by the power of gravity, some may find a difficulty in conceiving how this is possible, when the moon is full, or in opposition to the sun; since the earth revolves about the sun, and must continually fall towards it, and therefore cannot fall contrary ways at the same time: or if the earth is constantly falling towards the moon, they must come together at last. To remove this difficulty, let it be considered, that it is not the centre of the earth that describes the annual orbit round the sun, but the (E) common centre of gravity of the earth and moon together; and that whilst the earth is moving round the sun, it also describes a circle round that centre of gravity; going as many times round it in one revolution about the sun as there are lunations or courses of the moon round the earth in a year: and therefore the earth is constantly falling towards the moon from a tangent to the circle it describes round the said common centre of gravity. Let M be Fig. 150. the moon, TW part of the moon's orbit, and C the centre of gravity of the earth and moon; whilst the moon goes round her orbit, the centre of the earth describes the circle *dge* round C, to which circle *gak* is a tangent; and therefore when the moon has gone from M to a little past W, the earth has moved from *g* to *e*; and in that time has fallen towards the moon, from the tangent at *a* to *e*: and so on, round the whole circle.

The sun's influence in raising the tides is but small in

(E) This centre is as much nearer the earth's centre than the moon's as the earth is heavier, or contains a greater quantity of matter than the moon, namely, about 40 times. If both bodies were suspended on it, they would hang *in equilibrio*. So that dividing 240,000 miles, the moon's distance from the earth's centre, by 40, the excess of the earth's weight above the moon's, the quotient will be 6000 miles, which is the distance of the common centre of gravity of the earth and moon from the earth's centre.

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in comparison of the moon's; for though the earth's diameter bears a considerable proportion to its distance from the moon, it is next to nothing when compared to its distance from the sun. And therefore the difference of the sun's attraction on the sides of the earth under and opposite to him, is much less than the difference of the moon's attraction on the sides of the earth under and opposite to her; and therefore the moon must raise the tides much higher than they can be raised by the sun.

402 Influence of the sun in raising tides.

403 Why they are not highest when the moon is in the meridian.

On this theory, the tides ought to be highest directly under and opposite to the moon; that is, when the moon is due north and south. But we find, that in open seas, where the water flows freely, the moon M is generally past the north and south meridian, as at *p*, when it is high water at Z and at *n*. The reason is obvious: for though the moon's attraction was to cease altogether when she was past the meridian, yet the motion of ascent communicated to the water before that time would make it continue to rise for some time after; much more must it do so when the attraction is only diminished; as a little impulse given to a moving ball will cause it still to move farther than otherwise it could have done; and as experience shows that the day is hotter about three in the afternoon, than when the sun is on the meridian, because of the increase made to the heat already imparted.

The tides answer not always to the same distance of the moon from the meridian at the same places; but are variously affected by the action of the sun, which brings them on sooner when the moon is in her first and third quarters, and keeps them back later when she is in her second and fourth: because, in the former case, the tide raised by the sun alone would be earlier than the tide raised by the moon: and, in the latter case later.

The moon goes round the earth in an elliptic orbit; and therefore, in every lunar month, she approaches nearer to the earth than her mean distance, and recedes farther from it. When she is nearest, she attracts strongest, and so raises the tides most: the contrary happens when she is farthest, because of her weaker attraction. When both luminaries are in the equator, and the moon in perigee, or at her least distance from the earth, she raises the tides highest of all, especially at her conjunction and opposition; both because the equatorial parts have the greatest centrifugal force from their describing the largest circle, and from the concurring actions of the sun and moon. At the change, the attractive forces of the sun and moon being united, they diminish the gravity of the waters under the moon, and their gravity on the opposite side is diminished by means of a greater centrifugal force. At the full, whilst the moon raises the tide under and opposite to her, the sun, acting in the same line, raises the tide under and opposite to him; whence their conjoint effect is the same as at the change; and, in both cases, occasion what we call the *Spring Tides*. But at the quarters the sun's action on the waters at O and H diminishes the effect of the moon's action on the waters at Z and N; so that they rise a little under and opposite to the sun at O and H, and fall as much under and opposite to the moon at Z and N; making what we call the *Neap Tides*, because the sun and moon then act cross-wise to each other. But these tides happen not till some time after; because in this, as in other cases, the actions do not produce the greatest effect when they are at the strongest, but some time afterward.

The sun being nearer the earth in winter than in summer, is of course nearer to it in February and October than in March and September; and therefore the greatest tides happen not till some time after the autumnal equinox, and return a little before the vernal.

The sea, being thus put in motion, would continue to ebb and flow several times, even though the sun and moon were annihilated, or their influence should cease; as, if a bason of water were agitated, the water would continue to move for some time after the bason was left to stand still; or, like a pendulum, which, having been put in motion by the hand, continues to make several vibrations without any new impulse.

When the moon is in the equator, the tides are equally high in both parts of the lunar day, or time of the moon's revolving from the meridian to the meridian again, which is 24 hours 50 minutes. But as the moon declines from the equator towards either pole, the tides are alternately higher and lower at places having north or south latitude. For one of the highest elevations, which is that under the moon, follows her towards the pole to which she is nearest; and the other declines towards the opposite pole; each elevation describing parallels as far distant from the equator, on opposite sides, as the moon declines from it to either side; and consequently the parallels described by these elevations of the water are twice as many degrees from one another as the moon is from the equator; increasing their distance as the moon increases her declination, till it be at the greatest, when the said parallels are, at a mean state, 47 degrees from one another: and on that day, the tides are most unequal in their heights. As the moon returns towards the equator, the parallels described by the opposite elevations approach towards each other, until the moon comes to the equator, and then they coincide. As the moon declines towards the opposite pole, at equal distances, each elevation describes the same parallel in the other part of the lunar day, which its opposite elevation described before. Whilst the moon has north declination, the greatest tides in the northern hemisphere are when she is above the horizon; and the reverse whilst her declination is south. Let NESQ be the earth, NSC its axis, EQ the equator, T ♋ the tropic of Cancer, *t* ♑ the tropic of Capricorn, *a b* the arctic circle, *c d* the antarctic, N the north pole, S the south pole, M the moon, F and G the two eminences of water, whose lowest parts are at *a* and *d*, at N and S, and at *b* and *c*, always 90 degrees from the highest. Now, when the moon is in her greatest north declination at M, the highest elevation G under her is on the tropic of Cancer T ♋, and the opposite elevation F on the tropic of Capricorn *t* ♑; and these two elevations describe the tropics by the earth's diurnal rotation. All places in the northern hemisphere ENQ have the highest tides when they come into the position *b* ♋ Q, under the moon; and the lowest tides when the earth's diurnal rotation carries them into the position *a* TE, on the side opposite the moon; the reverse happens at the same time in the southern hemisphere ESQ, as is evident to sight. The Fig. 151 152, 153.

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The axis of the tides *a* C *d* had now its poles *a* and *d* (being always 90 degrees from the highest elevations) in the arctic and antarctic circles; and therefore it is plain, that at these circles there is but one tide of flood, and one of ebb, in the lunar day. For, when the point *a* revolves half round to *b* in 12 lunar hours, it has a tide of flood; but when it comes to the same point *a* again in 12 hours more, it has the lowest ebb. In seven days afterward, the moon M comes to the equinoctial circle, and is over the equator EQ, when both elevations describe the equator; and in both hemispheres, at equal distances from the equator, the tides are equally high in both parts of the lunar day. The whole phenomena being reversed, when the moon has south declination, to what they were when her declination was north, require no farther description.

In the three last-mentioned figures, the earth is orthographically projected on the plane of the meridian; but in order to describe a particular phenomenon, we now project it on the plane of the ecliptic. Let HZON be the earth and sea, FED the equator, T the tropic of Cancer, C the arctic circle, P the north pole, and the curves, 1, 2, 3, &c. 24 meridians or hour circles, intersecting each other in the poles: AGM is the moon's orbit, S the sun, M the moon, Z the water elevated under the moon, and N the opposite equal elevation. As the lowest parts of the water are always 90 degrees from the highest, when the moon is in either of the tropics (as at M), the elevation Z is on the tropic of Capricorn, and the opposite elevation N on the tropic of Cancer; the low-water circle HCO touches the polar circles at C; and the high-water circle ETP 6 goes over the poles at P, and divides every parallel of latitude into two equal segments. In this case, the tides upon every parallel are alternately higher and lower; but they return in equal times: the point T, for example, on the tropic of Cancer, (where the depth of the tide is represented by the breadth of the dark shade) has the shallower tide of flood at T than when it revolves half round from thence to 6, according to the order of the numeral figures; but it revolves as soon from 6 to T as it did from T to 6. When the moon is in the equinoctial, the elevations Z and N are transferred to the equator at O and H, and the high and low-water circles are got into each other's former places; in which case the tides return in unequal times, but are equally high in both parts of the lunar day; for a place at 1 (under D) revolving as formerly, goes sooner from 1 to 11 (under F) than from 11 to 1, because the parallel it describes is cut into unequal segments by the high-water circle HCO: but the points 1 and 11 being equidistant from the pole of the tides at C, which is directly under the pole of the moon's orbit MGA, the elevations are equally high in both parts of the day.

Fig. 151.

404 Tides turn on the axis of the moon's orbit.

And thus it appears, that as the tides are governed by the moon, they must turn on the axis of the moon's orbit, which is inclined $23\frac{1}{2}$ degrees to the earth's axis at a mean state: and therefore the poles of the tides must be so many degrees from the poles of the earth, or in opposite points of the polar circles, going round these circles in every lunar day. It is true, that according to fig. 153. when the moon is vertical to the equator ECQ, the poles of the tides seem to fall in with the poles of the world N and S: but when we consider that FGH is under the moon's orbit, it will appear, that when the moon is over H, in the tropic of Capricorn, the north pole of the tides (which can be no more than 90 degrees from under the moon) must be at C in the arctic circle, not at P the north pole of the earth; and as the moon ascends from H to G in her orbit, the north pole of the tides must shift from *c* to *a* in the arctic circle, and the south poles as much in the antarctic.

It is not to be doubted, but that the earth's quick rotation brings the poles of the tides nearer to the poles of the world than they would be if the earth were at rest, and the moon revolved about it only once a month; for otherwise the tides would be more unequal in their height and times of their returns, than we find they are. But how near the earth's rotation may bring the poles of its axis and those of the tides together, or how far the preceding tides may affect those which follow, so as to make them keep up nearly to the same heights and times of ebbing and flowing, is a problem more fit to be solved by observation than by theory.

Those who have opportunity to make observations, and choose to satisfy themselves whether the tides are really affected in the above manner by the different positions of the moon, especially as to the unequal times of their return, may take this general rule for knowing when they ought to be so affected. When the earth's axis inclines to the moon, the northern tides, if not retarded in their passage through shoals and channels, nor affected by the winds, ought to be greatest when the moon is above the horizon, least when she is below it, and quite the reverse when the earth's axis declines from her; but in both cases, at equal intervals of time. When the earth's axis inclines sidewise to the moon, both tides are equally high, but they happen at unequal intervals of time. In every lunation the earth's axis inclines once to the moon, once from her, and twice sidewise to her, as it does to the sun every year; because the moon goes round the ecliptic every month, and the sun but once in a year. In summer, the earth's axis inclines towards the moon when new; and therefore the day-tides in the north ought to be highest, and night-tides lowest, about the change: at the full, the reverse. At the quarters, they ought to be equally high, but unequal in their returns: because the earth's axis then inclines sidewise to the moon. In winter, the phenomena are the same at full moon as in summer at new. In autumn the earth's axis inclines sidewise to the moon when new and full; therefore the tides ought to be equally high and uneven in their returns at these times. At the first quarter, the tides of flood should be least when the moon is above the horizon, greatest when she is below it; and the reverse at her third quarter. In spring, the phenomena of the first quarter answer to those of the third quarter in autumn; and *vice versa*. The nearer any tide is to either of the seasons, the more the tides partake of the phenomena of these seasons; and in the middle between any two of them the tides are at a mean state between those of both.

In open seas, the tides rise but to very small heights in proportion to what they do in wide-mouthed rivers, opening in the direction of the stream of tide. For in channels growing narrower gradually, the water is accumulated

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cumulated by the opposition of the contracting bank; like a gentle wind, little felt on an open plain, but strong and brisk in a street; especially if the wider end of the street be next the plain, and in the way of the wind.

405 Irregularities of tides accounted for.

The tides are so retarded in their passage through different shoals and channels, and otherwise so variously affected by striking against capes and headlands, that to different places they happen at all distances of the moon from the meridian, consequently at all hours of the lunar day. The tide propagated by the moon in the German ocean, when she is three hours past the meridian, takes 12 hours to come from thence to London bridge, where it arrives by the time that a new tide is raised in the ocean. And therefore, when the moon has north declination, and we should expect the tide at London to be greatest when the moon is above the horizon, we find it is least; and the contrary when she has south declination. At several places it is high water three hours before the moon comes to the meridian; but that tide which the moon pushes as it were before her, is only the tide opposite to that which was raised by her when she was nine hours past the opposite meridian.

There are no tides in lakes, because they are generally so small, that when the moon is vertical she attracts every part of them alike, and therefore by rendering all the water equally light, no part of it can be raised higher than another. The Mediterranean and Baltic seas have very small elevations, because the inlets by which they communicate with the ocean are so narrow, that they cannot, in so short a time, receive or discharge enough to raise or sink their surfaces sensibly.

For a more complete discussion of this important subject, we refer the reader to the article TIDE.

SECT. IX. *Of the Precession of the Equinoxes, and the Nutation of the Earth's Axis.*

406 Precession of the equinoctial points, &c.

It now remains to consider the precession of the equinoctial points, with its equations, arising from the nutation of the earth's axis as a physical phenomenon, and to endeavour to account for it upon those mechanical principles which have so happily explained all the other phenomena of the celestial motions.

407 Observations of Newton and others on this subject.

This did not escape the penetrating eye of Sir Isaac Newton; and he quickly found it to be a consequence, and the most beautiful proof, of the universal gravitation of all matter to all matter; and there is no part of his immortal work where his sagacity and fertility of resource shine more conspicuously than in this investigation. It must be acknowledged, however, that Newton's investigation is only a shrewd guess, founded on assumptions, of which it would be extremely difficult to demonstrate either the truth or falsity, and which required the genius of a Newton to pick out in such a complication of abstruse circumstances. The subject has occupied the attention of the first mathematicians of Europe since his time; and is still considered as the most curious and difficult of all mechanical problems. The most elaborate and accurate dissertations on the precession of the equinoxes are those of Sylvabella and Walmesly, in the Philosophical Transactions, published about the year 1754; that of Thomas Simpson, published in his Miscellaneous Tracts; that of Father Frisius, in the Memoirs of the Berlin Academy, and afterwards, with great improvements, in his Cosmographia; that of Euler in the Memoirs of Berlin; that of D'Alembert in a separate dissertation; and that of De la Grange on the Libration of the Moon, which obtained the prize in the Academy of Paris in 1769. We think the dissertation of Father Frisius the most perspicuous of them all, being conducted in the method of geometrical analysis; whereas most of the others proceed in the fluxionary and symbolic method, which is frequently deficient in distinct notions of the quantities under consideration, and therefore does not give us the same perspicuous conviction of the truth of the results. In a work like ours, it is impossible to do justice to the problem, without entering into a detail which would be thought extremely disproportioned to the subject by the generality of our readers. Yet those who have the necessary preparation of mathematical knowledge, and wish to understand the subject fully, will find enough here to give them a very distinct notion of it; and in the article ROTATION, they will find the fundamental theorems, which will enable them to carry on the investigation. We shall first give a short sketch of Newton's investigation, which is of the most palpable and popular kind, and is highly valuable, not only for its ingenuity, but also because it will give our unlearned readers distinct and satisfactory conceptions of the chief circumstances of the whole phenomena.

Sketch of Newton's investigation

Let S (fig. 154.) be the sun, E the earth, and M the moon, moving in the orbit NMCD n, which cuts the plane of the ecliptic in the line of the nodes N n, and has one half raised above it, as represented in the figure, the other half being hid below the ecliptic. Suppose this orbit folded down; it will coincide with the ecliptic in the circle N $m\,c\,d\,n$. Let EX represent the axis of this orbit, perpendicular to its plane, and therefore inclined to the ecliptic. Since the moon gravitates to the sun in the direction MS which is all above the ecliptic, it is plain that this gravitation has a tendency to draw the moon towards the ecliptic. Suppose this force to be such that it would draw the moon down from M to i in the time that she would have moved from M to t, in the tangent to her orbit. By the combination of these motions, the moon will desert her orbit, and describe the line M r, which makes the diagonal of the parallelogram; and if no farther action of the sun be supposed, she will describe another orbit M λ n', lying between the orbit MCD n and the ecliptic, and she will come to the ecliptic, and pass through it in a point n', nearer to M than n is, which was the former place of her descending node. By this change of orbit, the line EX will no longer be perpendicular to it; but there will be another line E x, which will now be perpendicular to the new orbit. Also the moon, moving from M to r, does not move as if she had come from the ascending node N, but from a point N lying beyond it; and the line of the nodes of the orbit in this new position is N$'n$. Also the angle MN$'m$ is less than the angle MNm.

Thus the nodes shift their places in a direction opposite to that of her motion, or move to the westward; the axis of the orbit changes its position, and the orbit itself changes its inclination to the ecliptic. These momentary changes are different in different parts of the orbit, according to the position of the line of the nodes.

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nodes. Sometimes the inclination of the orbit is increased, and sometimes the nodes move to the eastward. But, in general, the inclination increases from the time that the nodes are in the line of syzigee, till they get into quadrature, after which it diminishes till the nodes are again in syzigee. The nodes advance only while they are in the octants after the quadratures, and while the moon passes from quadrature to the node, and they recede in all other situations. Therefore the recess exceeds the advance in every revolution of the moon round the earth, and, on the whole, they recede.

What has been said of one moon, would be true of each of a continued ring of moons surrounding the earth, and they would thus compose a flexible ring, which would never be flat, but waved, according to the difference (both in kind and degree) of the disturbing forces acting on its different parts. But suppose these moons to cohere, and to form a rigid and flat ring, nothing would remain in this ring but the excess of the contrary tendencies of its different parts. Its axis would be perpendicular to its plane, and its position in any moment will be the mean position of all the axes of the orbits of each part of the flexible ring; therefore the nodes of this rigid ring will continually recede, except when the plane of the ring passes through the sun, that is, when the nodes are in syzigee; and (says Newton) the motion of these nodes will be the same with the mean motion of the nodes of the orbit of one moon. The inclination of this ring to the ecliptic will be equal to the mean inclination of the moon's orbit during any one revolution which has the same situation of the nodes. It will therefore be least of all when the nodes are in quadrature, and will increase till they are in syzigee, and then diminish till they are again in quadrature.

Suppose this ring to contract in dimensions, the disturbing forces will diminish in the same proportion, and in this proportion will all their effects diminish. Suppose its motion of revolution to accelerate, or the time of a revolution to diminish; the linear effects of the disturbing forces being as the squares of the times of their action, and their angular effects as the times, those errors must diminish also on this account; and we can compute what those errors will be for any diameter of the ring, and for any period of its revolution. We can tell, therefore, what would be the motion of the nodes, the change of inclination, and deviation of the axis, of a ring which would touch the surface of the earth, and revolved in 24 hours; nay, we can tell what these motions would be, should this ring adhere to the earth. They must be much less than if the ring were detached; for the disturbing forces of the ring must drag along with it the whole globe of the earth. The quantity of motion which the disturbing forces would have produced in the ring alone, will now (says Newton) be produced in the whole mass; and therefore the velocity must be as much less as the quantity of matter is greater: But still this can be computed.

Now there is such a ring on the earth: for the earth is not a sphere, but an elliptical spheroid. Sir Isaac Newton therefore engaged in a computation of the effects of the disturbing force, and has exhibited a most beautiful example of mathematical investigation. He first asserts, that the earth *must* be an elliptical spheroid, whose polar axis is to its equatorial diameter as 229 to 230. Then he demonstrates, that if the sine of the inclination of the equator be called π, and if t be the number of days (sidereal) in a year, the annual motion of a detached ring will be $360^\circ \times \frac{3\sqrt{1-\pi^2}}{4t}$. He then shows that the effect of the disturbing force on this ring is to its effect on the matter of the same ring, distributed in the form of an elliptical stratum (but still detached) as 5 to 2; therefore the motion of the nodes will be $360^\circ \times \frac{3\sqrt{1-\pi^2}}{10t}$, or $16' 16'' 24'''$ annually. He then proceeds to show, that the quantity of motion in the sphere is to that in an equatorial ring revolving in the same time, as the matter in the sphere to the matter in the ring, and as three times the square of a quadrantal arch to two squares of a diameter, jointly: Then he shows, that the quantity of matter in the terrestrial sphere is to that in the protuberant matter of the spheroid, as 52900 to 461 (supposing all homogeneous). From these premises it follows, that the motion of $16' 16'' 24'''$, must be diminished in the ratio of 10717 to 100, which reduces it to $9'' 07'''$ annually. And this (he says) is the precession of the equinoxes, occasioned by the action of the sun; and the rest of the $50\frac{1}{3}''$, which is the observed precession, is owing to the action of the moon, nearly five times greater than that of the sun. This appeared a great difficulty: for the phenomena of the tides show that it *cannot* much exceed twice the sun's force.

409 His determination of the form and dimensions of the earth demonstrated by M'Laurin.

Nothing can exceed the ingenuity of this process. Justly does his celebrated and candid commentator, Daniel Bernoulli, say (in his Dissertation on the Tides, which shared the prize of the French Academy with M'Laurin and Euler), that Newton saw through a veil what others could hardly discover with a microscope in the light of the meridian sun. His determination of the form and dimensions of the earth, which is the foundation of the whole process, is not offered as any thing better than a probable guess, *in re difficillima;* and it has been since demonstrated with geometrical rigour by M'Laurin.

His next principle, that the motion of the nodes of the rigid ring is equal to the mean motion of the nodes of the moon, has been most critically discussed by the first mathematicians, as a thing which could neither be proved nor refuted. Frisius has at least shown it to be a mistake, and that the motion of the nodes of the ring is double the mean motion of the nodes of a single moon; and that Newton's own principles should have produced a precession of $18\frac{1}{4}$ seconds annually, which removes the difficulty formerly mentioned.

His third assumption, that the quantity of motion of the ring must be shared with the included sphere, was acquiesced in by all his commentators, till D'Alembert and Euler, in 1749, showed that it was not the quantity of motion round an axis of rotation which remained the same, but the quantity of momentum or rotatory effort. The quantity of motion is the product of every particle by its velocity; that is, by its distance from the axis; while its momentum, or power of producing rotation, is as the square of that distance, and is to be had by taking the sum of each particle multiplied by the square of its distance from the axis. Since the earth

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earth differs so little from a perfect sphere, this makes no sensible difference in the result. It will increase Newton's precession about three-fourths of a second.

410 Examination of the phenomenon of precession on mechanical principles.

We proceed now to the examination of this phenomenon upon the fundamental principles of mechanics.

Because the mutual gravitation of the particles of matter in the solar system is in the inverse ratio of the squares of the distance, it follows, that the gravitations of the different parts of the earth to the sun or to the moon are unequal. The nearer particles gravitate more than those that are more remote.

Let PQ *p* E (fig. 155.), be a meridional section of the terrestrial sphere, and PO *pq* the section of the inscribed sphere. Let CS be a line in the plane of the ecliptic passing through the sun, so that the angle ECS is the sun's declination. Let NCM be a plane passing through the centre of the earth at right angles to the plane of the meridian PQ *p* E; NCM will therefore be the plane of illumination.

In consequence of the unequal gravitation of the matter of the earth to the sun, every particle, such as B, is acted on by a disturbing force parallel to CS, and proportional to BD, the distance of the particle from the plane of illumination; and this force is to the gravitation of the central particle to the sun, as three times BD is to CS, the distance of the earth from the sun.

Let AB *a* be a plane passing through the particle B, parallel to the plane EQ of the equator. This section of the earth will be a circle, of which A *a* is a diameter, and Q *q* will be the diameter of its section with the inscribed sphere. These will be two concentric circles, and the ring by which the section of the spheroid exceeds the section of the sphere will have AQ for its breadth; P *p* is the axis of figure.

Let EC be presented by the symbol -	a
OC or PC - - - - -	b
EO their difference $=\frac{a^2-b^2}{a+b}$ -	d
CL - - - - - -	x
QL - - - - -	$\sqrt{d^2-x^2}$
The periphery of a circle to radius 1 -	Π
The disturbing force at the distance 1 from the plane NCM - -	f
The sine of declination ECS -	m
The cosine of ECS - - -	n

It is evident, that with respect to the inscribed sphere, the disturbing forces are completely compensated, for every particle has a corresponding particle in the adjoining quadrant, which is acted on by an equal and opposite force. But this is not the case with the protuberant matter which makes up the spheroid. The segments NS *s n* and MT *t m* are more acted on than the segments NT *t n* and MS *s m*; and thus there is produced a tendency to a conversion of the whole earth, round an axis passing through the centre C, perpendicular to the plane PQ *p* E. We shall distinguish this motion from all others to which the spheroid may be subject, by the name LIBRATION. The axis of this libration is always perpendicular to that diameter of the equator over which the sun is, or to that meridian in which he is.

PROB. I. To determine the momentum of libration corresponding to any position of the earth respecting the sun, that is, to determine the accumulated energy of the disturbing forces on all the protuberant matter of the spheroid.

Let B and *b* be two particles in the ring formed by the revolution of AQ, and so situated, that they are at equal distances from the plane NM; but on opposite sides of it. Draw BD, *b d*, perpendicular to NM, and FLG perpendicular to LT.

Then, because the momentum, or power of producing rotation, is as the force and as the distance of its line of direction from the axis of rotation, jointly, the combined momentum of the particles B and *b*, will be $f.\mathrm{BD}.\mathrm{DC}-f.bd.dc$, (for the particles B and *b* are urged in contrary directions). But the momentum of B is $f.\mathrm{BF}.\mathrm{DC}+f.\mathrm{FD}.\mathrm{DC}$, and that of *b* is $f.b.\mathrm{G}.d\mathrm{C}-f.d\mathrm{G}.d\mathrm{C}$; and the combined momentum is $f.\mathrm{BF}.\mathrm{D}d-f.\mathrm{FD}.\overline{\mathrm{DC}+d\mathrm{C}},=2f.\mathrm{BF}.\mathrm{LF}-2f.\mathrm{LT}.\mathrm{TC}$.

Because m and n are the sine and cosine of the angle ECS or LCT, we have $\mathrm{LT}=m.\mathrm{CL}$, and $\mathrm{CT}=n.\mathrm{CL}$, and $\mathrm{LF}=m.\mathrm{BL}$, and $\mathrm{BF}=n.\mathrm{BL}$. This gives the momentum $=2fmn\,\overline{\mathrm{BL}^2-\mathrm{CL}^2}$.

The breadth AQ of the protuberant ring being very small, we may suppose, without any sensible error, that all the matter of the line AQ is collected in the point Q; and, in like manner, that the matter of the whole ring is collected in the circumference of its inner circle, and that B and *b* now represent, not single particles, but the collected matter of lines such as AQ, which terminate at B and *b*. The combined momentum of two such lines will therefore be $2mnf.\mathrm{AQ}.\overline{\mathrm{BL}^2-\mathrm{CL}^2}$.

Let the circumference of each parallel of latitude be divided into a great number of indefinitely small and equal parts. The number of such parts in the circumference, of which Q *q* is the diameter, will be $\Pi\cdot\mathrm{QL}$. To each pair of these there belongs a momentum $2mnf\cdot\mathrm{AQ}\cdot\overline{\mathrm{BL}^2-\mathrm{CL}^2}$. The sum of all the squares of BL, which can be taken round the circle, is one half of as many squares of the radius CL: for BL is the sine of an arch, and the sum of its square and the square of its corresponding cosine is equal to the square of the radius. Therefore the sum of all the squares of the sines, together with the sum of all the squares of the cosines, is equal to the sum of the same number of squares of the radius; and the sum of the squares of the sines is equal to the sum of the squares of the corresponding cosines; therefore the sum of the squares of the radius is double of either sum. Therefore $\int\Pi\cdot\mathrm{QL}\cdot\mathrm{BL}^2=\frac{1}{2}\Pi\cdot\mathrm{QL}\cdot\mathrm{QL}^2$. In like manner the sum of the number $\Pi\cdot\mathrm{QL}$ of CL^2s will be $=\Pi\cdot\mathrm{QL}\cdot\mathrm{CL}^2$. These sums, taken for the semicircle, are $\frac{1}{4}\Pi\cdot\mathrm{QL}\cdot\mathrm{QL}^2$, and $\frac{1}{2}\Pi\,\mathrm{QL}\cdot\mathrm{CL}^2$, or $\Pi\cdot\mathrm{QL}\cdot\frac{1}{4}\mathrm{QL}^2$, and $\Pi\cdot\mathrm{QL}.\frac{1}{2}\mathrm{CL}^2$: therefore the momentum of the whole ring will be $2mnf\cdot\mathrm{AQ}\cdot\mathrm{QL}\cdot\Pi\cdot(\frac{1}{4}\mathrm{QL}^2-\frac{1}{2}\mathrm{CL}^2)$: for the momentum of the ring is the combined momenta of a number of pairs, and this number is $\frac{1}{2}\Pi\cdot\mathrm{QL}$.

By the ellipse we have $\mathrm{OC}:\mathrm{QL}=\mathrm{EO}:\mathrm{AQ}$, and $\mathrm{AQ}=\mathrm{QL}\frac{\mathrm{EO}}{\mathrm{OC}},=\mathrm{QL}\frac{d}{b}$; therefore the momentum of the ring is $2mnf\frac{d}{b}\mathrm{QL}^2\Pi\,(\frac{1}{4}\mathrm{QL}^2-\frac{1}{2}\mathrm{CL}^2),=mnf\frac{a}{b}\,\mathrm{QL}^2\Pi\,(\frac{1}{2}\mathrm{QL}^2-\mathrm{CL}^2)$: but $\mathrm{QL}^2=b^2-x^2$; therefore

$\frac{1}{2}\mathrm{QL}^2$

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$\frac{1}{2}QL^2 - CL^2 = \frac{1}{2}b^2 - \frac{1}{2}x^2 - x^2, = \frac{1}{2}b^2 - \frac{3}{2}x^2, = \frac{b^2-3x^2}{2}$; therefore the momentum of the ring is $mnf\frac{b}{d}\Pi\,(b^2-x^2)\left(\frac{b^2-3x^2}{2}\right) = mnf\frac{d}{b}\Pi\left(\frac{b^4-4b^2x^2+3x^4}{2}\right), = mnf\frac{d}{2b}\Pi\,(b^4-4b^2x^2+3x^4)$. If we now suppose another parallel extremely near to A a, as represented by the dotted line, the distance L l between them being $\dot{x}$, we shall have the fluxion of the momentum of the spheroid $mnf\frac{d}{2b}\Pi\,(b^4\dot{x}-4b^2x^2\dot{x}+3x^4\dot{x})$, of which the fluent is $mnf\frac{d}{2b}\Pi\left(b^4x-4b^2\frac{x^3}{3}+\frac{3x^5}{5}\right)$. This expresses the momentum of the zone EA a Q, contained between the equator and the parallel of latitude A a. Now let x become $=b$, and we shall obtain the momentum of the hemispheroid $= mnf\frac{d}{2b}\Pi\,(b^5-\frac{4}{3}b^5+\frac{3}{5}b^5)$, and that of the spheroid $= mnf\frac{d}{b}\Pi\,(b^5-\frac{4}{3}b^5+\frac{3}{5}b^5) = \frac{4}{15}mnfd\,\Pi b^4$.

This formula does not express any motion, but only a pressure tending to produce motion, and particularly tending to produce a libration by its action on the cohering matter of the earth, which is affected as a number of levers. It is similar to the common mechanical formula $w.\,d$, where w means a weight, and d its distance from the fulcrum of the lever.

It is worthy of remark, that the momentum of this protuberant matter is just $\frac{1}{5}$ of what it would be if it were all collected at the point O of the equator: for the matter in the spheroid is to that in the inscribed sphere as a^2 to b^2, and the contents of the inscribed sphere is $\frac{4}{3}\Pi\,b^3$. Therefore $a^2 : a^2-b^2 = \frac{4}{3}\Pi\,b^3 : \frac{4}{3}\Pi\,b^3\frac{a^2-b^2}{a^2}$, which is the quantity of protuberant matter. We may, without sensible error, suppose $\frac{a^2-b^2}{a} = 2d$; then the protuberant matter will be $\frac{4}{3}\Pi b^2 d$. If all this were placed at O, the momentum would be $\frac{4}{3}\Pi\,db^2f\cdot OH\cdot HC, = \frac{4}{3}mnfdb^4$, because $OH\cdot HC = mnb^2$; now $\frac{4}{3}$ is 5 times $\frac{4}{15}$.

Also, because the sum of all the rectangles OH·HC round the equator is half of as many squares of OC, it follows that the momentum of the protuberant matter placed in a ring round the equator of the sphere, or spheroid, is one half of what it would be if collected in the point G or E; whence it follows that the momentum of the protuberant matter in its natural place is two-fifths of what it would be if it were disposed in an equatorial ring. It was in this manner, that Sir Isaac Newton was enabled to compare the effect of the sun's action on the protuberant matter of the earth, with his effect on a rigid ring of moons. The preceding investigation of the momentum is nearly the same with his, and appears to us greatly preferable in point of perspicuity to the fluxionary solutions given by later authors. These indeed have the appearance of greater accuracy, because they do not suppose all the protuberant matter to be condensed on the surface of the inscribed sphere: nor were we under the necessity of doing this; only it would have led to very complicated expressions, had we supposed the matter in each line AQ collected in its centre of oscillation or gyration. We made a compensation for the error introduced by this which may amount to $\frac{1}{113}$ of the whole, and should not be neglected, by taking d as equal to $\frac{a^2-b^2}{2a}$ instead of $\frac{a^2-b^2}{a+b}$. The consequence is, that our formula is the same with that of the later authors.

Thus far Sir Isaac Newton proceeded with mathematical rigour; but in the application he made two assumptions, or, as he calls them hypotheses, which have been found to be unwarranted. The first was, that when the ring of protuberant matter is connected with the inscribed sphere, and subjected to the action of the disturbing force, the same quantity of motion is produced in the whole mass as in the ring alone. The second was, that the motion of the nodes of a rigid ring of moons is the same with the mean motion of the nodes of a solitary moon. But we are now able to demonstrate, that it is not the quantity of motion, but of momentum, which remains the same, and that the nodes of a rigid ring move twice as fast as those of a single particle. We proceed therefore to, 411

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PROB. II. To determine the deviation of the axis, and the retrograde motion of the nodes which result from this libratory momentum of the earth's protuberant matter.

But here we must refer our readers to some fundamental propositions of rotatory motions which are demonstrated in the article ROTATION.

If a rigid body is turning round an axis A, passing through its centre of gravity with the angular velocity a, and receives an impulse which alone would cause it to turn round an axis B, also passing through its centre of gravity, with the angular velocity b, the body will now turn round a third axis C, passing through its centre of gravity, and lying in the plane of the axis A and B, and the sine of the inclination of this third axis to the axis A will be to the sine of the inclination to the axis B as the velocity b to the velocity a.

When a rigid body is made to turn round any axis by the action of an external force, the quantity of momentum produced (that is, the sum of the products of every particle by its velocity and by its distance from the axis) is equal to the momentum or similar product of the moving force or forces.

If an oblate spheroid, whose equatorial diameter is a, and polar diameter b, be made to librate round an equatorial diameter, and the velocity of that point of the equator which is farthest from the axis of libration be v, the momentum of the spheroid is $\frac{4}{15}\Pi\,a^2b^2v$.

The two last are to be found in every elementary book of mechanics.

Let ANan (fig. 156.) be the plane of the earth's equator, cutting the ecliptic CNKn in the line of the nodes or equinoctial points Na. Let OAS be the section of the earth by a meridian passing through the sun, so that the line OCS is in the ecliptic, and CA is an arch of an hour-circle or meridian, measuring the sun's declination. The sun not being in the plane of the equator, there is, by prop. 1. a force tending to produce a libration round an axis ZOz at right angles to the diameter Aa of that meridian in which the sun is situated, and

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and the momentum of all the disturbing forces is $\frac{4}{15} m n f d \Pi b^4$. The product of any force by the moment $\dot{t}$ of its action expresses the momentary increment of velocity; therefore the momentary velocity, or the velocity of libration granted in the time $\dot{t}$ is $\frac{4}{15} m n f d \Pi b^4 \dot{t}$. This is the absolute velocity of a point at the distance 1 from the axis, or it is the space which would be uniformly described in the moment $\dot{t}$, with the velocity which the point has acquired at the end of that moment. It is double the space actually described by the libration during that moment; because this has been an uniformly accelerated motion, in consequence of the continued and uniform action of the momentum during this time. This must be carefully attended to, and the neglect of it has occasioned very faulty solutions of this problem.

Let v be the velocity produced in the point A, the most remote from the axis of libration. The momentum excited or produced in the spheroid is $\frac{4}{15} \Pi a^2 b^2 v$ (as above), and this must be equal to the momentum of the moving force, or to $\frac{4}{15} m n f d \Pi b^4 \dot{t}$; therefore we obtain $v = \frac{\frac{4}{15} m n f d \Pi b^4 \dot{t}}{\frac{4}{15} \Pi a^2 b}$, that is, $v = m n f d \dot{t} \frac{b^2}{a^2}$ or very nearly $m n f d \dot{t}$, because $\frac{b^2}{a^2} = 1$ very nearly. Also, because the product of the velocity and time gives the space uniformly described in that time, the space described by A in its libration round Z $\varkappa$ is $m n f d \dot{t}^2$, and the angular velocity is $\frac{m n f d \dot{t}}{a}$.

Let $\dot{r}$ be the momentary angle of diurnal rotation. The arch A r, described by the point A of the equator in this moment $\dot{t}$ will therefore be $a\dot{r}$, that is, $a \times \dot{r}$, and the velocity of the point A is $\frac{a\dot{r}}{\dot{t}}$, and the angular velocity of rotation is $\frac{\dot{r}}{\dot{t}}$.

Here then is a body (fig. 157.) turning round an axis OP, perpendicular to the plane of the equator $\varkappa o \varkappa$, and therefore situated in the plane ZP$\varkappa$; and it turns round this axis with the angular velocity $\frac{\dot{r}}{\dot{t}}$. It has received an impulse, by which alone it would librate round the axis Z $\varkappa$, with the angular velocity $\frac{m n f d \dot{t}}{a}$. It will therefore turn round neither axis, but round a third axis OP′, passing through O, and lying in the plane ZP $\varkappa$, in which the other two are situated, and the sine P′Π of its inclination to the axis of libration Z $\varkappa$ will be to the sine P′p of its inclination to the axis OP of rotation as $\frac{\dot{r}}{\dot{t}}$ to $\frac{m n f d \dot{t}}{a}$.

Now A, in fig. 156. is the summit of the equator both of libration and rotation: $m n f d \dot{t}^2$ is the space described by its libration in the time $\dot{t}$; and $a\dot{r}$ is the space or arch Ar (fig. 156.) described in the same time by its rotation: therefore, taking A r to A c (perpendicular to the plane of the equator of rotation, and lying in the equator of libration), as $a\dot{r}$ to $m n f d \dot{t}^2$, and completing the parallelogram A $r m c$, A m will be the compound motion of A, and $a\dot{r} : m n d f \dot{t}^2 = 1 : \frac{m n f d \dot{t}^2}{a\dot{r}}$, which will be the tangent of the angle m A r, or of the change of position of the equator. But the axes of rotation are perpendicular to their equator; and therefore the angle of deviation $\dot{w}$ is equal to this angle r A m. This appears from fig. 5.; for Π P′ : P′p=O′p : P′p,=OP : tan. POP; and it is evident that $a\dot{r} : m n f d \dot{t}^2 = \frac{\dot{r}}{\dot{t}} \dot{m} n f d \frac{\dot{t}}{a}$, as is required by the composition of rotations.

In consequence of this change of position, the plane of the equator no longer cuts the plane of the ecliptic in the line N n. The plane of the new equator cuts the former equator in the line AO, and the part AN of the former equator lies between the ecliptic and the new equator AN′, while the part A n of the former equator is above the new one A n'; therefore the new node N′, from which the point A was moving, is removed to the westward, or farther from A; and the new node n', to which A is approaching, is also moved westward, or nearer to A; and this happens in every position of A. The nodes therefore, or equinoctial points, continually shift to the westward, or in a contrary direction to the rotation of the earth; and the axis of rotation always deviates to the east side of the meridian which passes through the sun.

This account of the motions is extremely different from what a person should naturally expect. If the earth were placed in the summer solstice, with respect to us who inhabit its northern hemisphere, and had no rotation round its axis, the equator would begin to approach the ecliptic, and the axis would become more upright; and this would go on with a motion continually accelerating, till the equator coincided with the ecliptic. It would not stop here, but go as far on the other side, till its motion were extinguished by the opposing forces; and it would return to its former position, and again begin to approach the ecliptic, playing up and down like the arm of a balance. On this account this motion is very properly termed *libration*: but this very slow libration, compounded with the incomparably swifter motion of diurnal rotation, produces a third motion extremely different from both. At first the north pole of the earth inclines forward toward the sun; after a long course of years it will incline to the left hand, as viewed from the sun, and be much more inclined to the ecliptic, and the plane of the equator will pass through the sun. The south pole will come into view, and the north pole will begin to decline from the sun; and this will go on (the inclination of the equator diminishing all the while) till, after a course of years, the north pole will be turned quite away from the sun, and the inclination of the equator will be restored to its original quantity. After this the phenomena will have another period similar to the former, but the axis will now deviate to the right hand. And thus, although both the earth and sun should not move from their places, the inhabitants of the earth would have a complete succession of the seasons accomplished in a period of many centuries. This would be prettily illustrated by an iron ring poised very nicely on a cap like the card of of a mariner's compass, having its centre of gravity coinciding with the point of the cap, so that it may whirl round in any position. As this is extremely difficult to execute, the cap may be pierced a little deeper, which will cause the ring to maintain a horizontal position with a very small force. When the ring is whirling very steadily, and pretty briskly, in the direction of the hours of a watch-dial, hold a strong magnet above the middle of the nearer semicircle (above the 6 hour point) at the distance of three or four inches. We shall immediately observe the ring rise from the 9 hour point, and sink at the 3 hour point, and gradually acquire a motion of precession and nutation, such as has been described.

If the earth be now put in motion round the sun, or the sun round the earth, motions of libration and deviation will still obtain, and the succession of their different phases, if we may so call them, will be perfectly analogous to the above statement. But the quantity of deviation, and change of inclination, will now be prodigiously diminished, because the rapid change of the sun's position quickly diminishes the disturbing forces, annihilates them by bringing the sun into the plane of the equator, and brings opposite forces into action.

We see in general that the deviation of the axis is always at right angles to the plane passing through the sun, and that the axis, instead of being raised from the ecliptic, or brought nearer to it, as the libration would occasion, deviates sidewise; and the equator, instead of being raised or depressed round its east and west points, is twisted sidewise round the north and south points; or at least things have this appearance: but we must now attend to this circumstance more minutely.

The composition of rotation shows us that this change of the axis of diurnal rotation is by no means a translation of the former axis (which we may suppose to be the axis of figure) into a new position, in which it again becomes the axis of diurnal motion; nor does the equator of figure, that is, the most prominent section of the terrestrial spheroid, change its position, and in this new position continue to be the equator of rotation. This was indeed supposed by Sir Isaac Newton; and this supposition naturally resulted from the train of reasoning which he adopted. It was strictly true of a single moon, or of the imaginary orbit attached to it; and therefore Newton supposed that the whole earth did in this manner deviate from its former position, still, however, turning round its axis of figure. In this he has been followed by Walmesly, Simpson, and most of his commentators. D'Alembert was the first who entertained any suspicion that this might not be certain; and both he and Euler at last showed that the new axis of rotation was really a new line in the body of the earth, and that its axis and equator of figure did not remain the axis and equator of rotation. They ascertained the position of the real axis by means of a most intricate analysis, which obscured the connexion of the different positions of the axis with each other, and gave us only a kind of momentary information. Father Frisius turned his thoughts to this problem, and fortunately discovered the composition of rotations as a general principle of mechanical philosophy. Few things of this kind have escaped the penetrating eyes of Sir Isaac Newton. Even *this* principle had been glanced at by him. He affirms it in express terms with respect to a body that is perfectly spherical (cor. 22. prop. 66. book i.). But it was reserved for Frisius to demonstrate it to be true of bodies of any figure, and thus to enrich mechanical science with a principle which gives simple and elegant solutions of the most difficult problems.

But here a very formidable objection naturally offers itself. If the axis of the diurnal motion of the heavens is not the axis of the earth's spheroidal figure, but an imaginary line in it, round which even the axis of figure must revolve; and if this axis of diurnal rotation has so greatly changed its position, that it now points at a star at least 12 degrees distant from the pole observed by Timochares, how comes it that the equator has the very same situation on the surface of the earth that it had in ancient times? No sensible change has been observed in the latitudes of places.

The answer is very simple and satisfactory: Suppose that in 12 hours the axis of rotation has changed from the position PR (fig. 158.) to $p\,r$, so that the north pole, instead of being at P, which we may suppose to be a particular mountain, is now at p. In this 12 hours the mountain P, by its rotation round $p\,r$, has acquired the position π. At the end of the next 12 hours, the axis of rotation has got the position $\pi\,\varrho$, and the axis of figure has got the position $p\,r$, and the mountain P is now at p. Thus, on the noon of the following day, the axis of figure PR is in the situation which the real axis of rotation occupied at the intervening midnight. This goes on continually, and the axis of figure follows the position of the axis of rotation, and is never further removed from it than the deviation of 12 hours, which does not exceed $\frac{1}{700}$th part of one second, a quantity altogether imperceptible. Therefore the axis of figure will always sensibly coincide with the axis of rotation, and no change can be produced in the latitudes of places on the surface of the earth.

412 Application of this reasoning to nutation and precession.

We have hitherto considered this problem in the most general manner; let us now apply the knowledge we have gotten of the deviation of the axis or of the momentary action of the disturbing force to the explanation of the phenomena; that is, let us see what precession and what nutation will be accumulated after any given time of action.

For this purpose we must ascertain the precise deviation which the disturbing forces are competent to produce. This we can do by comparing the momentum of libration with the gravitation of the earth to the sun, and this with the force which would retain a body on the equator while the earth turns round its axis.

The gravitation of the earth to the sun is in the proportion of the sun's quantity of matter M directly, and to the square of the distance A inversely, and may therefore be expressed by the symbol $\frac{M}{A^2}$. The disturbing force at the distance 1 from the place of illumination is to the gravitation of the earth's centre to the sun as 3 to A, (A being measured on the same scale which measures the distance from the plane of illumination). Therefore $\frac{3M}{A^3}$ will be the disturbing force f of our formula.

Let p be the centrifugal force of a particle at the distance 1 from the axis of rotation; and let t and T be the time of rotation and of annual revolution, viz.

 sidereal

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sidereal day and year. Then $p : \frac{M}{A^2} = \frac{1}{t^2} : \frac{A}{T^2}$. Hence we derive $\frac{3M}{A^3} = 3p\frac{t^2}{T^2}$. But since $\dot{r}$ was the angular velocity of rotation, and consequently $1 \times \dot{r}$ the space described, and $\frac{1 \times \dot{r}}{\dot{t}}$ the velocity; and since the centrifugal force is as the square of the velocity divided by the radius, (this being the measure of the generated velocity, which is the proper measure of any accelerating force), we have $p = \frac{1^2 \times \dot{r}^2}{1^2 \times \dot{t}^2}, = \frac{\dot{r}^2}{\dot{t}^2}$, and $f = \frac{3\dot{r}^2}{\dot{t}^2} \times \frac{t^2}{T^2}$. Now the formula $f\,m\,n\,d\frac{\dot{t}^2}{a}$ expressed the sine of the angle. This being extremely small, the sine may be considered as equal to the arc which measures the angle. Now, substitute for it the value now found, viz. $\frac{3\dot{r}^2}{\dot{t}^2} \times \frac{t^2}{T^2}$, and we obtain the angle of deviation $\dot{w} = \dot{r}\frac{3t^2}{T^2}m\,n\frac{d}{a}$, and this is the simplest form in which it can appear. But it is convenient, for other reasons, to express it a little differently: d is nearly equal to $\frac{a^2 - b^2}{2a^2}$ therefore $\dot{w} = \dot{r} \times \frac{3t^2}{2T^2}m\,n\frac{a^2 - b^2}{a^2}$, and this is the form in which we shall now employ it.

The small angle $\dot{r}\frac{3t^2}{2T^2}m\,n\frac{a^2 - b^2}{a^2}$ is the angle in which the new equator cuts the former one. It is different at different times, as appears from the variable part $m\,n$, the product of the sine and cosine of the sun's declination. It will be a maximum when the declination is in the solstice, for $m\,n$ increases all the way to 45°, and the declination never exceeds $23\frac{1}{2}$. It increases, therefore, from the equinox to the solstice, and then diminishes.

Let ESL (fig. 159.) be the ecliptic, EAC the equator, BAD the new position which it acquires by the momentary action of the sun, cutting the former in the angle $BAE = \dot{r}\frac{3t^2}{2T^2}m\,n\frac{a^2 - b^2}{a^2}$. Let S be the sun's place in the ecliptic, and AS the sun's declination, the meridian AS being perpendicular to the equator. Let $\frac{a^2 - b^2}{a^2}$ be k. The angle BAE is then $= \dot{r}\frac{3t^2}{2T^2}k\,m\,n$. In the spherical triangle BAE we have sin. B : sin. AE = sin. A : sin. BE, or = A : BE, because very small angles and arches are as their sines. Therefore BE, which is the momentary precession of the equinoctial point E, is equal to $A\frac{\text{sin. AE}}{\text{sin. B}}, = \dot{r} \times \frac{3t^2}{2T^2}k\,m\,n\frac{\text{sin. R. ascens.}}{\text{sin. obl. ecl.}}$.

413 Various modes of application.

The equator EAC, by taking the position BAD, recedes from the ecliptic in the colure of the solstices CL, and CD is the change of obliquity or the nutation. For let CL be the solstitial colure of BAD, and cl the solstitial colure of EAC. Then we have sin. B : sin. E = sin. LD : sin. lc; and therefore the difference of the arches LD and lc will be the measure of the difference of the angles B and E. But when BE is indefinitely small, CD may be taken for the difference of LD and lc, they being ultimately in the ratio of equality. Therefore CD measures the change of the obliquity of the ecliptic, or the nutation of the axis with respect to the ecliptic.

The real deviation of the axis is the same with the change in the position of the equator, Pp being the measure of the angle EAB. But this not being always made in a plane perpendicular to the ecliptic, the change of obliquity generally differs from the change in the position of the axis. Thus, when the sun is in the solstice, the momentary change of the position of the equator is the greatest possible; but being made at right angles to the plane in which the obliquity of the ecliptic is computed, it makes no change whatever in the obliquity, but the greatest possible change in the precession.

In order to find CD the change of obliquity, observe that in the triangle CAD, R : sin. AC, or R : cos. AE = sin. A : sin. CD, = A : CD (because A and CD are exceedingly small). Therefore the change of obliquity (which is the thing commonly meant by nutation) $CD = A \times \text{cos. AE}, = \dot{r}\frac{3t^2}{2T^2}k\,m\,n$, cos. $AE' = \dot{r}\frac{3t^2}{2T^2}k \times$ sin. declin. $\times$ cos. declin. $\times$ cos. R. ascens.

But it is more convenient for the purposes of astronomical computation to make use of the sun's longitude SE. Therefore make

The sun's longitude ES	- -	$= z$
Sine of the sun's long.	- -	$= x$
Cosine	- - -	$\sqrt{1 - x^2} = y$
Sine obliq. eclipt.	- -	$23\frac{1}{2} = p$
Cosine obliq.	- - -	$= q$

In the spherical triangle EAS, right-angled at A (because AS is the sun's declination perpendicular to the equator), we have R : sin. ES = sin. E : sin. AS, and sin. AS $= p\,x$. Also R : cos. AS = cos. AE : cos. ES, and cos. ES or y = cos. AS $\times$ cos. AE. Therefore $p\,x\,y$ = sin. AS cos. AS $\times$ cos. AE, $= m\,n \times$ cos. AE. Therefore the momentary nutation $CD = \dot{r} \times \frac{3t^2}{2T^2}k\,p\,x\,y$.

We must recollect that this angle is a certain fraction of the momentary diurnal rotation. It is more convenient to consider it as a fraction of the sun's annual motion, that so we may directly compare his motion on the ecliptic with the precession and nutation corresponding to his situation in the heavens. This change is easily made, by augmenting the fraction in the ratio of the sun's angular motion to the motion of rotation, or multiplying the fraction by $\frac{T}{t}$; therefore the momentary nutation will be $\dot{r}\frac{3t}{2T}k\,p\,x\,y$. In this value $\frac{3tkp}{2T}$ is a constant quantity, and the momentary nutation is proportional to $x\,y$, or to the product of the sine and cosine of the sun's longitude, or to the sine of twice the sun's longitude; for $x\,y$ is equal to half the sine of twice z.

If therefore we multiply this fraction by the sun's momentary angular motion, which we may suppose, with abundant accuracy, proportional to $\dot{z}$, we obtain the fluxion of the nutation, the fluent of which will express

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press the whole nutation while the sun describes the arch z of the ecliptic, beginning at the vernal equinox. Therefore, in place of y put $\sqrt{1-x^2}$, and in place of $\dot{z}$ put $\frac{\dot{x}}{\sqrt{1-x^2}}$, and we have the fluxion of the nutation for the moment when the sun's longitude is z, and the fluent will be the whole nutation. The fluxion resulting from this process is $\frac{3\,t\,k\,p}{2\mathrm{T}}\,x\dot{x}$, of which the fluent is $\frac{3\,t\,k\,p}{4\mathrm{T}}x^2$. This is the whole change produced on the obliquity of the ecliptic while the sun moves along the arch z ecliptic, reckoned from the vernal equinox. When this arch is 90°, x is 1, and therefore $\frac{3\,t\,k\,p}{4\mathrm{T}}$ is the nutation produced while the sun moves from the equinox to the solstice.

414 The real and momentary change greatest at the solstices, and at the equinoxes nothing.

The momentary change of the axis and plane of the equator (which is the measure of the changing force) is $\frac{3\,t\,k}{2\mathrm{T}}m\,n$.

The momentary change of the obliquity of the ecliptic is $\frac{3\,t\,k\,p}{2\mathrm{T}}\,x\dot{x}$.

The whole change of obliquity is $\frac{3\,t\,k\,p}{4\mathrm{T}}\,x^2$.

Hence we see that the force and the real momentary change of position are greatest at the solstices, and diminish to nothing at the equinoxes.

The momentary change of obliquity is greatest at the octants, being proportional to $x\dot{x}$ or to $x\,y$.

The whole accumulated change of obliquity is greatest at the solstices, the obliquity itself being then smallest.

415 Quantity of precession in a given time.

We must in like manner find the accumulated quantity of the precession after a given time, that is, the arch BE for a finite time.

We have ER : CD = sin. EA : sin. CA (or cos. EA) = tan. EA : 1, and EB : ER = 1 : sin. B. Therefore EB : CD = tan. EA : sin. B. But tan. EA = cos. E × tan. ES, = cos. E × $\frac{\text{sin. long.}}{\text{cos. long.}} = \frac{q\,x}{\sqrt{1-x^2}}$.

Therefore EB : CD $= \frac{q\,x}{\sqrt{1-x^2}}p$, and CD = EB : $\frac{\text{sin. obliq. eclip.}}{\text{tan. long. ☉}}$. If we now substitute for CD its value found in N° 40, viz. $\frac{3\,t\,k\,p}{2\mathrm{T}}\,x\dot{x}$, we obtain EB $= \frac{3\,t}{2\mathrm{T}} \times \frac{k q x^2 \dot{x}}{\sqrt{1-x^2}}$, the fluxion of the precession of the equinoxes occasioned by the action of the sun. The fluent of the variable part $\frac{x\dot{x}}{\sqrt{1-x^2}} = x\,\dot{y}$, of which the fluent is evidently a segment of a circle whose arch is z and sine x, that is, $= \frac{z - x\sqrt{1-x^2}}{2}$, and the whole precession, while the sun describes the arch z, is $\frac{3\,t}{2\mathrm{T}} \times \frac{k\,q}{2}\left(z - x\sqrt{1-x^2}\right)$. This is the precession of the equinoxes while the sun moves from the vernal equinox along the arch z of the ecliptic.

In this expression, which consists of two parts, $\frac{3\,t\,k\,q}{4\mathrm{T}}$ z, and $\frac{3tkq}{4\mathrm{T}}\left(-x\sqrt{1-x^2}\right)$, the first is incomparably greater than the second, which never exceeds 1″, and is always compensated in the succeeding quadrant. The precession occasioned by the sun will be $\frac{3\,t\,k\,q}{4\mathrm{T}}\,z$, and from this expression we see that the precession increases uniformly, or at least increases at the same rate with the sun's longitude z, because the quantity $\frac{3tkq}{4\mathrm{T}}$ is constant.

In order to make use of these formulæ, which are now reduced to very great simplicity, it is necessary to determine the values of the two constant quantities $\frac{3tkp}{4\mathrm{T}}$, $\frac{3tkq}{4\mathrm{T}}$, which we shall call N and P, as factors of the nutation and precession. Now t is one sidereal day, and T is 366¼. k is $\frac{a^2-b^2}{a^2}$, which according to Sir Isaac Newton is $\frac{231^2-230^2}{231^2}, = \frac{1}{115}$; p and q are the sine and cosine of 23° 28′, viz. 0,39822 and 0,91729. 416 Mode of using the formulæ.

These data give N $= \frac{1}{141030}$ and P $= \frac{1}{61224}$, of which the logarithms are 4.85069 and 5.21308, viz. the arithmetical complements of 5.14931 and 4.78692.

417 Example of the utility of the investigation.

Let us, for an example of the use of this investigation, compute the precession of the equinoxes when the sun has moved from the vernal equinox to the summer solstice, so that z is 90°, or 324000″.

Log. 324000″ = z - - - -	5.51055
Log. P - - - - - -	5.21308
Log. 5″,292 - - - - -	0.72363

The precession therefore in a quarter of a year is 5,292 seconds; and, since it increases uniformly, it is 21″,168 annually.

418 Assumptions on which the computation proceeds.

We must now recollect the assumptions on which this computation proceeds. The earth is supposed to be homogeneous, and the ratio of its equatorial diameter to its polar axis is supposed to be that of 231 to 230. If the earth be more or less protuberant at the equator, the precession will be greater or less in the ratio of this protuberance. The measures which have been taken of the degrees of the meridian are very inconsistent among themselves; and although a comparison of them all indicates a smaller protuberance, nearly $\frac{1}{312}$ instead of $\frac{1}{231}$, their differences are too great to leave much confidence in this method. But if this figure be thought more probable, the precession will be reduced to about 17″ annually. But even though the figure of the earth were accurately determined, we have no authority to say that it is homogeneous. If it be denser towards the centre, the momentum of the protuberant matter will not be so great as if it were equally dense with the inferior parts, and the precession will be diminished on this account. Did we know the proportion of the matter in the moon to that in the sun, we could

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could easily determine the proportion of the whole observed annual precession of $50\frac{1}{3}''$ which is produced by the sun's action. But we have no unexceptionable data for determining this; and we are rather obliged to infer it from the effect which she produces in disturbing the regularity of the precession, as will be considered immediately. So far, therefore, as we have yet proceeded in this investigation, the result is very uncertain. We have only ascertained unquestionably the law which is observed in the solar precession. It is probable, however, that this precession is not very different from 20″ annually; for the phenomena of the tides show the disturbing force of the sun to be very nearly $\frac{2}{5}$ of the disturbing force of the moon. Now 20″ is $\frac{2}{5}$ of 50″.

419 **Effect of the moon's action on the protuberant matter of the earth.** But let us now proceed to consider the effect of the moon's action on the protuberant matter of the earth; and as we are ignorant of her quantity of matter, and consequently of her influence in similar circumstances with the sun, we shall suppose that the disturbing force of the moon is to that of the sun as m to 1. Then (*cæteris paribus*) the precession will be to the solar precession π in the ratio of the force and of the time of its action jointly. Let t and T therefore represent a periodical month and year, and the lunar precession will be $=\frac{m\pi t}{T}$. This precession must be reckoned on the plane of the lunar orbit, in the same manner as the solar precession is reckoned on the ecliptic. We must also observe, that $\frac{m\pi t}{T}$ represents the lunar precession only on the supposition that the earth's equator is inclined to the lunar orbit in an angle of $23\frac{1}{2}$ degrees. This is indeed the mean inclination; but it is sometimes increased to above 28°, and sometimes reduced to 18°. Now in the value of the solar precession the cosine of the obliquity was employed. Therefore whatever is the angle E contained between the equator and the lunar orbit, the precession will be $=\frac{m\pi t}{T}\cdot\frac{\text{Cos. E}}{\text{Cos. }23\frac{1}{2}^{\circ}}$, and it must be reckoned on the lunar orbit.

Now let ♈ B (fig. 160.) be the immoveable plane of the ecliptic, ♈ ED♎F the equator in its first situation, before it has been deranged by the action of the moon, AGRDBH the equator in its new position, after the momentary action of the moon. Let EGNFH be the moon's orbit, of which N is the ascending node, and the angle N=5° 8′ 46″.

Let N ♈ the long. of the node be	z
Sine N ♈	x
Cosine N ♈	y
Sine ♈ $=23\frac{1}{2}$	a
Cosine ♈	b
Sine N=5.8.46	c
Cosine N	d
Circumference to radius 1,=6,28	e
Force of the moon	m
Solar precession (supposed $=14\frac{1}{2}''$ by observation)	π
Revolution of ☾ $=27\text{d}\frac{1}{3}$	t
Revolution of ☉ $=366\frac{1}{4}$	T
Revolution of N =18 years 7 months	n

420 **Lunar precession in a month reduced to the ecliptic.** In order to reduce the lunar precession to the ecliptic, we must recollect that the equator will have the same inclination at the end of every half revolution of the sun or of the moon, that is, when they pass through the equator, because the sum of all the momentary changes of its position begins again each revolution. Therefore if we neglect the motion of the node during one month, which is only $1\frac{1}{2}$ degree, and can produce but an insensible change, it is plain that the moon produces, in one half revolution, that is, while she moves from H to G, the greatest difference that she can in the position of the equator. The point D, therefore, half way from G to H, is that in which the moveable equator cuts the primitive equator, and DE and DF are each 90°. But S being the solstitial point, ♈ S is also 90°. Therefore DS=♈ E. Therefore, in the triangle DGE, we have sin. ED : sin. G = sin. EG : sin. D, = EG : D. Therefore D = EG × sin. G, = EG × sin. E nearly. Again, in the triangle ♈ DA we have sin. A : sin. ♈ D (or cos. ♈ E)=sin. D : sin. ♈ A, = D : ♈ A. Therefore $\Upsilon\,\text{A}=\frac{\text{D}\cdot\text{Cos. }\Upsilon\,\text{E}}{\text{Sin. A}},=\frac{\text{EG}\cdot\text{Sin. E}\cdot\text{Cos.}\Upsilon\,\text{E}}{\text{Sin. }23\frac{1}{2}},=\frac{m\pi t}{T}\,\frac{\text{Sin. E}\cdot\text{Cos. E}\cdot\text{Cos. }\Upsilon\,\text{E}}{\text{Sin. }\Upsilon\cdot\text{Cos. }\Upsilon}$.

This is the lunar precession produced in the course of one month, estimated on the ecliptic, not constant like the solar precession, but varying with the inclination of the angle E or F, which varies both by a change in the angle N, and also by a change in the position of N on the ecliptic.

421 **Nutation in the same time.** We must find in like manner the nutation SR produced in the same time, reckoned on the colure of the solstices RL. We have R : sin. DS=D : RS, and RS=D · sin. DS, =D · sin. ♈ E. But D=EG · sin. E. Therefore RS=ED · sin. E · sin. ♈ E, $=\frac{m\pi t\ \text{Cos. E}}{\text{T}\cdot\text{Cos. }\Upsilon}\times\text{sin. E}\times\text{sin. }\Upsilon\,\text{E}$. In this expression we must substitute the angle N, which may be considered as constant during the month, and the longitude ♈ N, which is also nearly constant, by observing that sin. E : sin. ♈ N=sin. N : sin. ♈ E. Therefore $\text{RS}=\frac{m\pi t}{\text{T}}\times\frac{\text{Sin. N}\cdot\text{Sin. }\Upsilon\,\text{N}\cdot\text{Cos. E}}{\text{Cos. }\Upsilon}$. But we must exterminate the angle E, because it changes by the change of the position of N. Now, in the triangle ♈ EN we have cos. E=cos. ♈ N · sin. N · sin. ♈ — cos. N · cos. ♈, $=yca-db$. And because the angle E is necessarily obtuse, the perpendicular will fall without the triangle, the cosine of E will be negative, and we shall have cos. E=$bd-acy$. Therefore the nutation for one month will be $=\frac{m\pi t}{T}\times\frac{cx(bd-acy)}{b}$, the node being supposed all the while in N.

422 **may be considered as momentary parts of the moon's action.** These two expressions of the monthly precession and nutation may be considered as momentary parts of the moon's action, corresponding to a certain position of the node and inclination of the equator, or as the fluxions of the whole variable precession and nutation, while the node continually changes its place, and in the space of 18 years makes a complete tour of the heavens.

423 **Precession and nutation compared.** We must, therefore, take the motion of the nodes as the fluent of comparison, or we must compare the fluxions of the node's motion with the fluxions of the precession and nutation; therefore, let the longitude of the node be z, and its monthly change $=\dot{z}$; we shall then have

t:

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$t : n = \dot{z} : e$, and $t = \frac{n\dot{z}}{e}, = \frac{n\dot{x}}{e} \frac{}{\sqrt{1-x^2}}$. Let T be $=1$, in order that n may be 18,6, and substitute for t its value in the fluxion of the nutation, by putting $\sqrt{1-x^2}$ in place of y. By this substitution we obtain $m \pi n \frac{c}{e b} \left(\frac{d b x \dot{x}}{\sqrt{1-x^2}} - a c x \dot{x}^2 \right)$. The fluent of this is $m \pi n \frac{c}{e b} \left(-d b \sqrt{1-x^2} - \frac{a c x^2}{2} \right)$. (*Vide* Simpson's Fluxions, § 77.) But when x is $=o$, the nutation must be $=o$, because it is from the position in the equinoctial points that all our deviations are reckoned, and it is from this point that the periods of the lunar action recommence. But if we make $x=o$ in this expression, the term $-\frac{a c x^2}{2}$ vanishes, and the term $-db\sqrt{1-x^2}$ becomes $=-db$; therefore our fluent has a constant part $+db$; and the complete fluent is $m \pi n \frac{c}{e b} \left(db - db\sqrt{1-x^2} - \frac{a c x^2}{2} \right)$. Now this is equal to $m \pi n \frac{c}{e b}$ ($d b \times$ versed sine, $z - \frac{1}{4} a c \times$ versed sine $2z$) : For the versed sine of z is equal to ($1-$cos. z) ; and the square of the sine of an arch is $\frac{1}{2}$ the versed sine of twice that arch.

This, then, is the whole nutation while the moon's ascending node moves from the vernal equinox to the longitude ♈ N $= z$. It is the expression of a certain number of seconds, because π, one of its factors, is the solar precession in seconds; and all the other factors are numbers, or fractions of the radius 1; even e is expressed in terms of the radius 1.

The fluxion of the precession, or the monthly precession, is to that of the nutation as the cotangent of ♈ E is to the sine of ♈. This also appears by considering fig. 159. Pp measures the angle A, or change of position of the equator; but the precession itself, reckoned on the ecliptic, is measured by Po, and the nutation by po; and the fluxion of the precession is equal to the fluxion of nutation $\times \frac{\text{cot. ♈ E}}{\text{sine ♈}}$, but cot. ♈ E $= \frac{a d + b c y}{c x}$; therefore $\frac{\text{cot. ♈ E}}{\text{sine ♈}} = \frac{a d + b c\sqrt{1-x^2}}{c x}$: This, multiplied into the fluxion of the nutation, gives $\frac{m \pi n}{a b e} \left(\frac{a b d^2}{\sqrt{1-xx}} + (b^2-a^2) d c - a b c^2 . \sqrt{1-xx} \right) \dot{x}$ for the monthly precession. The fluent of this $\frac{m \pi n}{a b e} \left(a d^2 b z + (b^2-a^2) d c x - \frac{1}{2} a b c^2 z - \frac{1}{2} a b c^2 x \sqrt{1-x^2} \right)$, or it is equal to $\frac{m \pi n}{a b e} \left((d^2 - \frac{1}{2} c^2) a b z + (b^2-a^2) d c x - \frac{1}{4} a b c^2 \text{ sine } 2z \right)$.

Let us now express this in numbers: When the node has made a half revolution, we have $z=180°$, whose versed sine is 2, and the versed sine of $2z$, or 360°, is $=0$; therefore, after half a revolution of the node, the nutation becomes $\frac{m \pi n c}{e b} 2 b d$. If, in this expression, we supposed $m = 2\frac{1}{2}$, and $\pi = 14\frac{1}{2}''$, we shall find the nutation to be $19\frac{1}{5}''$.

Now the observed nutation is about 18″. This requires m to be $2\frac{1}{10}$, and $\pi = 16\frac{1}{4}''$. But it is evident, that no astronomer can pretend to warrant the accuracy of his observations of the nutation within 1″.

To find the lunar precession during half a revolution of the node, observe, that then z becomes $= \frac{e}{2}$, and the sine of z and of $2z$ vanish, d^2 becomes $1-c^2$, and the precession becomes $\frac{m \pi n}{2} (d^2 - \frac{1}{2} c^2), = \frac{m \pi n}{2} (1 - \frac{3}{2} c^2)$, and the precession in 18 years is $m \pi n \overline{1 - \frac{3}{2} c^2}$.

We see, by comparing the nutation and precession for nine years, that they are as $\frac{4 c d}{e}$ to $1 - \frac{3}{2} c^2$, nearly as 1 to $17\frac{2}{5}$. This gives 313″ of precession, corresponding to 18″, the observed nutation, which is about 35″ of precession annually produced by the moon.

424 And thus we see that the inequality produced by the moon in the precession of the equinoxes, and, more particularly, the nutation occasioned by the variable obliquity of her orbit, enables us to judge of her share in the whole phenomenon; and therefore informs us of her disturbing force, and therefore of her quantity of matter. This phenomenon, and those of the tides, are the only facts which enable us to judge of this matter: and this is one of the circumstances which has caused this problem to occupy so much attention. Dr Bradley, by a nice comparison of his observations with the mathematical theory, as it is called, furnished him by Mr Machin, found that the equation of precession computed by that theory was too great, and that the theory would agree better with the observations, if an ellipse were substituted for Mr Machin's little circle. He thought that the shorter axis of this ellipse, lying in the colure of the solstices, should not exceed 16″. Nothing can more clearly show the astonishing accuracy of Bradley's observations than this remark: for it results from the theory, that the pole must really describe an ellipse, having its shorter axis in the solstitial colure, and the ratio of the axes must be that of 18 to 16,8; for the mean precession during half a revolution of the node is $\frac{m \pi n}{2} \left(d^2 - \frac{c^2}{2} \right)$; and therefore for the longitude z, it will be $\frac{z m \pi n}{e} \left(d^2 - \frac{c^2}{2} \right)$; when this is taken from the true precession for that longitude, it leaves the equation of precession $\frac{m \pi n}{a b e} \left((b^2-a^2) d c \text{ sine } z - \frac{1}{4} a b c \text{ sine } 2z \right)$; therefore when the node is in the solstice, and the equation greatest, we have it $= \frac{m \pi n c d}{a b e} (b^2-a^2)$. We here neglect the second term as insignificant.

Gives the disturbing force and matter of the moon.

This

Theory of Universal Gravitation.

This greatest equation of precession is to $\frac{2m\pi ncd}{c}$, the nutation of 18″, as b^2-a^2 to $2ab$; that is, as radius to the tangent of twice the obliquity of the ecliptic. This gives the greatest equation of precession 16″,8, not differing half a second from Bradley's observations.

425 Greatest equation of precession.

Thus have we attempted to give some account of this curious and important phenomenon. It is curious, because it affects the whole celestial motions in a very intricate manner, and received no explanation from the more obvious application of mechanical principles, which so happily accounted for all the other appearances. It is one of the most illustrious proofs of Sir Isaac Newton's sagacity and penetration, which catched at a very remote analogy between this phenomenon and the libration of the moon's orbit.—It is highly important to the progress of practical and useful astronomy, because it has enabled us to compute tables of such accuracy, that they can be used with confidence for determining the longitude of a ship at sea. This alone fixes its importance: but it is still more important to the philosopher, affording the most incontestable proof of the universal and mutual gravitation of all matter to all matter. It left nothing in the solar system unexplained from the theory of gravity but the acceleration of the moon's mean motion; and this has at last been added to the list of our acquisitions by M. de la Place.

Quæ toties animos veterum torsere Sophorum,
Quæque scholas frustra rauco certamine vexant,
Obvia conspicimus, nube pellente Mathesi.
Jam dubios nulla caligine prægravat error
Queis superum penetrare domos, atque ardua cœli
Scandere sublimis genii concessit acumen.
Nec fas est propius mortali attingere divos.

HALLEY.

SECT. X. *Of the Libration of the Moon.*

The only phenomena which still remain to be explained are the libration of the moon and the motion of the nodes of her equator. The moon, in consequence of her rotation round her axis, is a little flattened towards the poles; but the attraction of the earth must have lengthened the axis of the moon directed towards that planet. If the moon were homogeneous and fluid, she would assume the form of an ellipsoid, whose shorter axis would pass through her poles of rotation; the longer axis would be directed towards the earth, and in the plane of the moon's equator; and the mean axis, situated in the same plane, would be perpendicular to the two others. The excess of the longer over the shorter would be quadruple the excess of the mean axis over the shorter, and would amount to about $\frac{1}{29711}$, the shorter axis being represented by unity.

It is easy to see, that if the longer axis of the moon deviate a little from the direction of the radius vector, which joins together the centres of the earth and moon, the attraction of the earth will tend to bring it towards that radius just as gravity tends to bring a pendulum towards the vertical position. If the rotation of the satellite had been at first sufficiently rapid to overcome this tendency, the time of a rotation would not have been equal to that of a revolution round the earth, and their difference would have discovered to us successively all the points of the moon's surface. But the angular motions of rotation and revolution having been at first but very little different, the force with which the longer axis separated from the radius vector was not sufficient to overcome the tendency toward the radius vector occasioned by the attraction of the earth. This last tendency, therefore, has rendered the two motions rigidly equal. And, as a pendulum driven from the vertical direction by a very small force constantly returns to it, making small oscillations on each side, in like manner the longer axis of the moon ought to oscillate on each side of the radius vector of her orbit. The libration of the moon then depends upon the small difference which originally subsisted between the angular motions of the moon's rotation and revolution.

Thus we see, that the theory of gravitation explains the equality which subsists between the mean rotation and revolution of the moon. It is only necessary to suppose, that the original difference between them was small. In that case the attraction of the earth would soon reduce them to a state of equality.

The singular coincidence of the nodes of the moon's equator, with those of its orbit, is also owing to the attraction of the earth. This was first demonstrated by La Grange. The planes of the equator and of the orbit of the moon, and the plane which passes through its centre, parallel to the ecliptic, have always nearly the same intersection. The secular movements of the ecliptic neither alter the coincidence of the nodes of these three planes, nor their mean inclination, which the attraction of the earth keeps always the same.

We have now examined all the phenomena of the heavenly bodies, and have found that they are all explicable on the theory of gravitation, and indeed necessary consequences of that theory. The exact coincidence of all the phenomena must be considered as a complete demonstration of the truth of the theory; and indeed places it beyond the reach of every possible objection. With respect to the nature of this force called *gravitation*, nothing whatever is known, nor is it likely that any thing ever will be known. The discussion being evidently above the reach of the human faculties, all the different theories which have been published, explaining it by ethers, &c. have only served to show the weakness of human reason, when it attempts to leave the plain path of experience, and indulge in fancy and conjecture.

APPENDIX.

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APPENDIX.

In the preceding article we have endeavoured to give as full a view as possible of astronomy; avoiding, at the same time, the introduction of minute details upon those subjects which are not essential, that the readers attention might not be distracted and diverted from objects of primary importance. But for the sake of those persons who may wish to indulge their taste for practical astronomy, we have thought proper to subjoin an appendix; in which we shall give, in the first place, the rules for calculating eclipses, and in the second, a description of the most important astronomical instruments.

I. *Method of Calculating Eclipses.*

The method of constructing tables for the calculation of eclipses will be understood from the following observations.

The motions of the sun and moon are observed to be continually accelerated from the apogee to the perigee, and as gradually retarded from the perigee to the apogee; being slowest of all when the mean anomaly is nothing, and swiftest of all when it is six signs.

When the luminary is in its apogee or perigee, its place is the same as it would be if its motion were equable in all parts of its orbit. The supposed equable motions are called *mean;* the unequable are justly called the *true.*

The mean place of the sun or moon is always forwarder than the true place, whilst the luminary is moving from its apogee to its perigee: and the true place is always forwarder than the mean, whilst the luminary is moving from its perigee to its apogee. In the former case, the anomaly is always less than six signs; and in the latter case, more.

It has been found, by a long series of observations, that the sun goes through the ecliptic, from the vernal equinox to the same equinox again, in 365 days 5 hours 48 minutes 55 seconds; from the first star of Aries to the same star again, in 365 days 6 hours 9 minutes 24 seconds; and from his apogee to the same again, in 365 days 6 hours 14 minutes 0 seconds.—The first of these is called the *solar year;* the second the *sidereal year;* and the third the *anomalistic year.* So that the solar year is 20 minutes 29 seconds shorter than the sidereal; and the sidereal year is four minutes 36 seconds shorter than the anomalistic. Hence it appears, that the equinoctial point, or intersection of the ecliptic and equator at the beginning of Aries, goes backward with respect to the fixed stars, and that the sun's apogee goes forward.

It is also observed, that the moon goes through her orbit from any given fixed star to the same star again, in 27 days 7 hours 43 minutes 4 seconds at a mean rate; from her apogee to her apogee again, in 27 days 13 hours 18 minutes 43 seconds; and from the sun to the sun again, in 29 days 12 hours 44 minutes $3\frac{1}{10}$ seconds. This shows that the moon's apogee moves forward in the ecliptic, and that at a much quicker rate than the sun's apogee does: since the moon is 5 hours 55 minutes 39 seconds longer in revolving from her apogee to her apogee again, than from any star to the same star again.

The moon's orbit crosses the ecliptic in two opposite points, which are called her *nodes:* and it is observed, that she revolves sooner from any node to the node again, than from any star to the star again, by 2 hours 38 minutes 22 seconds; which shows that her nodes move backward, or contrary to the order of signs in the ecliptic.

The time in which the moon revolves from the sun to the sun again (or from change to change) is called a *lunation;* which, according to Dr Pound's mean measures, would always consist of 29 days 12 hours 44 minutes 3 seconds 2 thirds 58 fourths, if the motions of the sun and moon were always equable. Hence 12 mean lunations contain 354 days 8 hours 48 minutes 36 seconds 35 thirds 40 fourths, which is 10 days 21 hours 11 minutes 23 seconds 24 thirds 20 fourths less than the length of a common Julian year, consisting of 365 days 6 hours; and 13 mean lunations contain 383 days 21 hours 32 minutes 39 seconds 38 thirds 38 fourths, which exceeds the length of a common Julian year, by 18 days 15 hours 32 minutes 39 seconds 38 thirds 38 fourths.

The mean time of a new moon being found for any given year and month, as suppose for March 1700 old style, if this mean new moon falls later than the 11th day of March, then 12 mean lunations added to the time of this mean new moon will give the time of the mean new moon in March 1701, after having thrown off 365 days. But when the mean new moon happens to be before the 11th of March, we must add 13 mean lunations, in order to have the time of mean new moon in March the year following; always taking care to subtract 365 days in common years, and 366 days in leap years, from the sum of this addition.

Thus, A. D. 1700, old style, the time of mean new moon in March was the 8th day, at 16 hours 11 minutes 25 seconds after the noon of that day (viz. at 11 minutes 25 seconds past four in the morning of the 9th day), according to common reckoning. To this we must add 13 mean lunations, or 383 days 21 hours 32 minutes 39 seconds 38 thirds 38 fourths, and the sum will be 392 days 13 hours 44 minutes 4 seconds 38 thirds 38 fourths: from which subtract 365 days, because the year 1701 is a common year, and there will remain 27 days 13 hours 44 minutes 4 seconds 38 thirds 38 fourths for the time of mean new moon in March, A. D. 1701.

Carrying on this addition and subtraction till A. D. 1703, we find the time of mean new moon in March that year to be on the 6th day, at 7 hours 21 minutes, 17 seconds 49 thirds 46 fourths past noon; to which add 13 mean lunations, and the sum will be 390 days 4 hours 53 minutes 57 seconds 28 thirds 20 fourths; from which subtract 366 days, because the year 1704 is a leap-year, and there will remain 24 days 4 hours 53 minutes 57 seconds 28 thirds 20 fourths, for the time of mean new moon in March A. D. 1704.

In this manner was the first of the following tables constructed to seconds, thirds, and fourths; and then wrote out to the nearest seconds. The reason why we chose to begin the year with March, was to avoid the inconvenience of adding a day to the tabular time in leap-years after February, or subtracting a day therefrom

from in January and February in those years; to which all tables of this kind are subject, which begin the year with January, in calculating the times of new or full moons.

The mean anomalies of the sun and moon, and the sun's mean motion from the ascending node of the moon's orbit, are set down in Table III. from 1 to 13 mean lunations. These numbers, for 13 lunations, being added to the radical anomalies of the sun and moon, and to the sun's mean distance from the ascending node, at the time of mean new moon in March 1700 (Table I.) will give their mean anomalies, and the sun's mean distance from the node, at the time of mean new moon in March 1701; and being added for 12 lunations to those for 1701, give them for the time of mean new moon in March 1702. And so on as far as you please to continue the table (which is here carried on to the year 1800), always throwing off 12 signs when their sum exceeds 12, and setting down the remainder as the proper quantity.

If the number belonging to A. D. 1700 (in Table I.) be subtracted from those belonging to 1800, we shall have their whole differences in 100 complete Julian years; which accordingly we find to be 4 days 8 hours 10 minutes 52 seconds 15 thirds 40 fourths, with respect to the time of mean new moon. These being added together 60 times (always taking care to throw off a whole lunation when the days exceed $29\frac{1}{2}$) make up 60 centuries or 6000 years, as in Table VI. which was carried on to seconds, thirds, and fourths: and then wrote out to the nearest seconds. In the same manner were the respective anomalies and the sun's distance from the node found, for these centurial years; and then (for want of room) wrote out only to the nearest minutes, which is sufficient in whole centuries. By means of these two tables, we may find the time of any mean new moon in March, together with the anomalies of the sun and moon, and the sun's distance from the node at these times, within the limits of 6000 years either before or after any given year in the 18th century; and the mean time of any new or full moon in any given month after March, by means of the third and fourth tables, within the same limits, as shown in the precepts for calculation.

Thus it would be a very easy matter to calculate the time of any new or full moon, if the sun and moon moved equably in all parts of their orbits. But we have already shown, that their places are never the same as they would be by equable motions, except when they are in apogee or perigee; which is when their mean anomalies are either nothing or six signs: and that their mean places are always forwarder than their true places, whilst the anomaly is less than six signs; and their true places are forwarder than the mean, whilst the anomaly is more.

Hence it is evident, that whilst the sun's anomaly is less than six signs, the moon will overtake him, or be opposite to him, sooner than she could if his motion were equable; and later whilst his anomaly is more than six signs. The greatest difference that can possibly happen between the mean and true time of new or full moon, on account of the inequality of the sun's motion, is 3 hours 48 minutes 28 seconds: and that is, when the sun's anomaly is either 3 signs 1 degree, or 8 signs 29 degrees; sooner in the first case, and later in the last.—In all other signs and degrees of anomaly, the difference is gradually less, and vanishes when the anomaly is either nothing or six signs.

The sun is in his apogee on the 30th of June, and in his perigee on the 30th of December, in the present age: so that he is nearer the earth in our winter than in our summer.—The proportional difference of distance, deduced from the difference of the sun's apparent diameter at these times, is as 983 to 1017.

The moon's orbit is dilated in winter, and contracted in summer; therefore the lunations are longer in winter than in summer. The greatest difference is found to be 22 minutes 29 seconds; the lunations increasing gradually in length whilst the sun is moving from his apogee to his perigee, and decreasing in length whilst he is moving from his perigee to his apogee.—On this account the moon will be later every time in coming to her conjunction with the sun, or being in opposition to him, from December till June, and sooner from June till December, than if her orbit had continued of the same size all the year round.

As both these differences depend on the sun's anomaly, they may be fitly put together into one table, and called *The annual or first equation of the mean to the true syzigy*, (See Table VII.). This equational difference is to be subtracted from the time of the mean syzigy when the sun's anomaly is less than six signs, and added when the anomaly is more.—At the greatest it is 4 hours 10 minutes 57 seconds, viz. 3 hours 48 minutes 28 seconds, on account of the sun's unequal motion, and 22 minutes 29 seconds, on account of the dilatation of the moon's orbit.

This compound equation would be sufficient for reducing the mean time of new or full moon to the true time thereof, if the moon's orbit were of a circular form, and her motion quite equable in it. But the moon's orbit is more elliptical than the sun's, and her motion in it is so much the more unequal. The difference is so great, that she is sometimes in conjunction with the sun, or in opposition to him, sooner by 9 hours 47 minutes 54 seconds, than she would be if her motion were equable; and at other times as much later. The former happens when her mean anomaly is 9 signs 4 degrees, and the latter when it is 2 signs 26 degrees. See Table IX.

At different distances of the sun from the moon's apogee, the figure of the moon's orbit becomes different. It is longest of all, or most eccentric, when the sun is in the same sign and degree either with the moon's apogee or perigee; shortest of all, or least eccentric, when the sun's distance from the moon's apogee is either three signs or nine signs; and at a mean state when the distance is either 1 sign 15 degrees, 4 signs 15 degrees, 7 signs 15 degrees, or 10 signs 15 degrees. When the moon's orbit is at its greatest eccentricity, her apogeal distance from the earth's centre is to her perigeal distance therefrom, as 1067 is to 933; when least eccentric, as 1043 is to 957; and when at the mean state, as 1055 is to 945.

But the sun's distance from the moon's apogee is equal to the quantity of the moon's mean anomaly at the time of new moon, and by the addition of 6 signs it becomes equal in quantity to the moon's mean anomaly at the time of full moon. Therefore, a table may be constructed so as to answer to all the various inequalities depending on the different eccentricities of the moon's orbit, in the syzigies, and called *The second*

cond equation of the mean to the true syzigy. (See Table IX.): and the moon's anomaly, when equated by Table VIII. may be made the proper argument for taking out this second equation of time; which must be added to the former equated time, when the moon's anomaly is less than six signs, and subtracted when the anomaly is more.

There are several other inequalities in the moon's motion, which sometimes bring on the true syzigy a little sooner, and at other times keep it back a little later, than it would otherwise be; but they are so small, that they may be all omitted except two; the former of which (see Table X.) depends on the difference between the anomalies of the sun and moon in the syzigies, and the latter (see Table XI.) depends on the sun's distance from the moon's nodes at these times. The greatest difference arising from the former is 4 minutes 58 seconds; and from the latter, 1 minute 34 seconds.

The tables here inserted being calculated by Mr Ferguson according to the methods already given, he gives the following directions for their use.

To calculate the True Time of New or Full Moon.

426 Directions for the use of those tables.

PRECEPT I. If the required time be within the limits of the 18th century, write out the mean time of new moon in March, for the proposed year, from Table I. in the old style, or from Table II. in the new; together with the mean anomalies of the sun and moon, and the sun's mean distance from the moon's ascending node. If you want the time of full moon in March, add the half lunation at the foot of Table III. with its anomalies, &c. to the former numbers, if the new moon falls before the 15th of March; but if it falls after, subtract the half lunation, with the anomalies, &c. belonging to it, from the former numbers, and write down the respective sums or remainders.

II. In these additions or subtractions, observe, that 60 seconds make a minute, 60 minutes make a degree, 30 degrees make a sign, and 12 signs make a circle. When you exceed 12 signs in addition, reject 12, and set down the remainder. When the number of signs to be subtracted is greater than the number you subtract from, add 12 signs to the lesser number, and then you will have a remainder to set down. In the tables signs are marked thus ^{s}, degrees thus $^\circ$, minutes thus $'$, and seconds thus $''$.

III. When the required new or full moon is in any given month after March, write out as many lunations with their anomalies, and the sun's distance from the node from Table III. as the given month is after March, setting them in order below the number taken out for March.

IV. Add all these together, and they will give the mean time of the required new or full moon, with the mean anomalies and sun's mean distance from the ascending node, which are the arguments for finding the proper equations.

V. With the number of days added together, enter Table IV. under the given month; and against that number you have the day of mean new or full moon in the left-hand column, which set before the hours, minutes, and seconds, already found.

But (as it will sometimes happen) if the said number of days fall short of any in the column under the given month, add one lunation and its anomalies, &c. (from Table III.) to the foresaid sums, and then you will have a new sum of days wherewith to enter Table IV. under the given month, where you are sure to find it the second time, if the first falls short.

VI. With the signs and degrees of the sun's anomaly, enter Table VII. and therewith take out the annual or first equation for reducing the mean syzigy to the true; taking care to make proportions in the table for the odd minutes and seconds of anomaly, as the table gives the equation only to whole degrees.

Observe, in this and every other case of finding equations, that if the signs are at the head of the table, their degrees are at the left hand, and are reckoned downwards; but if the signs are at the foot of the table, their degrees are at the right hand, and are counted upward; the equation being in the body of the table, under or over the signs, in a collateral line with the degrees. The titles *Add* or *Subtract* at the head or foot of the tables where the signs are found, show whether the equation is to be added to the mean time of new or full moon, or to be subtracted from it. In this table, the equation is to be subtracted, if the signs of the sun's anomaly are found at the head of the table; but it is to be added, if the signs are at the foot.

VII. With the signs and degrees of the sun's mean anomaly, enter Table VIII. and take out the equation of the moon's mean anomaly; subtract this equation from her mean anomaly, if the signs of the sun's anomaly be at the head of the table; but add it if they are at the foot; the result will be the moon's equated anomaly, with which enter Table IX. and take out the second equation for reducing the mean to the true time of new or full moon; adding this equation, if the signs of the moon's anomaly are at the head of the table, but subtracting it if they are at the foot; and the result will give you the mean time of the required new or full moon twice equated, which will be sufficiently near for common almanacs.—But when you want to calculate an eclipse, the following equations must be used: thus,

VIII. Subtract the moon's equated anomaly from the sun's mean anomaly, and with the remainder in signs and degrees enter Table X. and take out the third equation, applying it to the former equated time, as the titles *Add* or *Subtract* do direct.

IX. With the sun's mean distance from the ascending node enter Table XI. and take out the equation answering to that argument, adding it to, or subtracting it from, the former equated time, as the titles direct, and the result will give the time of new or full moon, agreeing with well regulated clocks or watches very near the truth. But to make it agree with the solar or apparent time, you must apply the equation of natural days, taken from an equation-table, as it is leap-year, or the first, second, or third after. This, however, unless in very nice calculations, needs not be regarded, as the difference between true and apparent time is never very considerable.

The method of calculating the time of any new or full moon without the limits of the 18th century will be shown further on. And a few examples compared with the precepts will make the whole work plain.

N. B. The tables begin the day at noon, and reckon forward from thence to the noon following.—Thus, March the 31st, at 22 h. 30 m. 25 sec. of tabular time is April 1st (in common reckoning) at 30 m. 25 sec. after 10 o'clock in the morning.

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Of Calculating Eclipses, &c.

EXAMPLE I.

Required the true time of New Moon in April 1764, New Style?

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
March 1764,	2	8	55	36	8	2	20	0	10	13	35	21	11	4	54	48
Add 1 Lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
Mean New Moon,	31	21	39	39	9	1	26	19	11	9	24	21	0	5	35	2
First Equation,	+	4	10	40	11	10	59	18	+	1	34	57	Sun from Node, and Arg. 4th equation.			
Time once equated,	32	1	50	19	9	20	27	1	11	10	59	18				
Second Equation,	—	3	24	49	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	31	22	25	30												
Third Equation,		+	4	37												
Time thrice equated,	31	22	30	7												
Fourth Equation,			+	18												
True New Moon,	31	22	30	25												
Equation of days,		—	3	48												
Apparent time,	31	22	26	37												

So the true time is 22 h. 30 min. 25 sec. after the noon of the 31st March; that is, April 1st, at 30 min. 25 sec. after ten in the morning. But the apparent time is 26 min. 37 sec. after ten in the morning.

EXAMPLE II.

Qu. *The true time of Full Moon in May 1762, New Style?*

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
March 1762,	24	15	18	24	8	23	48	16	1	23	59	11	10	18	49	14
Add 2 lunations,	59	1	28	6	1	28	12	39	1	21	38	1	2	1	20	28
New Moon, May,	22	16	46	30	10	22	0	55	3	15	37	12	0	20	9	42
Subt. ½ Lunation,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon, May,	7	22	24	28	10	7	27	45	9	2	42	42	0	4	49	35
First Equation,	+	3	16	36	9	3	57	18	+	1	14	36	Sun from Node, and Arg. 4th equation.			
Time once equated,	8	1	41	4	1	3	30	27	9	3	57	18				
Second Equation,	—	9	47	53	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	7	15	53	11												
Third Equation,		—	2	36												
Time thrice equated,	7	15	50	35												
Fourth Equation,			+	15												
The Full Moon,	7	15	50	50												

Ans. May 7th at 15 h. 50 min. 50 sec. past noon, viz. May 8th at 3 h. 50 sec. in the morning.

To calculate the time of New and Full Moon in a given year and month of any particular century between the Christian era and the 18th century.

Precept I. Find a year of the same number in the 18th century with that of the year in the century proposed, and take out the mean time of new moon in March, old style, for that year, with the mean anomalies and sun's mean distance from the node at that time, as already taught.

II. Take as many complete centuries of years from Table VI. as, when subtracted from the above-said year in the 18th century, will answer to the given year; and take out the first mean new moon and its anomalies, &c. belonging to the said centuries, and set them below those taken out for March in the 18th century.

III. Subtract the numbers belonging to these centuries from those of the 18th century, and the remainders will be the mean time and anomalies, &c. of new moon in March, in the given year of the century proposed.— Then, work in all respects for the true time of new or full moon, as shown in the above precepts and examples.

IV. If the days annexed to these centuries exceed the number of days from the beginning of March taken out in the 18th century, add a lunation and its anomalies, &c. from Table III. to the time and anomalies of new moon in March, and then proceed in all respects as above. This circumstance happens in Example V.

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EXAMPLE III.

Required the true time of Full Moon in April, Old Style, A. D. 30?

From 1730 substract 1700 (or 17 centuries) and there remains 30.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s.	°	'	"	s.	°	'	"	s.	°	'	"
March 1730,	7	12	34	16	8	18	4	31	9	0	32	17	1	23	17	16
Add ½ Lunation.	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon,	22	6	56	18	9	2	37	41	3	13	26	47	2	8	37	23
1700 years subtr.	14	17	36	42	11	28	46	0	10	29	36	0	4	29	23	0
Full ☽ March A. D. 30.	7	13	19	36	9	3	51	41	4	13	50	47	9	9	14	23
Add 1 Lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
Full Moon, April	6	2	3	39	10	2	58	0	5	9	39	47	10	9	54	37
First Equation,	+	3	28	4	5	10	58	40	+	1	18	53	Sun from Node, and Arg. fourth equation.			
Time once equated,	6	5	31	43	4	21	59	20	4	10	58	40				
Second Equation,	+	2	57	48	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	6	8	29	31												
Third Equation,		—	2	54												
Time thrice equated,	6	8	26	37												
Fourth Equation,		—	1	33												
True Full Moon, April,	6	8	25	4												

Hence it appears, that the true time of Full Moon in April A. D. 30, old style, was on the 6th day, at 25 m. 4 s. past eight in the evening.

To Calculate the true time of New or Full Moon in any given year and month before the Christian era.

Precept I. Find a year in the 18th century, which being added to the given number of years before Christ diminished by one, shall make a number of complete centuries.

II. Find this number of centuries in Table VI. and subtract the time and anomalies belonging to it from those of the mean new moon in March, the above found year of the 18th century; and the remainder will denote the time and anomalies, &c. of mean new moon in March, the given year before Christ.—Then, for the true time thereof in any month of that year, proceed as above taught.

EXAMPLE IV.

Required the true time of New Moon in May, Old Style, the year before Christ 585?

The years 584 added to 1716, make 2300, or 23 centuries.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s.	°	'	"	s.	°	'	"	s.	°	'	"
March 1716,	11	17	33	29	8	22	50	39	4	4	14	2	4	27	17	5
2300 years subtract,	11	5	57	53	11	19	47	0	1	5	59	0	7	25	27	0
March before Christ 585,	0	11	35	36	9	3	3	39	2	28	15	2	9	1	50	5
Add 3 Lunations,	88	14	12	9	2	27	18	58	2	17	27	1	3	2	0	42
May before Christ 585,	28	1	47	45	0	0	22	37	5	15	42	3	2	3	50	47
First Equation,		—	1	37	5	15	41	17			—	46	Sun from Node, and Arg. fourth equation.			
Time once equated,	28	1	46	8	6	14	41	20	5	19	41	17				
Second equation,	+	2	15	1	Arg. 3d. equation.				Arg. 2d equation.							
Time twice equated,	28	4	1	9												
Third Equation,		+	1	9												
Time thrice equated,	28	4	2	18												
Fourth equation.			+	12												
True New Moon,	28	4	2	30												

So the true time was May 28th, at 2 minutes 30 seconds past four in the afternoon.

These Tables are calculated for the meridian of London; but they will serve for any other place, by subtracting four minutes from the tabular time, for every degree that the meridian of the given place is westward of London, or adding four minutes for every degree that the meridian of the given place is eastward: as in

EXAMPLE

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Of Calculating Eclipses, &c

EXAMPLE V.

Required the true time of Full Moon at Alexandria in Egypt in September, Old Style, the year before Christ 201?

The years 200 added to 1800, make 2000 or 20 centuries.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
March 1800,	13	0	22	17	8	23	19	55	10	7	52	36	11	3	58	24
Add 1 Lunation,	29	12	44	3	0	29	6	19	0	25	48	0	1	0	40	14
From the sum,	42	13	6	20	9	22	26	14	11	3	41	36	0	4	38	38
Subtract 2000 years,	27	18	9	19	0	8	50	0	0	15	42	0	6	27	45	0
N. M. bef. Chr. 201,	44	18	57	1	0	13	36	14	10	17	59	36	5	6	53	38
Add { 6 Lunations,	177	4	24	18	5	24	37	56	5	4	54	3	6	4	1	24
{ half Lunations,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full moon, September,	22	17	43	21	3	22	47	20	10	5	48	9	11	26	15	9
First Equation,	—	3	52	6	10	4	19	55	—	1	28	14	Sun from Node, and Argument 4th equation.			
Time once equated,	22	13	51	15	5	18	27	25	10	4	19	55				
Second Equation,	—	8	25	4	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	22	5	26	11												
Third Equation,			—	58												
Time thrice equated,	22	5	25	13												
Fourth Equation,			—	12												
True time at London,	22	5	25	1												
Add for Alexandria,		2	1	27												
True time there,	22	7	26	28												

Thus it appears, that the true time of Full Moon, at Alexandria, in September, old style, the year before Christ 201, was the 22d day, at 26 minutes 28 seconds after seven in the evening.

EXAMPLE VI.

Required the true time of Full Moon at Babylon in October, Old Style, the year 4008 *before the first year of Christ, or* 4007 *before the year of his birth?*

The years 4007 added to 1793, make 5800, or 58 centuries.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
March 1793,	30	9	13	55	9	10	16	11	8	7	37	58	7	6	18	26
Subtract 5800 years,	15	12	38	7	10	21	35	0	6	24	43	0	9	13	1	0
N. M. bef. Chr. 4007,	14	20	35	48	10	18	41	11	1	12	54	58	9	23	17	26
Add { 7 Lunations,	206	17	8	21	6	23	44	15	6	0	43	3	7	4	41	38
{ half Lunations,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon, October,	22	8	6	11	5	26	58	36	1	26	32	31	5	13	19	11
First Equation,		—	13	26	1	26	27	26		—	5	5	Sun from Node, and Argument 4th equation.			
Time once equated,	22	7	52	45	4	0	31	10	1	26	27	26				
Second Equation,	+	8	29	21	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	22	16	22	6												
Third Equation,		—	4	10												
Time thrice equated,	22	16	17	56												
Fourth Equation,			—	51												
Full Moon at London,	22	16	17	5												
Add for Babylon,		2	25	41												
True time there,	22	18	42	46												

So that, on the meridian of London, the true time was October 23d, at 17 minutes 5 seconds past four in the morning; but at Babylon, the true time was October 23d, at 42 minutes 46 seconds past six in the morning.—This is supposed by some to have been the year of the creation.

Of Calculating Eclipses, &c.

To calculate the true time of New or Full Moon in any given year and month after the 18th century.

Precept I. Find a year of the same number in the 18th century with that of the year proposed, and take out the mean time and anomalies, &c. of new moon in March, old style, for that year, in Table I.

II. Take so many years from Table VI. as when added to the above-mentioned year in the 18th century will answer to the given year in which the new or full moon is required; and take out the first new moon, with its anomalies for these complete centuries.

III. Add all these together, and then work in all respects as above shown, only remember to subtract a lunation and its anomalies, when the above-said addition carries the new moon beyond the 31st of March; as in the following example.

EXAMPLE VII.

Required the true time of New Moon in July, Old Style, A. D. 2180?

Four centuries or (400 years) added to A. D. 1780, make 2100.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1780,	23	23	1	34	9	4	18	13	1	21	7	47	10	18	21	1
Add 400 years,	17	8	43	29	0	13	24	0	10	1	28	0	6	17	49	0
From the sum	41	7	45	13	9	17	42	13	11	22	35	47		6	10	1
Subtract 1 Lunation	29	12	44	3	0	29	6	19	0	25	49	0		0	40	14
New Moon March 2180,	11	19	1	10	8	18	35	54	10	26	46	47	4	5	29	47
Add 4 Lunations,	118	2	56	12	3	26	25	17	3	13	16	2	4	2	40	56
New Moon July 2180,	7	21	57	22	0	15	1	11	2	10	2	49	8	8	10	43
First Equation,	—	1	3	39	3	9	38	37		—	24	12	Sun from Node and Argument fourth equation.			
Time one equated,	7	20	53	43	10	5	22	34	2	9	38	37				
Second Equation,	+	9	24	8	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	8	6	17	51	True time, July 8th, at 22 minutes 55 seconds past six in the evening.											
Third Equation,		+	3	56												
Time thrice equated,	8	6	21	47												
Fourth Equation,	-	+	1	8												
True time, July,	8	6	22	55												

In keeping by the old style, we are always sure to be right, by adding or subtracting whole hundreds of years to or from any given year in the 18th century. But in the new style we may be very apt to make mistakes, on account of the leap year's not coming in regularly every fourth year: and therefore, when we go without the limits of the 18th century, we had best keep to the old style, and at the end of the calculation reduce the time to the new. Thus, in the 22d century there will be fourteen days difference between the styles; and therefore the true time of new moon in this last example being reduced to the new style will be the 22d of July, at 22 minutes 55 seconds past six in the evening.

To calculate the true place of the Sun for any given moment of time.

Precept I. In Table XII. find the next lesser year in number to that in which the sun's place is sought, and write out his mean longitude and anomaly answering thereto: to which add his mean motion and anomaly for the complete residue of years, months, days, hours, minutes, and seconds, down to the given time, and this will be the sun's mean place and anomaly at that time, in the old style, provided the said time be in any year after the Christian era. *See the first following example.*

II. Enter Table XIII. with the sun's mean anomaly, and making proportions for the odd minutes and seconds thereof, take out the equation of the sun's centre: which, being applied to his mean place as the title *Add* or *Subtract* directs, will give his true place or longitude from the vernal equinox, at the time for which it was required.

III. To calculate the sun's place for any time in a given year before the Christian era, take out his mean longitude and anomaly for the first year thereof, and from these numbers subtract the mean motions and anomalies for the complete hundreds or thousands next above the given year; and to the remainders, add those for the residue of years, months, &c. and then work in all respects as above. *See the second example following.*

EXAMPLE.

EXAMPLE I.

Required the Sun's true place, March 20th, Old Style, 1764, at 22 hours 30 minutes 25 seconds past Noon? In common reckoning, March 21st, at 10 hours 30 minutes in the Forenoon.

		Sun's Longitude.				Sun's Anomaly.			
		s	°	′	″	s	°	′	″
To the radical year after Christ - -	1701	9	20	43	50	6	13	1	0
Add complete years - - - - -	60	0	0	27	12	11	29	26	0
	3	11	29	17	0	11	29	14	0
	March	1	28	9	11	1	28	9	0
Bissextile Days -	20		20	41	55		20	41	55
Hours -	22			54	13			54	13
Minutes -	30			1	14			1	14
Seconds -	25				1				1
Sun's mean place at the given time - -		0	10	14	36	9	1	27	23
Equation of the Sun's centre, add - - - -			1	55	36	Mean Anomaly.			
Sun's true place at the same time - - -		0	12	10	12	or ♈	12	10	12

EXAMPLE II.

Required the Sun's true place, Oct. 23d, Old Style, at 16 hours 57 minutes past Noon, in the 4008th year before the year of Christ 1; which was the 4007th before the year of his birth, and the year of the Julian period 706.

By the Precepts.		Sun's Longitude.				Sun's Anomaly.			
		s	°	′	″	s	°	′	″
From the radical numbers after Christ -	1	9	7	53	10	6	28	48	0
Subtract those for 5000 complete years - -		1	7	46	40	10	13	25	0
Remains for a new radix - -		8	0	6	30	8	15	23	0
To which add, to bring it to the given time: complete years -	900	0	6	48	0	11	21	37	0
	80	0	0	36	16	11	29	15	0
	12	0	0	5	26	11	29	53	0
	October	8	29	4	54	8	29	4	0
Days	23		22	40	12		22	40	12
Hours	16			39	26			39	26
Minutes	57			2	20			2	20
Sun's mean place at the given time - -		6	0	3	4	5	28	33	58
Equation of the Sun's centre subtract - -				3	4	Sun's Anomaly.			
Sun's true place at the same time - - -		6	0	0	0	or ♎	0	0	0

So that in the meridian of London, the sun was then just entering the sign ♎ Libra, and consequently was upon the point of the autumnal equinox.

If to the above time of the autumnal equinox at London, we add 2 h. 25 m. 41 sec. for the longitude of Babylon, we shall have for the time of the same equinox, at that place, October 23d, at 19 h. 22 m. 41 sec.; which, in the common way of reckoning, is October 24th, at 22 m. 41 sec. past seven in the morning.

And it appears by Example VI. that in the same year the true time of full moon at Babylon was October 23d, at 42 m. 46 sec. after six in the morning; so that the autumnal equinox was on the day next after the day of full moon.—The dominical letter for that year was G, and consequently the 24th of October was on a Wednesday.

To find the Sun's distance from the Moon's ascending node, at the time of any given new or full moon: and consequently, to know whether there is an eclipse at that time or not.

The sun's distance from the moon's ascending node is the argument for finding the moon's fourth equation in the syzigies; and, therefore, it is taken into all the foregoing examples in finding the times thereof. Thus, at the time of mean new moon in April 1764, the sun's mean

mean distance from the ascending node is $0^s\ 5^\circ\ 35'\ 2''$. See Example I.

The descending node is opposite to the ascending one, and they are just six signs distant from each other.

When the sun is within 17 degrees of either of the nodes at the time of new moon, he will be eclipsed at that time; and when he is within 12 degrees of either of the nodes at the time of full moon, the moon will be then eclipsed. Thus we find, that there will be an eclipse of the sun at the time of new moon in April 1764.

But the true time of that new moon comes out by the equations to be 50 minutes 46 seconds later than the mean time thereof, by comparing these times in the above example: and therefore we must add the sun's motion from the node during that interval to the above mean distance $0^s\ 5^\circ\ 35'\ 2''$, which motion is found in Table XII. for 50 minutes 46 seconds, to be $2'\ 12''$. And to this we must apply the equation of the sun's mean distance from the node in Table XV. found by the sun's anomaly, which, at the mean time of new moon in Example I. is $9^s\ 1^\circ\ 26'\ 19''$; and then we shall have the sun's true distance from the node, at the true time of new moon, as follows:

	Sun from Node. s	°	′	″
At the mean time of new moon in April 1764	0	5	35	2
Sun's motion from the node for 50 minutes			2	10
46 seconds				2
Sun's mean distance from node at true new moon	0	5	37	14
Equation of mean distance from node, add		2	5	0
Sun's true distance from the ascending node	0	7	42	14

Which being far within the above limit of 17 degrees, shows that the sun must then be eclipsed.

And now we shall show how to project this, or any other eclipse, either of the sun or moon.

To project an Eclipse of the Sun.

In order to this, we must find the 10 following elements by means of the tables.

1. The true time of conjunction of the sun and moon; and at that time, 2. The semidiameter of the earth's disk, as seen from the moon, which is equal to the moon's horizontal parallax. 3. The sun's distance from the solstitial colure to which he is then nearest. 4. The sun's declination. 5. The angle of the moon's visible path with the ecliptic. 6. The moon's latitude. 7. The moon's true horary motion from the sun. 8. The sun's semidiameter. 9. The moon's. 10. The semidiameter of the penumbra.

We shall now proceed to find these elements for the sun's eclipse in April 1764.

To find the true time of new moon. This, by Example I. is found to be on the first day of the said month, at 30 minutes 25 seconds after ten in the morning.

2. *To find the moon's horizontal parallax, or semidiameter of the earth's disk, as seen from the moon.* Enter Table XVII. with the signs and degrees of the moon's anomaly (making proportions, because the anomaly is in the table only to every 6th degree), and thereby take out the moon's horizontal parallax; which for the above time, answering to the anomaly $11^s\ 9^\circ\ 24'\ 21''$, is $54'\ 43''$.

3. *To find the sun's distance from the nearest solstice, viz. the beginning of Cancer, which is* 3^s *or* 90° *from the beginning of Aries.* It appears by Example I. (where the sun's place is calculated to the above time of new moon), that the sun's longitude from the beginning of Aries is then $0^s\ 12^\circ\ 10'\ 12''$: that is, the sun's place at that time is ♈ Aries, $12^\circ\ 10'\ 12''$.

	s	°	′	″
Therefore from - -	3	0	0	0
Subtract the sun's longitude or place	0	12	10	12
Remains the sun's distance from the solstice ♋	=2	17	49	48

Or $77^\circ\ 49'\ 48''$; each sign containing 30 degrees.

4. *To find the sun's declination.* Enter Table XIV. with the signs and degrees of the sun's true place, viz. $0^s\ 12^\circ$, and making proportions for the $10'\ 12''$, take out the sun's declination answering to his true place, and it will be found to be $4^\circ\ 49'$ north.

5. *To find the moon's latitude.* This depends on her distance from her ascending node, which is the same as the sun's distance from it at the time of new moon; and is thereby found in Table XVI.

But we have already found that the sun's equated distance from the ascending node, at the time of new moon in April 1764, is $0^s\ 7^\circ\ 42'\ 14''$. See above.

Therefore, enter Table XVI. with 0 signs at the top, and 7 and 8 degrees at the left hand, and take out $36'$ and $39''$, the latitude for 7°; and $41'\ 51''$, the latitude for 8°: and by making proportions between these latitudes for the $42'\ 14''$, by which the moon's distance from the node exceeds 7 degrees, her true latitude will be found to be $40'\ 18''$ north ascending.

6. *To find the moon's true horary motion from the sun.* With the moon's anomaly, viz. $11^s\ 9^\circ\ 24'\ 21''$, enter Table XVII. and take out the moon's horary motion; which, by making proportions in that Table, will be found to be $30'\ 22''$. Then, with the sun's anomaly, $9^s\ 1^\circ\ 26'\ 19''$, take out his horary motion $2'\ 28''$ from the same table; and subtracting the latter from the former, there will remain $27'\ 54''$ for the moon's true horary motion from the sun.

7. *To find the angle of the moon's visible path with the ecliptic.* This, in the projection of eclipses, may be always rated at $5^\circ\ 35'$, without any sensible error.

8, 9. *To find the semidiameters of the sun and moon.* These are found in the same table, and by the same arguments, as their horary motions. In the present case, the sun's anomaly gives his semidiameter $16'\ 6''$, and the moon's anomaly gives her semidiameter $14'\ 57''$.

10. *To find the semidiameter of the penumbra.* Add the moon's semidiameter to the sun's, and their sum will be the semidiameter of the penumbra, viz. $31'\ 3''$.

Now collect these elements, that they may be found the more readily when they are wanted in the construction of this eclipse.

Of Calculating Eclipses, &c.

		°	′	″
1. True time of new moon in April 1764 - -	1	10	30	25
		°	′	″
2. Semidiameter of the earth's disk		0	54	53
3. Sun's distance from the nearest solst.		77	49	48
4. Sun's declination, north		4	49	0
5. Moon's latitude, north ascending		0	40	18
6. Moon's horary motion from the sun		0	27	54
7. Angle of the moon's visible path with the ecliptic		5	35	0
8. Sun's semidiameter			16	6
9. Moon's semidiameter			14	57
10. Semidiameter of the penumbra			31	3

To project an Eclipse of the Sun geometrically.

Fig. 158. *a.* Make a scale of any convenient length, as AC, and divide it into as many equal parts as the earth's semidisk contains minutes of a degree; which, at the time of the eclipse in April 1764, is 54′ 53″. Then, with the whole length of the scale as a radius, describe the semicircle AMB upon the centre C; which semicircle shall represent the northern half of the earth's enlightened disk as seen from the sun.

Upon the centre C raise the straight line CH, perpendicular to the diameter ACB; so ACB shall be a part of the ecliptic, and CH its axis.

Being provided with a good sector, open it to the radius CA in the line of chords; and taking from thence the chord of $23\frac{1}{2}$ degrees in your compasses, set it off both ways from H, to *g* and to *h*, in the periphery of the semidisk; and draw the straight line *g* V*h*, in which the north pole of the disk will be always found.

When the sun is in Aries, Taurus, Gemini, Cancer, Leo, and Virgo, the north pole of the earth is enlightened by the sun: but whilst the sun is in the other six signs, the south pole is enlightened, and the north pole is in the dark.

And when the sun is in Capricorn, Aquarius, Pisces, Aries, Taurus, and Gemini, the northern half of the earth's axis C XII P lies to the right hand of the axis of the ecliptic, as seen from the sun; and to the left hand, whilst the sun is in the other six signs.

Open the sector till the radius (or distance of the two 90's) of the sines be equal to the length of V *h*, and take the sine of the sun's distance from the solstice (77° 49′ 48″) as nearly as you can guess, in your compasses, from the line of the sines, and set off that distance from V to P in the line *g* V *h*, because the earth's axis lies to the right hand of the axis of the ecliptic in this case, the sun being in Aries; and draw the straight line C XII P for the earth's axis, of which P is the north pole. If the earth's axis had lain to the left hand from the axis of the ecliptic, the distance VP would have been set off from V towards *g*.

To draw the parallel of latitude of any given place, as suppose London, or the path of that place on the earth's enlightened disk as seen from the sun, from sunrise till sunset, take the following method.

Subtract the latitude of London, $51°\frac{1}{2}$, from 90°, and the remainder $38°\frac{1}{2}$ will be the colatitude, which take in your compasses from the line of chords, making CA or CB the radius, and set it from *h* (where the earth's axis meets the periphery of the disk) to VI and VI, and draw the occult or dotted line VI K VI. Then, from the points where this line meets the earth's disk, set off the chord of the sun's declination 4° 49′ to D and F, and to E and G, and connect these points by the two occult lines F XII G and DLE.

Bisect LK XII in K, and through the point K draw the black line VI K VI. Then make CB the radius of a line of sines on the sector, take the colatitude of London $38°\frac{1}{2}$ from the sines in your compasses, and set it both ways from K to VI and VI. These hours will be just in the edge of the disk at the equinoxes, but at no other time in the whole year.

With the extent K VI taken into your compasses, set one foot in K (in the black line below the occult one) as a centre, and with the other foot describe the semicircle VI 7 8 9 10, &c. and divide it into 12 equal parts. Then from these points of division draw the occult lines 7*p*, 8*o*, 9*n*, &c. parallel to the earth's axis C XII P.

With the small extent K XII as a radius, describe the quadrantal arc XII *f*, and divide it into six equal parts, as XII, *a*, *ab*, *bc*, *cd*, *de*, and *ef*; and through the division points *a*, *b*, *c*, *d*, *e*, draw the occult lines VII *e* V, VIII *d* IV, IX *c* III, X *b* II, and XI *a* I, all parallel to VI K VI, and meeting the former occult lines 7 *p*, 8 *o*, &c. in the points VII VIII IX X XI, V IV III II and I: which points shall mark the several situations of London on the earth's disk, at these hours respectively, as seen from the sun; and the elliptic curve VI VII VIII, &c. being drawn through these points, shall represent the parallel of latitude, or path of London on the disk, as seen from the sun, from its rising to its setting.

N. B. If the sun's declination had been south, the diurnal path of London would have been on the upper side of the line VI K VI, and would have touched the line DLE in L. It is requisite to divide the horary spaces into quarters (as some are in the figure), and, if possible, into minutes also.

Make CB the radius of a line of chords on the sector, and take therefrom the chord of 5° 35′, the angle of the moon's visible path with the ecliptic, set it off from H to M on the left hand of CH, the axis of the ecliptic, because the moon's latitude is north ascending. Then draw CM for the axis of the moon's orbit, and bisect the angle MCH by the right line C*z*. If the moon's latitude had been north descending, the axis of her orbit would have been on the right hand from the axis of the ecliptic.——N. B. The axis of the moon's orbit lies the same way when her latitude is south ascending as when it is north ascending; and the same way when south descending as when north descending.

Take the moon's latitude 40′ 18″ from the scale CA in your compasses, and set it from *i* to *x* in the bisecting line C*z*, making *ix* parallel to C*y*: and through *x*, at right angles to the axis of the moon's orbit CM, draw the straight line N *wxy* S for the path of the penumbra's centre over the earth's disk.—The point *w*, in the axis of the moon's orbit, is that where the penumbra's centre approaches nearest to the centre of the earth's disk, and consequently in the middle of the general eclipses: the point *x* is that where the conjunction of

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of the sun and moon falls, according to equal time by the tables; and the point *y* is the ecliptical conjunction of the sun and moon.

Take the moon's true horary motion from the sun, 27′ 54″, in your compasses, from the scale CA (every division of which is a minute of a degree), and with that extent make marks along the path of the penumbra's centre; and divide each space from mark to mark into 60 equal parts or horary minutes, by dots; and set the hours to every 60th minute, in such a manner, that the dot signifying the instant of new moon by the tables may fall into the point *x*, half way between the axis of the moon's orbit and the axis of the ecliptic; and then the rest of the dots will show the points of the earth's disk, where the penumbra's centre is at the instants denoted by them, in its transit over the earth.

Apply one side of a square to the line of the penumbra's path, and move the square backwards and forwards until the other side of it cuts the same hour and minute (as at *m* and *m*) both in the path of London and in the path of the penumbra's centre; and the particular minute or instant which the square cuts at the same time on both paths shall be the instant of the visible conjunction of the sun and moon, or greatest obscuration of the sun, at the place for which the construction is made, namely London, in the present example; and this instant is at $37\frac{1}{5}$ minutes past ten o'clock in the morning; which is 17 minutes five seconds later than the tabular time of true conjunction.

Take the sun's semidiameter, 16′ 6″, in your compasses, from the scale CA, and setting one foot on the path of London, at *m*, namely at $47\frac{1}{5}$ minutes past ten, with the other foot describe the circle UY, which shall represent the sun's disk as seen from London at the greatest obscuration.—Then take the moon's semidiameter, 14′ 57″, in your compasses from the same scale, and setting one foot on the path of the penumbra's centre at *m*, in the $47\frac{1}{5}$ minutes after ten, with the other foot describe the circle TY for the moon's disk, as seen from London, at the time when the eclipse is at the greatest, and the portion of the sun's disk which is hid or cut off by the moon's will show the quantity of the eclipse at that time; which quantity may be measured on a line equal to the sun's diameter, and divided into 12 equal parts for digits.

Lastly, take the semidiameter of the penumbra, 31′3″, from the scale CA in your compasses; and setting one foot in the line of the penumbra's centre path, on the left hand from the axis of the ecliptic, direct the other foot toward the path of London; and carry that extent backwards and forwards till both the points of the compasses fall into the same instants in both the paths: and these instants will denote the time when the eclipse begins at London.—Then do the like on the right hand of the axis of the ecliptic; and where the points of the compasses fall into the same instants in both the paths, they will show at what time the eclipse ends at London.

These trials give 20 minutes after nine in the morning for the beginning of the eclipse at London, at the points N and O; $47\frac{1}{5}$ minutes after ten, at the points *m* and *n*, for the time of greatest obscuration; and 18 minutes after twelve, at R and S, for the time when the eclipse ends; according to mean or equal time.

From these times we must subtract the equation of natural days, viz. 3 minutes, 48 seconds, in leap-year April 1. and we shall have the apparent times; namely, 9 hours 16 minutes 12 seconds for the beginning of the eclipse, 10 hours 43 minutes 42 seconds for the time of greatest obscuration, and 12 hours 14 minutes 12 seconds for the time when the eclipse ends. But the best way is to apply this equation to the true equal time of new moon, before the projection be begun; as is done in Example I. For the motion or position of places on the earth's disk answers to apparent or solar time.

In this construction it is supposed, that the angle under which the moon's disk is seen, during the whole time of the eclipse, continues invariably the same; and that the moon's motion is uniform and rectilineal during that time. But these suppositions do not exactly agree with the truth; and therefore, supposing the elements given by the tables to be accurate, yet the times and phases of the eclipse, deduced from its construction, will not answer exactly to what passeth in the heavens; but may be at least two or three minutes wrong, though done with the greatest care. Moreover, the paths of all places of considerable latitudes are nearer the centre of the earth's disk as seen from the sun than those constructions make them; because the disk is projected as if the earth were a perfect sphere, although it is known to be a spheroid. Consequently, the moon's shadow will go farther northward in all places of northern latitude, and farther southward in all places of southern latitude, than it is shown to do in these projections.——According to Meyer's Tables, this eclipse was about a quarter of an hour sooner than either these tables, or Mr Flamstead's, or Dr Halley's, make it; and was not annular at London. But M. de la Caille's make it almost central.

The Projection of Lunar Eclipses.

When the moon is within 12 degrees of either of her nodes at the time when she is full, she will be eclipsed; otherwise not.

We find by Example II. that at the time of mean full moon in May 1762, the sun's distance from the ascending node was only 4° 49′ 35″; and the moon being then opposite to the sun, must have been just as near her descending node, and was therefore eclipsed.

The elements for constructing an eclipse of the moon are eight in number, as follows:

1. The true time of full moon; and at that time, 2. The moon's horizontal parallax. 3. The sun's semidiameter. 4. The moon's. 5. The semidiameter of the earth's shadow at the moon. 6. The moon's latitude. 7. The angle of the moon's visible path with the ecliptic. 8. The moon's true horary motion from the sun.—Therefore,

1. *To find the true time of new or full moon.* Work as already taught in the precepts.—Thus we have the true time of full moon in May 1762 (see Example II. page 562) on the 8th day, at 50 minutes 50 seconds past three o'clock in the morning.

2. *To find the moon's horizontal parallax.* Enter Table XVII. with the moon's mean anomaly (at the above full) 9ˢ 2° 42′ 42″, and thereby take out her horizontal parallax; which, by making the requisite proportions, will be found to be 57′ 23″.

3, 4. *To find the semidiameters of the sun and moon.* Enter Table XVII. with their respective anomalies, the sun's being 10ˢ 7° 27′ 45″ (by the above example), and the moon's 9ˢ 2° 42′ 42″; and thereby take out their respective semidiameters; the sun's 15′ 56″, and the moon's 15′ 38″.

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Of Calculating Eclipses, &c.

5. *To find the semidiameter of the earth's shadow at the moon.* Add the sun's horizontal parallax, which is always 10′, to the moon's, which in the present case is 37′ 23″, the sum will be 57′ 33″, from which subtract the sun's semidiameter 15′ 56″, and there will remain 41′ 37″ for the semidiameter of that part of the earth's shadow which the moon then passes through.

6. *To find the moon's latitude.* Find the sun's true distance from the ascending node (as already taught at the true time of full moon); and this distance increased by six signs will be the moon's true distance from the same node; and consequently the argument for finding her true latitude.

Thus, in Example II. the sun's mean distance from the ascending node was $0^s\ 40^\circ\ 49'\ 35''$, at the time of mean full moon; but it appears by the example, that the true time thereof was six hours 33 minutes 38 seconds sooner than the mean time; and therefore we must subtract the sun's motion from the node (found in Table XII.) during this interval from the above mean distance of $0^s\ 4^\circ\ 49'\ 35''$, in order to have his mean distance from it at the true time of full moon. Then to this apply the equation of his mean distance from the node, found in Table XV. by his mean anomaly $10^s\ 7^\circ\ 27'\ 45''$: and lastly add six signs: so shall the moon's true distance from the ascending node be found as follows:

		s	°	′	″
Sun from node at mean full moon	-	0	4	40	35
His motion from it in 6 hours	-			15	35
His motion from it in 33 minutes	-			1	26
His motion from it in 38 seconds	-				2
Sum, subtract from the uppermost line	-			17	3
Remains his mean distance at true full moon		0	4	32	32
Equation of his mean distance, add	-		1	38	0
Sun's true distance from the node	-	0	6	10	32
To which add	- - -	6	0	0	0
And the sum will be	- - -	6	6	10	32

Which is the moon's true distance from her ascending node at the true time of her being full; and consequently the argument for finding her true latitude at that time.—Therefore, with this argument enter Table XVI. making proportions between the latitudes belonging to the 6th and 7th degree of the argument at the left hand (the signs being at top) for the 10′ 32″, and it will give 32′ 21″ for the moon's true latitude, which appears by the table to be south descending.

7. *To find the angle of the moon's visible path with the ecliptic.* This may be stated at 5° 35′, without any error of consequence in the projection of the eclipse.

8. *To find the moon's true horary motion from the sun.* With their respective anomalies take out their horary motions from Table XVII. and the sun's horary motion subtracted from the moon's, leaves remaining the moon's true horary motion from the sun: in the present case 30′ 32″.

Now collect these elements together for use.

		D.	H.	M.	S.
1. True time of full moon in May 1762	-	8	3	50	50
			°	′	″
2. Moon's horizontal parallax	- -		0	57	23
3. Sun's semidiameter	- - -		0	15	56
4. Moon's semidiameter	- - -		0	15	38
5. Semidiameter of the earth's shadow at the moon			0	41	37
6. Moon's true latitude, south descending	-		0	32	21
7. Angle of her visible path with the ecliptic	-		5	35	0
8. Her true horary motion from the sun	-		0	30	52

These elements being found for the construction of the moon's eclipse in May 1762, proceed as follows:

Of Calculating Eclipses, &c.

Make a scale of any convenient length, as WX (fig. 159. *a*), and divide it into 60 equal parts, each part standing for a minute of a degree.

Draw the right line ACB (fig. 160. *a.*) for part of the ecliptic, and CD perpendicular thereto for the southern part of its axis; the moon having south latitude.

Add the semidiameters of the moon and earth's shadow together, which in this eclipse will make 57′ 15″; and take this from the scale in your compasses, and setting one foot on the point C as a centre, with the other foot describe the semicircle ADB; in one point of which the moon's centre will be at the beginning of the eclipse, and in another at the end thereof.

Take the semidiameter of the earth's shadow, 41′ 37″, in your compasses from the scale, and setting one foot in the centre C, with the other foot describe the semicircle KLM for the southern half of the earth's shadow, because the moon's latitude is south in this eclipse.

Make CD equal to the radius of a line of chords on the sector, and set off the angle of the moon's visible path with the ecliptic 5° 35′ from D to E, and draw the right line CFE for the southern half of the axis of the moon's orbit lying to the right hand from the axis of the ecliptic CD, because the moon's latitude is south descending.—It would have been the same way (on the other side of the ecliptic) if her latitude had been north descending, but contrary in both cases, if her latitude had been either north ascending or south ascending.

Bisect the angle DCE by the right line C*g*, in which line the true equal time of opposition of the sun and moon falls as given by the table.

Take the moon's latitude 32′ 21″, from the scale with your compasses, and set it from C to G in the line CG*g*; and through the point G, at right angles to CFE, draw the right line PHGFN for the path of the moon's centre. Then F shall be the point in the earth's shadow, where the moon's centre is at the middle of the eclipse; G, the point where her centre is at the tabular time of her being full; and H, the point where her centre is at the instant of her ecliptical opposition.

Take the moon's horary motion from the sun, 30′ 52″, in your compasses from the scale; and with that extent make marks along the line of the moon's path PGN: then divide each space from mark to mark into 60 equal parts, or horary minutes, and set the hours to the proper dots in such a manner, that the dot signifying the instant of full moon (viz. 50 minutes 50 seconds after III in the morning) may be in the point G, where the line of the moon's path cuts the line that bisects the angle DCE.

Take the moon's semidiameter, 15′ 38″, in your compasses from the scale, and with that extent, as a radius, upon the points N, F, and P, as centres, describe the circle Q for the moon at the beginning of the eclipse, when she touches the earth's shadow at V; the circle R for the moon at the middle of the eclipse; and the circle S for the moon at the end of the eclipse, just leaving the earth's shadow at W.

The point N denotes the instant when the eclipse began, namely, at 15 minutes 10 seconds after II in the morning; the point F the middle of the eclipse at 47 minutes 44 seconds past III; and the point P the end of the eclipse, at 18 minutes after V.—At the greatest obscuration the moon was 10 digits eclipsed.

TABLE I.

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TABLE I. *The mean time of New Moon in March, Old Style; with the mean Anomalies of the Sun and Moon, and the Sun's mean distance from the Moon's ascending Node, from A. D. 1700 to A. D. 1800 inclusive.*

A. D.	Mean New Moon in March.				Sun's Mean Anomaly.				Moon's Mean Anomaly.				Sun's mean Dist from the Node			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1700	8	16	11	25	8	19	58	48	1	22	30	37	6	14	31	7
1701	27	13	44	5	9	8	20	59	0	28	7	42	7	23	14	8
1702	16	22	32	41	8	27	36	51	11	7	55	47	8	1	16	55
1703	6	7	21	18	8	16	52	43	9	17	43	52	8	9	19	42
1704	24	4	53	57	9	5	14	54	8	23	20	57	9	18	2	43
1705	13	13	42	34	8	24	30	47	7	3	9	2	9	26	5	30
1706	2	22	31	11	8	13	46	39	5	12	57	7	10	4	8	17
1707	21	20	3	50	9	2	8	50	4	18	34	13	11	12	51	18
1708	10	4	52	27	8	21	24	43	2	28	22	18	11	20	54	5
1709	29	2	25	7	9	9	46	54	2	3	59	24	0	29	37	6
1710	18	11	13	43	8	29	2	47	0	13	47	30	1	7	39	54
1711	7	20	2	20	8	18	18	39	10	23	35	36	1	15	42	41
1712	25	17	34	59	9	6	40	51	9	29	12	42	2	14	25	43
1713	15	2	23	36	8	25	56	43	8	9	0	47	3	2	28	30
1714	4	11	12	13	8	15	12	35	6	18	48	52	3	10	31	17
1715	23	8	44	52	9	3	34	47	5	24	25	57	4	19	14	18
1716	11	17	33	29	8	22	50	39	4	4	14	2	4	27	17	5
1717	1	2	22	5	8	12	6	32	2	14	2	8	5	5	19	52
1718	19	23	54	45	9	0	28	44	1	19	39	13	6	14	2	54
1719	9	8	43	22	8	19	44	37	11	29	27	18	6	22	5	41
1720	27	6	16	1	9	8	6	49	11	5	4	24	8	0	48	45
1721	16	15	4	38	8	27	22	41	9	14	52	29	8	8	51	29
1722	5	23	53	14	8	16	38	33	7	24	40	34	8	16	54	16
1723	24	21	25	54	9	5	0	45	7	0	17	40	9	25	37	18
1724	13	6	14	31	8	24	16	37	5	10	5	45	10	3	40	5
725	2	15	3	7	8	13	32	29	3	19	53	50	10	11	42	52
1726	21	12	35	47	9	1	54	41	2	25	30	56	11	20	25	54
1727	10	21	24	23	8	21	10	34	1	5	19	1	11	28	28	41
1728	28	18	57	3	9	9	52	46	0	10	56	7	1	7	11	42
1729	18	3	45	40	8	28	48	39	10	20	44	12	1	15	14	29
1730	7	12	34	16	8	18	4	31	9	0	32	17	1	23	17	16
1731	26	10	6	56	9	6	26	42	8	6	9	23	3	2	0	17
1732	14	18	55	33	8	25	42	34	6	15	57	28	3	10	3	4
733	4	3	44	9	8	14	58	26	4	25	45	33	3	18	5	51
734	23	1	16	49	9	3	20	39	4	1	22	39	4	26	48	52
735	12	10	5	25	8	22	36	30	2	11	10	44	5	4	51	40
736	0	18	54	2	8	11	52	22	9	20	58	49	5	12	54	27
737	19	16	26	42	9	0	14	34	11	26	35	55	6	21	37	29
738	9	1	15	18	8	19	30	26	10	6	24	0	6	29	40	16
739	27	22	47	58	9	7	52	38	9	12	1	6	8	8	23	18
740	16	7	36	34	8	27	8	30	7	21	49	11	8	16	26	5
741	5	16	25	11	8	16	24	22	6	1	37	16	8	24	28	52
742	24	13	57	52	9	4	46	34	5	7	14	22	10	3	11	54
743	13	22	46	27	8	24	2	27	3	17	2	27	10	1	14	41
744	2	7	35	4	8	13	18	20	1	26	50	32	10	19	17	28
745	21	5	7	44	9	1	40	32	1	2	27	38	11	28	0	30
646	10	13	56	20	8	20	56	24	11	12	15	43	0	6	3	17
747	29	11	29	0	9	9	18	36	10	17	52	49	1	14	46	19
748	17	20	17	36	8	28	34	28	8	27	40	54	1	22	49	5
749	7	5	6	13	8	17	50	20	7	7	28	59	2	0	51	52
750	26	2	38	53	9	6	12	32	6	13	6	5	3	9	34	53
751	15	11	27	29	8	25	28	24	4	22	54	10	3	17	37	40
752	3	20	16	6	8	14	44	16	3	2	42	15	3	25	40	27
1753	22	17	48	45	9	3	6	28	2	8	19	21	5	4	23	28
1754	12	2	37	22	8	22	22	20	0	18	7	26	5	12	26	15
1755	1	11	25	59	8	11	38	12	10	27	55	31	5	20	29	2
1756	19	8	58	38	9	0	0	24	10	3	32	37	6	29	12	3
1757	8	17	47	15	8	19	16	16	8	13	20	42	7	7	14	50
1758	27	15	19	54	9	7	38	28	7	18	57	48	8	15	57	52
1759	17	0	8	31	8	26	54	20	5	28	45	54	8	24	0	39
1760	5	8	57	8	8	16	10	12	4	8	34	0	9	2	3	26
1761	24	6	29	47	9	4	32	24	3	14	11	6	10	10	46	17
1762	13	15	18	24	8	23	48	16	6	23	59	11	10	18	49	14
1763	3	0	7	1	8	13	4	8	0	3	47	16	10	26	52	1
1764	20	21	39	40	9	1	26	20	11	9	24	21	0	5	35	2
1765	10	6	28	17	8	20	42	13	9	19	12	26	0	13	37	49
1766	29	4	0	56	9	9	4	20	8	24	49	32	1	22	20	51
1767	18	12	49	33	8	28	20	17	7	4	37	37	2	0	23	38
1768	6	21	38	10	8	17	36	9	5	14	25	42	2	8	26	25
1769	25	19	10	40	9	5	58	21	4	20	2	48	3	17	9	27
1770	15	3	59	26	8	25	14	13	2	29	50	53	3	25	12	14
1771	4	12	48	2	8	14	30	5	1	9	38	58	4	3	15	1
1772	22	10	20	43	9	2	52	17	0	15	16	4	5	11	58	3
1773	11	19	9	19	8	22	8	9	10	25	4	9	5	20	0	50
1774	1	3	57	55	8	11	24	1	9	4	52	14	5	28	3	37
1775	20	1	30	35	8	29	46	13	8	10	29	20	7	6	46	38
1776	8	10	19	12	8	19	2	5	6	20	17	25	7	14	49	25
1777	27	7	51	51	9	7	24	17	5	25	54	31	8	23	32	26
1778	16	16	40	28	8	26	40	9	4	5	42	36	9	1	35	13
1779	6	1	29	4	8	15	56	1	2	15	30	41	9	9	38	0
1780	23	23	1	44	8	4	18	13	1	21	7	47	10	18	21	1
1781	13	7	50	21	8	23	34	5	0	0	55	52	10	26	23	48
1782	2	16	38	57	8	12	49	58	0	10	43	57	11	4	26	35
1783	21	14	11	37	9	1	12	10	9	16	21	3	0	13	9	36
1784	9	23	0	13	8	20	28	3	7	26	9	8	0	21	12	23
1785	28	20	32	53	9	8	50	15	7	1	46	14	1	29	55	25
1786	18	5	21	30	8	28	6	7	5	11	34	19	2	7	58	12
1787	7	14	10	6	8	17	21	59	3	21	22	24	2	16	0	59
1788	25	11	42	46	9	5	44	11	2	26	59	30	3	24	44	1
1789	14	20	31	23	8	25	0	3	1	6	47	35	4	2	46	48
1790	4	5	19	59	8	14	15	55	11	16	35	40	4	10	49	35
1791	23	2	52	39	9	2	38	7	10	22	12	46	5	19	32	37
1792	11	11	41	15	8	21	53	59	9	2	0	52	5	27	35	24
1793	30	9	13	55	9	10	16	11	8	7	37	58	7	6	18	26
1794	19	18	2	32	8	29	32	3	6	17	26	4	7	14	21	13
1795	9	2	51	8	8	18	47	45	4	27	14	9	7	22	24	0
1796	27	0	23	48	9	7	10	7	4	2	51	14	9	1	7	1
1797	16	9	12	24	8	26	25	59	2	12	39	19	9	9	9	48
1798	5	18	1	1	8	15	45	51	0	22	27	25	9	17	12	35
1799	24	51	33	41	9	4	4	3	11	28	4	31	10	25	55	37
1800	13	0	22	17	8	23	19	55	10	7	52	36	11	3	58	24

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TABLE II. *Mean New Moon, &c. in March, New Style, from A. D. 1752 to A. D. 1800.*

Y. of Chr.	Mean New Moon in March D.	H.	M.	S.	Sun's mean Anomaly s	°	′	″	Moon's mean Anomaly s	°	′	″	Sun's mean Dist from the Node s	°	′	″
1752	14	20	16	6	8	14	44	16	3	2	42	15	3	25	40	27
1753	4	5	4	42	8	4	0	8	1	12	30	20	4	3	43	14
1754	23	2	37	22	8	22	22	20	0	18	7	26	5	12	26	15
1755	12	11	25	59	8	11	38	12	10	27	55	31	5	20	29	2
1756	30	8	58	38	9	0	0	24	10	0	32	37	6	29	12	3
1757	19	17	47	15	8	19	16	16	8	13	20	42	7	7	14	50
1758	9	2	35	51	8	8	32	8	6	23	8	47	7	15	17	38
1759	28	0	8	31	8	26	54	20	5	28	45	54	8	24	0	39
1760	16	8	57	8	8	16	10	12	4	8	34	0	9	2	3	26
1761	5	17	45	44	8	5	26	4	2	18	22	5	9	10	6	13
1762	24	15	18	24	8	23	48	16	1	23	59	11	10	18	49	14
1763	14	0	7	1	8	13	4	8	0	3	47	16	10	26	52	1
1764	2	8	55	36	8	2	20	0	10	13	35	21	11	4	54	48
1765	21	6	28	17	8	20	42	13	9	19	12	26	0	13	37	49
1766	10	15	16	53	8	9	58	5	7	29	0	31	0	21	40	37
1767	29	12	49	33	8	28	20	17	7	4	37	37	2	0	23	38
1768	17	21	38	9	8	17	36	9	5	14	25	42	2	8	26	25
1769	7	6	26	46	8	6	52	1	2	24	13	47	2	16	29	13
1770	26	3	59	26	8	25	14	13	2	29	50	53	3	25	12	14
1771	15	12	48	2	8	14	40	5	1	9	38	58	4	3	15	1
1772	3	21	36	39	8	3	54	57	11	19	27	3	4	11	17	48
1773	22	19	9	19	8	22	8	9	10	25	4	9	5	20	0	50
1774	12	3	57	55	8	11	24	1	9	4	52	14	5	28	3	37
1775	1	12	46	31	8	0	39	53	7	14	40	16	6	6	6	24
1776	19	10	19	12	8	19	2	5	6	20	17	25	7	14	49	25
1777	8	19	7	48	8	8	17	57	5	0	5	30	7	22	52	12
1778	27	16	40	28	8	26	40	9	4	5	42	36	9	2	35	13
1779	17	1	29	4	8	15	56	1	2	15	30	41	9	9	38	0
1780	5	10	17	40	8	5	11	53	0	25	18	46	9	17	40	47
1781	24	7	50	21	8	23	24	5	0	0	55	52	10	26	23	48
1782	13	16	38	57	8	12	49	58	10	10	43	57	11	4	26	35
1783	3	1	27	33	8	2	5	50	8	20	32	2	11	12	29	22
1784	20	23	0	13	8	20	28	3	9	26	9	8	0	21	12	23
1785	10	7	48	50	8	9	43	55	6	5	57	13	0	29	15	10
1786	29	5	21	30	8	28	6	7	5	11	34	19	2	7	58	12
1787	18	14	10	6	8	17	21	59	3	21	22	24	2	16	0	59
1788	6	22	58	42	8	6	37	51	2	1	10	29	2	24	3	46
1789	25	20	31	23	8	25	0	3	1	6	47	35	4	2	46	48
1790	15	5	19	59	8	14	15	55	11	16	35	40	4	10	49	35
1791	4	14	8	35	8	3	31	47	9	26	23	45	4	18	52	22
1792	22	11	41	15	8	21	53	59	9	2	0	52	5	27	35	24
1793	11	20	29	51	8	11	9	51	7	11	48	57	6	5	38	11
1794	30	18	2	32	8	29	32	3	6	17	26	4	7	14	21	13
1795	20	2	51	8	8	18	47	55	4	27	14	9	7	22	24	0
1796	8	11	39	44	8	8	3	47	3	7	2	14	8	0	26	47
1797	27	9	12	24	8	26	25	59	2	12	39	19	9	9	9	48
1798	16	18	1	1	8	15	41	51	0	22	27	25	9	17	12	35
1799	6	2	49	37	8	4	57	43	11	2	15	30	9	25	15	22
1800	25	0	22	17	8	23	19	55	10	7	56	36	11	3	58	24

TABLE III. *Mean Anomalies, and Sun's mean Distance from the Node, for 3 mean Lunations.*

N.	Mean Lunations D.	H.	M.	S.	Sun's mean Anomaly s	°	′	″	Moon's mean Anomaly s	°	′	″	Sun's mean Dist. from the Node s	°	′	″
1	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
2	59	1	28	6	1	28	12	39	1	21	38	1	2	1	20	28
3	88	14	12	9	2	27	18	58	2	17	27	1	3	2	0	42
4	118	2	56	12	3	26	25	17	3	13	16	2	4	2	40	56
5	147	15	40	15	4	25	31	37	4	9	5	2	5	3	21	10
6	177	4	24	18	5	24	37	56	5	4	54	3	6	4	1	24
7	206	17	8	21	6	23	44	15	6	0	43	3	7	4	41	38
8	236	5	52	24	7	22	50	35	6	26	32	3	8	5	21	52
9	265	18	36	27	8	21	56	54	7	22	21	4	9	6	2	6
10	295	7	20	30	9	21	3	14	8	18	10	4	10	6	42	20
11	324	20	4	33	10	20	9	33	9	13	59	5	11	7	22	34
12	354	8	48	36	11	19	15	55	10	9	48	5	0	8	2	47
13	383	21	32	49	0	18	22	12	11	5	37	6	1	8	43	1
½	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7

TABLE IV. *The Days of the Year, reckoned from the beginning of March.*

Days	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1	1	32	62	93	123	154	185	215	246	276	307	338
2	2	33	63	94	124	155	186	216	247	277	308	339
3	3	34	64	95	125	156	187	217	248	278	309	340
4	4	35	65	96	126	157	188	218	249	279	310	341
5	5	36	66	97	127	158	189	219	250	280	311	342
6	6	37	67	98	128	159	190	220	251	281	312	343
7	7	38	68	99	129	160	191	221	252	282	313	344
8	8	39	69	100	130	161	192	222	253	283	314	345
9	9	40	70	101	131	162	193	223	254	284	315	346
10	10	41	71	102	132	163	194	224	255	285	316	347
11	11	42	72	103	133	164	195	225	256	286	317	348
12	12	43	73	104	134	165	196	226	257	287	318	349
13	13	44	74	105	135	166	197	227	258	288	319	350
14	14	45	75	106	136	167	198	228	259	289	320	351
15	15	46	76	107	137	168	199	229	260	290	321	352
16	16	47	77	108	138	169	200	230	261	291	322	353
17	17	48	78	109	139	170	201	231	262	292	323	354
18	18	49	79	110	140	171	202	232	263	293	324	355
19	19	50	80	111	141	172	203	233	264	294	325	356
20	20	51	81	112	142	173	204	234	265	295	326	357
21	21	52	82	113	143	174	205	235	266	296	327	358
22	22	53	83	114	144	175	206	236	267	297	328	359
23	23	54	84	115	145	176	207	237	268	298	329	360
24	24	55	85	116	146	177	208	238	269	299	330	361
25	25	56	86	117	147	178	209	239	270	300	331	362
26	26	57	87	118	148	179	210	240	271	301	332	363
27	27	58	88	119	149	180	211	241	272	302	333	364
28	28	59	89	120	150	181	212	242	273	303	334	365
29	29	60	90	121	151	182	213	243	274	304	335	366
30	30	61	91	122	152	183	214	244	275	305	336	
31	31		92		153	184		245		306	337	

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TABLE V. *Mean Lunations from* 1 *to* 100000.

Lunat.	Days. Decimal Parts.	Days.	H.	M.	S.	Th.	Fo.
1	29.53059085108o =	29	12	44	3	2	58
2	59.061181702160	59	1	28	6	5	57
3	88.591772553240	88	14	12	9	8	55
4	118.122363404320	118	2	56	12	11	53
5	147.652954255401	147	15	40	15	14	52
6	177.183545106481	177	4	24	18	17	50
7	206.714135957561	206	17	8	21	20	48
8	236.244726808641	236	5	52	24	23	47
9	265.775317659722	265	18	36	27	26	45
10	295.305908510800	295	7	20	30	29	43
20	590.611817021600	590	14	41	0	59	26
30	885.917725532400	885	22	1	31	29	10
40	1181.223634043200	1181	5	22	1	58	53
50	1476.529542554010	1476	12	42	32	28	36
60	1771.835451064810	1771	20	3	2	58	19
70	2067.141359575610	2067	3	23	33	28	2
80	2362.447268086410	2362	10	44	3	57	46
90	2657.753176597220	2657	18	4	34	27	29
100	2953.059085108000	2953	1	25	4	57	12
200	5906.118170216000	5906	2	50	9	54	24
300	8859.177255324000	8859	4	15	14	51	36
400	11812.236340432000	11812	5	40	19	48	48
500	14765.295425540100	14765	7	5	24	46	0
600	17718.354510648100	17718	8	30	29	43	12
700	20671.413595756100	20671	9	55	34	40	24
800	23624.472680864100	23624	11	20	39	37	36
900	26577.531765972200	26577	12	45	44	34	48
1000	29530.590851080000	29530	14	10	49	32	0
2000	59061.181702160000	59061	4	21	39	4	0
3000	88591.772553240000	88591	18	32	28	36	0
4000	118122.363404320000	118122	8	43	18	8	0
5000	147652.954255401000	147652	22	54	7	40	0
6000	177183.545106481000	177183	13	4	57	12	0
7000	206714.135957561000	206714	3	15	46	44	0
8000	236244.726808641000	236244	17	26	36	16	0
9000	265775.317659722000	265775	7	37	25	48	0
10000	295305.908510800000	295305	21	48	15	20	0
20000	590611.817021600000	590611	19	36	30	40	0
30000	885917.725532400000	885917	17	24	46	0	0
40000	1181223.634043200000	1181223	15	13	1	20	0
50000	1476529.542554010000	1476529	13	1	16	40	0
60000	1771835.451064810000	1771835	10	49	32	0	0
70000	2067141.359575610000	2067141	8	37	47	20	0
80000	2362447.268086410000	2362447	6	25	2	40	0
90000	2657753.176597220000	2657753	4	14	18	0	0
100000	2953059.085108000000	2953059	2	2	33	20	0

TABLE VI. *The first mean New Moon, with the mean Anomalies of the Sun and Moon, and the Sun's mean Distance from the Ascending Node, next after complete Centuries of Julian Years.*

Lunations.	Julian Years.	First New Moon.				Sun's mean Anomaly.			M's mean Anomaly.			Sun from Node.		
		D.	H.	M.	S.	s	°	′	s	°	′	s	°	′
1237	100	4	8	10	52	0	3	21	8	15	22	4	19	27
2474	200	8	16	21	44	0	6	42	5	0	44	9	8	55
3711	300	13	0	32	37	0	10	3	1	16	6	1	28	22
4948	400	17	8	43	29	0	13	24	10	1	28	6	17	49
6185	500	21	16	54	21	0	16	46	6	16	50	11	7	16
7422	600	26	1	5	14	0	20	7	2	2	12	3	26	44
8658	700	0	20	32	3	11	24	22	10	21	45	7	15	31
9895	800	5	4	42	55	11	27	43	7	7	7	0	4	58
11132	900	9	12	53	47	0	1	4	3	22	29	4	24	25
12369	1000	13	21	4	40	0	4	25	0	7	51	9	13	53
13606	1100	18	5	15	32	0	7	46	8	23	53	2	3	20
14843	1200	22	13	26	24	0	11	7	5	8	35	6	22	47
16080	1300	26	21	37	16	0	14	28	1	23	57	11	12	15
17316	1400	1	17	4	6	11	18	43	9	13	30	3	1	2
18553	1500	6	1	14	58	11	22	4	5	28	52	7	20	29
19790	1600	10	9	25	50	11	25	25	2	14	14	0	9	56
21072	1700	14	17	36	42	11	28	46	10	29	36	4	29	23
22264	1800	19	1	47	35	0	2	8	7	14	58	9	18	51
23501	1900	23	9	58	27	0	5	29	4	0	20	2	8	18
24738	2000	27	18	9	19	0	8	50	0	15	42	6	27	45
25974	2100	2	13	36	8	11	13	5	8	5	15	10	16	32
27211	2200	6	21	47	1	11	16	26	4	20	37	3	6	0
28448	2300	11	5	57	53	11	19	47	1	5	59	7	25	27
29685	2400	15	14	8	45	11	23	8	9	21	21	0	14	54
30922	2500	19	22	19	38	11	26	29	6	6	43	5	4	22
32159	2600	24	6	30	30	11	29	50	2	22	4	9	23	49
33396	2700	28	14	41	22	0	3	11	11	7	26	2	13	16
34632	2800	3	10	8	11	11	7	26	6	26	59	6	2	3
35869	2900	7	18	19	3	11	10	47	3	12	21	10	21	30
37106	3000	12	2	29	56	11	14	8	11	27	43	3	10	58
38343	3100	16	10	40	48	11	17	30	8	13	5	8	0	25
39580	3200	20	18	51	40	11	20	51	4	28	27	0	19	52
40817	3300	25	3	2	33	11	24	12	1	13	49	5	9	20
42054	3400	29	11	13	25	11	27	33	9	29	11	9	28	47
43290	3500	4	6	40	14	11	1	48	5	18	44	1	17	34
44527	3600	8	14	51	6	11	5	9	2	4	6	6	7	1
45764	3700	12	23	1	59	11	8	30	10	19	28	10	26	27
47001	3800	17	7	12	51	11	11	51	7	4	50	2	15	56
48238	3900	21	15	23	43	11	15	12	3	20	12	8	5	23
49475	4000	25	23	34	35	11	18	33	0	5	34	0	24	50
50711	4100	0	19	1	25	10	22	48	7	25	7	4	13	37
51948	4200	5	3	12	17	10	26	9	4	10	29	9	3	5
53185	4300	9	11	23	9	10	29	31	0	25	51	1	22	32
54422	4400	13	19	34	1	11	2	52	9	11	13	6	11	59
55659	4500	18	3	44	54	11	6	13	5	26	35	11	1	27
56896	4600	22	11	55	46	11	9	34	2	11	57	3	20	54
58133	4700	26	20	6	38	11	12	55	10	27	19	8	10	21
59369	4800	1	15	33	27	10	17	9	6	16	52	11	29	8
60606	4900	5	23	44	20	10	20	31	3	2	14	4	18	36
61843	5000	10	7	55	12	10	23	52	11	17	36	9	8	3
63080	5100	14	16	6	4	10	27	13	8	2	58	1	27	30
64317	5200	19	0	16	56	11	0	34	4	18	20	6	16	57
65554	5300	23	8	27	49	11	3	55	1	3	42	11	6	25
66791	5400	27	16	38	41	11	7	16	9	19	4	2	25	52
68028	5500	2	12	5	30	10	11	31	5	8	37	7	14	39
69265	5600	6	20	16	22	10	14	52	1	23	59	0	4	6
70502	5700	11	4	27	13	10	18	14	10	9	21	4	23	34
71739	5800	15	12	38	7	10	21	35	6	24	43	9	13	1
72976	5900	19	20	48	59	10	24	56	3	10	5	2	2	28
74212	6000	24	4	59	52	10	28	17	11	25	27	6	21	57

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TABLE VII. *The annual or first Equation of the mean to the true Sizygy.*

Argument. Sun's mean Anomaly.

Subtract.

Degrees	0 Signs. H. M. S	1 Sign H. M. S.	2 Signs H. M. S.	3 Signs H. M. S.	4 Signs H. M. S.	5 Signs H. M. S.	Degrees
0	0 0 0	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	30
1	0 4 18	2 6 55	3 37 10	4 10 57	3 37 19	2 3 55	29
2	0 8 35	2 10 36	3 39 18	4 10 55	3 35 6	2 0 1	28
3	0 12 51	2 14 15	3 31 23	4 10 49	3 32 50	1 56 5	27
4	0 17 8	2 17 52	3 43 26	4 10 39	3 30 30	1 52 6	26
5	0 21 24	2 21 27	3 45 25	4 10 24	3 28 5	1 48 4	25
6	0 25 39	2 25 9	3 47 19	4 10 4	3 25 35	1 41 1	24
7	0 28 55	2 28 29	3 49 7	4 9 39	3 23 0	1 39 56	23
8	0 34 11	2 31 57	3 50 50	4 9 10	3 20 20	1 35 49	22
9	0 38 26	2 35 22	3 52 29	4 8 37	3 17 35	1 31 41	21
10	0 42 39	2 38 44	3 54 4	4 7 59	3 14 49	1 27 31	20
11	0 46 52	2 42 3	3 55 35	4 7 16	3 11 59	1 23 19	19
12	0 51 4	2 45 18	3 57 2	4 6 29	3 9 6	1 19 5	18
13	0 55 17	2 48 30	3 58 27	4 5 37	3 6 10	1 14 49	17
14	0 59 27	2 51 40	3 59 49	4 4 41	3 3 10	1 10 32	16
15	1 3 36	2 54 48	3 1 7	4 3 40	3 0 7	1 6 15	15
16	1 7 45	2 57 53	4 2 18	4 2 35	2 57 0	1 1 56	14
17	1 11 53	3 0 54	4 3 23	4 1 26	2 53 49	0 57 36	13
18	1 16 0	3 3 51	4 4 22	4 0 12	2 50 36	0 53 15	12
19	1 20 6	3 6 45	4 5 18	3 58 52	2 47 18	0 48 52	11
20	1 24 10	3 9 36	4 6 10	3 57 27	2 43 57	0 44 28	10
21	1 28 12	3 12 24	4 6 58	3 55 59	2 40 33	0 40 2	9
22	1 32 12	3 15 9	4 7 41	3 54 26	2 37 6	0 35 36	8
23	1 36 10	3 17 51	4 8 21	3 52 49	2 33 35	0 31 10	7
24	1 40 6	3 20 30	4 8 57	3 51 9	2 30 2	0 26 44	6
25	1 44 1	3 23 5	4 9 29	3 49 26	2 26 26	0 22 17	5
26	1 47 54	3 25 36	4 9 55	3 47 38	2 22 47	0 17 50	4
27	1 51 46	3 28 3	4 10 16	3 45 44	2 19 5	0 13 23	3
28	1 55 37	3 30 26	4 10 33	3 43 45	2 15 20	0 8 56	2
29	1 59 26	3 32 45	4 10 45	3 41 40	2 11 35	0 4 29	1
30	2 0 12	3 35 0	4 10 53	3 39 30	2 7 45	0 0 0	0
Deg.	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	Deg.

Add

TABLE VIII. *Equation of the Moon's mean Anomaly.*

Argument. Sun's mean Anomaly.

Subtract.

Degrees	0 Signs ° ′ ″	1 Sign ° ′ ″	2 Signs ° ′ ″	3 Signs ° ′ ″	4 Signs ° ′ ″	5 Signs ° ′ ″	Degrees
0	0 0 0	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	30
1	0 1 37	0 48 10	1 22 21	1 35 2	1 22 14	0 46 51	29
2	0 3 13	0 49 34	1 23 10	1 35 1	1 21 24	0 45 23	28
3	0 4 52	0 50 53	1 23 57	1 35 0	1 20 32	0 43 54	27
4	0 6 28	0 52 19	1 24 41	1 34 57	1 19 38	0 42 24	26
5	0 8 6	0 53 40	1 25 24	1 34 50	1 18 42	0 40 53	25
6	0 9 42	0 55 0	1 26 6	1 34 43	1 17 45	0 39 21	24
7	0 11 20	0 56 21	1 26 48	1 34 33	1 16 48	0 37 49	23
8	0 12 56	0 57 38	1 27 28	1 34 22	1 15 47	0 36 15	22
9	0 14 33	0 58 56	1 28 6	1 34 9	1 14 44	0 34 40	21
10	0 16 10	1 0 13	1 28 43	1 33 53	1 13 41	0 33 5	20
11	0 17 47	1 1 29	1 29 17	1 33 37	1 12 37	0 31 31	19
12	0 19 23	1 2 43	1 29 51	1 33 20	1 11 33	0 29 54	18
13	0 20 59	1 3 56	1 30 22	1 33 0	1 10 26	0 28 18	17
14	0 22 35	1 5 8	1 30 50	1 32 38	1 9 17	0 26 40	16
15	0 24 10	1 6 18	1 31 19	1 32 14	1 8 8	0 25 3	15
16	0 25 45	1 7 27	1 31 45	1 31 50	1 6 58	0 23 23	14
17	0 27 19	1 8 36	1 32 12	1 31 23	1 5 46	0 21 45	13
18	0 28 52	1 9 42	1 32 34	1 30 55	1 4 32	0 20 7	12
19	0 30 25	1 10 49	1 32 57	1 30 25	1 3 19	0 18 28	11
20	0 31 57	1 11 54	1 33 17	1 29 54	1 2 1	0 16 48	10
21	0 33 29	1 12 58	1 33 36	1 29 20	1 0 45	0 15	9
22	0 35 2	1 14 1	1 33 52	1 28 45	0 59 26	0 13 28	8
23	0 36 32	1 15 1	1 34 6	1 28 9	0 58 7	0 11 48	7
24	0 38 1	1 16 0	1 34 18	1 27 30	0 56 45	0 10 7	6
25	0 39 29	1 16 59	1 34 30	1 26 50	0 55 23	0 8 20	5
26	0 40 59	1 17 57	1 34 40	1 26 27	0 54 1	0 6 44	4
27	0 42 26	1 18 52	1 34 48	1 25 5	0 52 37	0 5 3	3
28	0 43 54	1 19 47	1 34 54	1 24 39	0 51 12	0 3 21	2
29	0 45 19	1 20 40	1 34 58	1 23 52	0 49 45	0 1 40	1
30	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	0 0 0	0
Deg.	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	Deg.

Add

TABLE IX. *The second Equation of the mean to the true Sizygy.*

Argument. Moon's equated Anomaly.

Add

Degrees.	0 Signs H. M. S.	1 Sign H. M. S.	2 Signs H. M. S.	3 Signs H. M. S.	4 Signs H. M. S.	5 Signs H. M. S.	Degrees
0	0 0 0	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	30
1	0 10 58	5 21 56	8 51 45	9 45 3	8 3 12	4 26 1	29
2	0 21 56	5 30 57	8 56 10	9 45 12	7 57 23	4 17 25	28
3	0 32 54	5 39 51	9 0 25	9 44 11	7 51 33	4 8 47	27
4	0 43 52	5 48 37	9 4 31	9 42 59	7 45 46	4 0 7	26
5	0 54 50	5 57 17	9 8 25	9 41 36	7 39 46	3 51 23	25
6	1 5 48	6 5 51	9 12 9	9 40 3	7 33 36	3 42 32	24
7	1 16 46	6 14 19	9 15 43	9 38 19	7 27 22	3 33 38	23
8	1 27 44	6 22 41	9 19 5	9 36 24	7 21 2	3 24 42	22
9	1 38 40	6 30 57	9 22 14	9 34 18	7 14 30	3 15 44	21
10	1 49 33	6 39 4	9 25 12	9 32 1	7 7 50	3 6 45	20
11	2 0 23	6 47 0	9 27 54	9 29 33	7 1 2	2 57 43	19
12	2 11 10	6 54 46	9 30 32	9 26 54	6 54 8	2 48 39	18
13	2 21 54	7 2 24	9 32 58	9 24 4	6 47 9	2 39 34	17
14	2 32 34	7 9 52	9 35 14	9 21 3	6 40 6	2 30 28	16
15	2 43 9	7 17 9	9 37 12	9 17 51	6 32 56	2 21 19	15

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TABLE IX. *Concluded.*

Deg.	0 Signs H.	M.	S.	1 Sign H.	M.	S.	2 Signs H.	M.	S.	3 Signs H.	M.	S.	4 Signs H.	M.	S.	5 Signs H.	M.	S.	Degrees
0	0	0	0	5	12	48	8	47	8	9	46	44	8	8	59	4	34	33	30
16	2	53	38	7	24	19	9	39	8	9	14	28	6	25	40	2	12	8	14
17	3	4	3	7	31	18	9	40	51	9	10	54	6	18	18	2	2	53	13
18	3	14	24	7	38	9	9	42	21	9	7	9	6	10	49	1	53	36	12
19	3	24	42	7	44	51	9	43	42	9	3	13	6	3	16	1	44	16	11
20	3	34	58	7	51	24	9	44	53	8	59	6	5	55	38	1	34	54	10
21	3	45	11	7	57	45	9	45	52	8	54	50	5	47	54	1	25	31	9
22	3	55	21	8	3	56	9	46	38	8	50	24	5	40	4	1	16	7	8
23	4	5	26	8	9	57	9	47	13	8	45	48	5	32	9	1	6	41	7
24	4	15	26	8	15	46	9	47	36	8	41	2	5	24	9	0	57	43	6
25	4	25	20	8	21	24	9	47	49	8	36	6	5	16	5	0	47	44	5
26	4	35	6	8	26	53	9	47	54	8	31	0	5	7	56	0	38	13	4
27	4	44	42	8	32	11	9	47	46	8	25	44	5	49	42	0	28	41	3
28	5	54	11	8	37	19	9	47	33	8	20	18	4	51	15	0	19	8	2
29	5	3	33	8	42	18	9	47	14	8	14	33	4	43	2	0	9	34	1
30	5	12	48	8	47	8	9	46	44	8	8	59	4	34	33	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

TABLE X. *The third equation of the mean to the true Syzygy.*

Argument. Sun's Anomaly—Moon's Anomaly.

Degrees	Signs 0 Sub. 6 Add. M.	S.	Signs 1 Sub. 7 Add. M.	S.	Signs 2 Sub. 8 Add. M.	S.	Degrees
0	0	0	2	22	4	12	30
1	0	5	2	26	4	15	29
2	0	10	2	30	4	18	28
3	0	15	2	34	4	21	27
4	0	20	2	38	4	24	26
5	0	25	2	42	4	27	25
6	0	30	2	46	4	30	24
7	0	35	2	50	4	32	23
8	0	40	2	54	4	34	22
9	0	45	2	58	4	36	21
10	0	50	3	2	4	38	20
11	0	55	3	6	4	40	19
12	1	0	3	10	4	42	18
13	1	5	3	14	4	44	17
14	1	10	3	18	4	46	16
15	1	15	3	22	4	48	15
16	1	20	3	26	4	50	14
17	1	25	3	30	4	51	13
18	1	30	3	34	4	52	12
19	1	35	3	38	4	53	11
20	1	40	3	42	4	54	10
21	1	45	3	45	4	55	9
22	1	49	3	48	4	56	8
23	1	52	3	51	4	57	7
24	1	56	3	54	4	57	6
25	2	0	3	57	4	57	5
26	2	4	4	0	4	58	4
27	2	9	4	3	4	58	3
28	2	13	4	6	4	58	2
29	2	18	4	9	4	58	1
30	2	22	4	12	4	58	0
Degrees	Signs 5 Sub. 11 Add		Signs 4 Sub. 10 Add		Signs 3 Sub. 9 Add		Degrees

TAB. XI. *The fourth equation of the mean to the true Syzygy.*

Argument. Sun's mean distance from the Node.

Add

Degrees	0, 6 Sig. M.	S.	1, 7 Sig. M.	S.	2, 8 Sig. M.	S.	Degrees
0	0	0	1	22	1	22	30
1	0	4	1	23	1	21	29
2	0	7	1	24	1	20	28
3	0	10	1	25	1	18	27
4	0	13	1	26	1	16	26
5	0	16	1	27	1	14	25
6	0	20	1	28	1	12	24
7	0	23	1	29	1	10	23
8	0	26	1	30	1	8	22
9	0	29	1	31	1	6	21
10	0	32	1	32	1	3	20
11	0	35	1	33	1	0	19
12	0	38	1	33	0	57	18
13	0	41	1	34	0	54	17
14	0	44	1	34	0	51	16
15	0	47	1	34	0	49	15
16	0	50	1	34	0	45	14
17	0	52	1	34	0	41	13
18	0	54	1	34	0	37	12
19	0	57	1	33	0	34	11
20	1	0	1	33	0	31	10
21	1	2	1	32	0	28	9
22	1	5	1	31	0	25	8
23	1	8	1	30	0	22	7
24	1	10	1	29	0	19	6
25	1	12	1	28	0	16	5
26	1	14	1	27	0	13	4
27	1	16	1	26	0	10	3
28	1	18	1	25	0	6	2
29	1	20	1	24	0	3	1
30	1	22	1	22	0	0	0
Deg.	5, 11 Sig.		4, 10 Sig.		3, 9 Sig.		Deg.

Subtract.

TABLE XII. *The Sun's mean Longitude, Motion, and Anomaly, Old Style.*

Years beginning	Sun's mean Longitude. s	°	′	″	Sun's mean Anomaly. s	°	′
1	9	7	53	10	6	28	48
201	9	9	23	50	6	26	57
301	9	10	9	10	6	26	1
401	9	10	54	30	6	25	5
501	9	15	39	50	6	24	9
1001	9	15	26	30	6	19	32
1101	9	16	11	50	6	18	36
1201	9	16	57	10	6	17	40
1301	9	17	42	30	6	16	44
1401	9	18	27	50	6	15	49
1501	9	19	13	10	6	14	53
1601	9	19	58	30	6	13	57
1701	9	20	43	50	6	13	1
1801	9	21	29	10	6	12	6

Years complete	Sun's mean Motion. s	°	′	″	Sun's mean Anomaly. s	°	′
1	11	29	45	40	11	29	45
2	11	29	31	20	11	29	29
3	11	29	17	0	11	29	14
4	0	0	1	49	11	29	58
5	11	29	47	29	11	29	42
6	11	29	33	9	11	29	27
7	11	29	18	49	11	29	11
8	0	0	3	38	11	29	55
9	11	29	49	18	11	29	40
10	11	29	34	58	11	29	24
11	11	29	20	38	11	29	9
12	0	0	5	26	11	29	53
13	11	29	51	7	11	29	37
14	11	29	36	47	11	29	22
15	11	29	22	25	11	29	7
16	0	0	7	15	11	29	50
17	11	29	52	55	11	29	35
18	11	29	38	35	11	29	20
19	10	29	24	16	11	29	4
20	0	0	9	4	11	29	48
40	0	0	18	8	11	29	37
60	0	0	27	12	11	29	26
80	0	0	36	16	11	29	15
100	0	0	45	20	11	29	4
200	0	1	30	40	11	28	8
300	0	2	16	0	11	27	12
400	0	3	1	20	11	26	16
500	0	3	46	40	11	25	21
600	0	4	32	0	11	24	25
700	0	5	17	20	11	23	29
800	0	6	2	40	11	22	33
900	0	6	48	0	11	21	37
1000	0	7	33	20	11	20	41
2000	0	15	6	40	11	11	22
3000	0	22	40	0	11	2	3
4000	1	0	13	20	10	22	44
5000	1	7	46	40	10	13	25
6000	1	15	20	0	10	4	6

Months.	Sun's mean Motion. s	°	′	″	Sun's mean Anomaly. s	°	′
Jan.	0	0	0	0	0	0	0
Feb.	1	0	33	18	1	0	33
Mar.	1	28	9	11	1	28	9
Apr.	2	28	42	30	2	28	42
May	3	28	16	40	3	28	17
June	4	28	49	50	4	28	50
July	5	28	24	,8	5	28	24
Aug.	6	28	57	26	6	28	57
Sept.	7	29	30	44	7	29	30
Oct.	8	29	4	54	8	29	4
Nov.	9	29	38	12	9	29	37
Dec.	10	29	12	22	10	29	11

Days.	Sun's mean Motion and Anomaly. s	°	′	″	H M S	Sun's mean Motion and Anomaly. ° ′ ″	′ ″ ‴	″ ‴ ⁗	Sun's mean dist. from the Node. ° ′ ″	′ ″ ‴	″ ‴ ⁗	H M S	Sun's mean Motion and Anomaly. ° ′ ″	′ ″ ‴	″ ‴ ⁗	Sun's mean dist. from the Node. ° ′ ″	′ ″ ‴	″ ‴ ⁗
1	0	0	59	8														
2	0	1	58	17	1	0	2	28	0	2	36	31	1	16	23	1	20	30
3	0	2	57	25	2	0	4	56	0	5	12	32	1	18	51	1	23	6
4	0	3	56	33	3	0	7	24	0	7	48	33	1	21	19	1	25	42
5	0	4	55	42	4	0	9	51	0	10	39	34	1	23	57	1	28	18
6	0	5	54	50	5	0	12	19	0	12	59	35	1	26	15	1	30	54
7	0	6	53	58	6	0	14	47	0	15	35	36	1	28	42	1	33	29
8	0	7	53	7	7	0	17	15	0	18	11	37	1	31	10	1	36	5
9	0	8	52	15	8	0	19	43	0	20	47	38	1	33	38	1	38	40
10	0	9	51	23	9	0	22	11	0	23	23	39	1	36	6	1	41	16
11	0	10	50	32	10	0	24	38	0	25	58	40	1	38	34	1	43	52
12	0	11	49	40	11	0	27	6	0	28	34	41	1	41	2	1	46	28
13	0	12	48	48	12	0	29	34	0	31	10	42	1	43	30	1	49	4
14	0	13	47	57	13	0	32	2	0	33	45	43	1	45	57	1	51	39
15	0	14	47	5	14	0	34	30	0	36	21	44	1	48	25	1	54	15
16	0	15	46	13	15	0	36	58	0	38	57	45	1	50	53	1	55	51
17	0	16	45	22	16	0	39	26	0	41	33	46	1	53	21	1	59	27
18	0	17	44	30	17	0	41	53	0	44	8	47	1	55	49	2	2	3
19	0	18	43	38	18	0	44	21	0	46	44	48	1	58	17	2	4	39
20	0	19	42	47	19	0	46	49	0	49	20	49	2	0	44	2	7	13
21	0	20	41	55	20	0	49	17	0	51	56	50	2	3	12	2	9	50
22	0	21	41	3	21	0	51	45	0	54	32	51	2	5	40	2	12	25
23	0	22	40	12	22	0	54	13	0	57	8	52	2	8	8	2	15	2
24	0	23	39	20	23	0	56	40	0	59	43	53	2	10	36	2	17	38
25	0	24	38	28	24	0	59	8	1	2	19	54	2	13	4	2	20	14
26	0	25	37	45	25	1	1	36	1	4	55	55	2	15	32	2	22	50
27	0	26	36	37	26	1	4	4	1	7	31	56	2	17	59	2	25	26
28	0	27	35	53	27	1	6	32	1	10	7	57	2	20	27	2	28	2
29	0	28	35	2	28	1	9	0	1	12	43	58	2	22	55	2	30	38
30	0	29	34	10	29	1	11	28	1	15	19	59	2	25	23	2	33	14
31	1	0	33	18	30	1	13	55	1	17	45	60	2	27	51	2	35	50

In Leap years, after February, add one day, and one day's motion.

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TABLE XIII. *Equation of the Sun's centre, or the difference between his mean and true place.*

Argument. Sun's mean Anomaly.

Subtract

Degrees	0 Signs °	′	″	1 Sign °	′	″	2 Signs °	′	″	3 Signs °	′	″	4 Signs °	′	″	5 Signs °	′	″	Degrees
0	0	0	0	0	56	47	1	39	6	1	55	37	1	41	12	0	58	33	30
1	0	1	59	0	58	30	1	40	7	1	55	39	1	40	12	0	57	7	29
2	0	3	57	1	0	12	1	41	6	1	55	38	1	39	10	0	55	19	28
3	0	5	56	1	1	53	1	42	3	1	55	36	1	38	6	0	53	30	27
4	0	7	54	1	3	33	1	42	59	1	55	31	1	37	0	0	51	40	26
5	0	9	52	1	5	12	1	43	52	1	55	24	1	35	52	0	49	49	25
6	0	11	50	1	6	50	1	44	44	1	55	15	1	34	43	0	47	57	24
7	0	13	48	1	8	27	1	45	34	1	55	3	1	33	32	0	46	5	23
8	0	15	46	1	10	2	1	46	22	1	54	50	1	32	19	0	44	11	22
9	0	17	43	1	11	36	1	47	8	1	54	35	1	31	4	0	42	16	21
10	0	19	40	1	13	9	1	47	53	1	54	17	1	29	47	0	41	21	20
11	0	21	37	1	14	41	1	48	35	1	53	57	1	28	29	0	38	25	19
12	0	23	33	1	16	11	1	49	15	1	53	36	1	27	9	0	36	28	18
13	0	25	29	1	17	40	1	49	54	1	53	12	1	25	48	0	34	30	17
14	0	27	25	1	19	8	1	50	30	1	52	46	1	24	25	0	32	32	16
15	0	29	20	1	20	34	1	51	5	1	52	18	1	23	0	0	30	33	15
16	0	31	15	1	21	59	1	51	37	1	51	48	1	21	34	0	28	33	14
17	0	33	9	1	23	22	1	52	8	1	51	15	1	20	6	0	26	33	13
18	0	35	2	1	24	44	1	52	36	1	50	41	1	18	36	0	24	33	12
19	0	36	55	1	26	5	1	53	3	1	50	5	1	17	5	0	22	32	11
20	0	38	47	1	27	24	1	53	27	1	49	26	1	15	33	0	20	30	10
21	0	40	39	1	28	41	1	53	51	1	48	46	1	13	59	0	18	28	9
22	0	42	30	1	29	57	1	54	10	1	48	3	1	12	24	0	16	26	8
23	0	44	20	1	31	11	1	54	28	1	47	19	1	10	47	0	14	24	7
24	0	46	9	1	32	25	1	54	44	1	46	12	1	9	9	0	12	21	6
25	0	47	57	1	33	35	1	54	58	1	45	44	1	7	29	0	10	18	5
26	0	49	45	1	34	45	1	55	10	1	44	53	1	5	49	0	8	14	4
27	0	51	32	1	35	53	1	55	20	1	44	1	1	4	7	0	6	11	3
28	0	53	18	1	36	59	1	55	28	1	43	7	1	2	24	0	4	7	2
29	0	55	3	1	38	3	1	55	34	1	42	10	1	0	39	0	2	4	1
30	0	56	47	1	39	6	1	55	37	1	41	12	0	58	53	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

Add

TABLE XIV. *The Sun's Declination.*

Argument. Sun's true place.

Degrees	Signs 0 / 6 °	N. / S. ′	Signs 1 / 7 °	N. / S. ′	Signs 2 / 8 °	N. / S. ′	Degrees	Degrees	Signs 0 / 6 °	N. / S. ′	Signs 1 / 7 °	N. / S. ′	Signs 2 / 8 °	N. / S. ′	Degrees
0	0	0	11	30	20	11	30	0	0	0	11	30	20	11	30
1	0	24	11	51	20	24	29	16	6	18	16	39	22	46	14
2	0	48	12	11	20	36	28	17	6	41	16	57	22	51	13
3	1	12	12	32	20	48	27	18	7	4	17	14	22	56	12
4	1	36	12	53	20	59	26	19	7	27	17	30	23	2	11
5	1	59	13	13	21	10	25	20	7	50	17	46	23	6	10
6	2	23	13	33	21	21	24	21	8	13	18	2	23	11	9
7	2	47	13	53	21	31	23	22	8	35	18	18	23	14	8
8	3	11	14	12	21	41	22	23	9	57	18	33	23	18	7
9	3	34	14	31	21	50	21	24	9	20	18	48	23	21	6
10	3	58	14	50	21	59	20	25	9	42	19	3	23	23	5
11	4	22	15	9	22	8	19	26	10	4	19	17	23	25	4
12	4	45	15	28	22	16	18	27	10	25	19	31	23	27	3
13	5	9	15	46	22	24	17	28	10	47	19	45	23	28	2
14	5	32	16	4	22	31	16	29	11	8	19	58	23	29	1
15	5	5	16	22	22	38	15	30	11	30	20	11	23	29	0
Degr.	Signs 11	S.	Signs 10	S.	Signs 9	S.	Degr.	Degr.	Signs 11	S.	Signs 10	S.	Signs 9	S.	Degr.

TABLE XV. *Equation of the Sun's mean Distance from the Node.*

Argument. Sun's mean Anomaly.

Subtract

Deg.	0 Signs °	′	1 Sign °	′	2 Signs °	′	3 Signs °	′	4 Signs °	′	5 Signs °	′	Deg.
0	0	0	1	2	1	47	2	5	1	50	1	4	30
1	0	2	1	4	1	48	2	5	1	48	1	2	29
2	0	4	1	6	1	49	2	5	1	47	1	0	28
3	0	6	1	8	1	50	2	5	1	46	0	58	27
4	0	9	1	10	1	51	2	5	1	45	0	56	26
5	0	11	1	12	1	52	2	5	1	44	0	54	25
6	0	13	1	14	1	53	2	5	1	43	0	52	24
7	0	15	1	16	1	54	2	4	1	41	0	50	23
8	0	17	1	17	1	55	2	4	1	40	0	48	22
9	0	19	1	18	1	56	2	4	1	39	0	46	21
10	0	21	1	19	1	57	2	4	1	37	0	44	20
11	0	23	1	21	1	58	2	3	1	36	0	42	19
12	0	25	1	22	1	58	2	3	1	34	0	40	18
13	0	28	1	24	1	59	2	3	1	33	0	37	17
14	0	30	1	26	2	0	2	2	1	31	0	35	16
15	0	32	1	27	2	0	2	2	1	30	0	33	15
Deg.	11 Signs		10 Signs		9 Signs		8 Signs		7 Signs		6 Signs		Deg.

Deg.	0 Signs °	′	1 Sign °	′	2 Signs °	′	3 Signs °	′	4 Signs °	′
0	0	0	1	2	1	47	2	5	1	50
16	0	34	1	28	2	1	2	1	1	28
17	0	36	1	30	2	1	2	1	1	27
18	0	38	1	31	2	2	2	0	1	25
19	0	40	1	34	2	2	2	0	1	24
20	0	42	1	35	2	3	1	59	1	23
21	0	44	1	36	2	3	1	59	1	21
22	0	46	1	37	2	4	1	58	1	19
23	0	48	1	39	2	4	1	57	1	17
24	0	50	1	40	2	4	1	56	1	15
25	0	52	1	41	2	4	1	55	1	13
26	0	54	1	43	2	5	1	54	1	11
27	0	56	1	44	2	5	1	53	1	9
28	0	58	1	45	2	5	1	52	1	8
29	1	0	1	46	2	5	1	51	1	6
30	1	2	1	47	2	5	1	50	1	4
Deg.	11 Signs		10 Signs		9 Signs		8 Signs		7 Signs	

Add

TABLE XVI. *The Moon's Latitude in Eclipses.*

Arg. Moon's equated Distance from the Node.

0 Signs. *North Ascend.*

6 Signs. *South Descend.*

°	°	′	″	°
0	0	0	0	30
1	0	5	15	29
2	0	10	30	28
3	0	15	45	27
4	0	20	59	26
5	0	26	13	25
6	0	31	26	24
7	0	36	39	23
8	0	41	51	22
9	0	47	2	21
10	0	52	13	20
11	0	57	23	19
12	1	2	31	18
13	1	7	38	17
14	1	12	44	16
15	1	17	49	15
16	1	22	52	14
17	1	27	53	13
18	1	32	52	12
19	1	37	49	11

5 Signs *North Descend.*

11 Signs. *South Ascend.*

This Table shows the Moon's Latitude a little beyond the utmost Limits of Eclipses.

TABLE XVII. *The Moon's horizontal Parallax, the Semidiameters and true Horary Motions of the and Moon, to every sixth degree of their mean An lies, the quantities for the intermediate degrees easily proportioned by sight.*

Anomaly of Sun and Moon. s	°	Moon's horizontal Parallax. ′	″	Sun's Semidiameter. ′	″	Moon's Semidiameter. ′	″	Moon's Horary Motion. ′	″	Sun's Horary Motion. ′	″	of Sun and Moon. s
0	0	54	29	15	50	14	54	30	10	2	23	12
	6	54	31	15	50	14	55	30	12	2	23	
	12	54	34	15	50	14	56	30	15	2	23	
	18	54	40	15	51	14	57	30	19	2	23	
	24	54	47	15	51	14	58	30	26	2	23	
1	0	54	56	15	52	14	59	30	34	2	24	11
	6	55	6	15	53	15	1	30	44	2	24	
	12	55	17	15	54	15	4	30	55	2	24	
	18	55	29	15	55	15	8	31	9	2	24	
	24	55	42	15	56	15	12	31	23	2	25	
2	0	55	56	15	58	15	17	31	40	2	25	10
	6	56	12	15	59	15	22	31	56	2	26	
	12	56	29	16	1	15	26	32	17	2	27	
	18	56	48	16	2	15	30	32	39	2	27	
	24	57	8	16	4	15	36	33	11	2	28	
3	0	57	30	16	6	15	41	33	23	2	28	9
	6	57	52	16	8	15	46	33	47	2	29	
	12	58	12	16	10	15	52	34	11	2	29	
	18	58	31	16	11	15	58	34	34	2	29	
	24	58	49	16	13	16	3	34	58	2	30	
4	0	59	6	16	14	16	9	35	22	2	30	8
	6	59	21	16	15	16	14	35	45	2	31	
	12	59	35	16	17	16	19	36	0	2	31	
	18	59	48	16	19	16	24	36	20	2	32	
	24	60	0	16	20	16	28	36	40	2	32	
5	0	60	11	16	21	16	31	37	0	2	32	7
	6	60	21	16	21	16	32	37	10	2	33	
	12	60	30	16	22	16	37	37	19	2	33	
	18	60	38	16	22	16	38	37	28	2	33	
	24	60	45	16	23	16	39	37	36	2	33	

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Description of Astronomical Instruments.

II. *Description of Astronomical Instruments serving to illustrate the Motions of the Heavenly Bodies.*

427 The orrery. The machine represented by fig. 161. is the GRAND ORRERY, first made in this kingdom by Mr Rowley for King George I. The frame of it, which contains the wheel-work, &c. and regulates the whole machine, is made of ebony, and about four feet in diameter; the outside thereof is adorned with 12 pilasters. Between these the 12 signs of the zodiac are neatly painted with gilded frames. Above the frame is a broad ring supported with 12 pillars. This ring represents the plane of the ecliptic; upon which are two circles of degrees, and between these the names and characters of the 12 signs. Near the outside is a circle of months and days, exactly corresponding to the sun's place at noon each day throughout the year. Above the ecliptic stand some of the principal circles of the sphere, agreeable to their respective situations in the heavens: viz. N° 10. are the two colures, divided into degrees and half degrees; N° 11. is one-half the equinoctial circle, making an angle of 23½ degrees. The tropic of Cancer and the arctic circle are each fixed parallel at their proper distance from the equinoctial. On the northern half of the ecliptic is a brass semicircle, moveable upon two points fixed in ♈ and ♎. This semicircle serves as a moveable horizon to be put to any degree of latitude upon the north part of the meridian, and the whole machine may be set to any latitude without disturbing any of the internal motions, by two strong hinges (N° 13.) fixed to the bottom-frame upon which the instrument moves, and a strong brass arch, having holes at every degree, through which a strong pin is put at every elevation. This arch and the two hinges support the whole machine when it is lifted up according to any latitude: and the arch at other times lies conveniently under the bottom-frame. When the machine is to be set to any latitude (which is easily done by two men, each taking hold of two handles conveniently fixed for the purpose), set the moveable horizon to the same degree upon the meridian, and hence you may form an idea of the respective altitude or depression of the planets both primary and secondary. The sun (N° 1.) stands in the middle of the whole system upon a wire, making an angle with the ecliptic of about 82 degrees. Next the sun is a small ball (2.), representing Mercury. Next to Mercury is Venus (3.), represented by a larger ball. The earth is represented (N° 4.) by an ivory ball, having some circles and a map sketched upon it. The wire which supports the earth makes an angle with the ecliptic of 66½ degrees, the inclination of the earth's axis to the ecliptic. Near the bottom of the earth's axis is a dial-plate (N° 9.), having an index pointing to the hours of the day as the earth turns round its axis. Round the earth is a ring supported by two small pillars, representing the orbit of the moon; and the divisions upon it answer to the moon's latitude. The motion of this ring represents the motion of the moon's orbit according to that of the nodes. Within this ring is the moon (N° 5.), having a black cap or case, by which its motion represents the phases of the moon according to her age. Without the orbits of the earth and moon is Mars (N° 6.). The next in order to Mars is Jupiter and his four moons (N° 7.). Each of these moons is supported by a wire fixed in a socket which turns about the pillar supporting Jupiter. These satellites may be turned by the hand to any position, and yet when the machine is put into motion, they will all move in their proper times. The outermost of all is Saturn, his five moons and his ring (N° 8.). These moons are supported and contrived similar to those of Jupiter. The machine is put into motion by turning a small winch (N° 14.); and the whole system is also moved by this winch, and by pulling out and pushing in a small cylindrical pin above the handle. When it is pushed in, all the planets, both primary and secondary, will move according to their respective periods by turning the handle. When it is drawn out, the motions of the satellites of Jupiter and Saturn will be stopped, while all the rest move without interruption. There is also a brass lamp, having two convex glasses to be put in room of the sun; and also a smaller earth and moon, made somewhat in proportion to their distance from each other, which may be put on at pleasure. The lamp turns round at the same time with the earth, and the glasses of it cast a strong light upon her; and when the smaller earth and moon are placed on, it will be easy to show when either of them will be eclipsed. When this machine is intended to be used, the planets must be duly placed by means of an ephemeris hereafter described; and you may place a small black patch or bit of wafer upon the middle of the sun. Right against the first degree of ♈, you may also place patches upon Venus, Mars, and Jupiter, right against some noted point in the ecliptic. Put in the handle, and push in the pin which is above it. One turn of this handle answers to a revolution of the ball which represents the earth about its axis; and consequently to 24 hours of time, as shown by the hour index (9.), which is marked and placed at the foot of the wire on which the ball of the earth is fixed. Again, when the index has moved the space of ten hours, Jupiter makes one revolution round its axis, and so of the rest. By these means the revolutions of the planets, and their motions round their own axes, will be represented to the eye. By observing the motions of the spots upon the surface of the sun and of the planets in the heavens, their diurnal rotation was first discovered, after the same manner as we in this machine observe the motions of their representatives by that of the marks placed upon them.

The ORRERY (fig. 162.) is a machine contrived by the late ingenious Mr James Ferguson. It shows the motions of the sun, Mercury, Venus, earth, and moon; and occasionally the superior planets, Mars, Jupiter, and Saturn, may be put on. Jupiter's four satellites are moved round him in their proper times by a small winch; and Saturn has his five satellites, and his ring which keeps its parallelism round the sun; and by a lamp put in the sun's place, the ring shows all its various phases already described.

In the centre, N° 1. represents the sun, supported by its axis, inclining almost 8 degrees from the axis of the ecliptic, and turning round in 25¼ days on its axis, of which the north pole inclines toward the eighth degree of Pisces in the great ecliptic (N° 11.), whereon the months and days are engraven over the signs and degrees in which the sun appears, as seen from the earth, on the different days of the year.

The

Description of Astronomical Instruments.

The nearest planet (N° 2.) to the sun is Mercury, which goes round him in 87 days, 23 hours, or $87\frac{2}{7}\frac{1}{3}$ diurnal rotations of the earth; but has no motion round its axis in the machine, because the time of its diurnal motion in the heavens is not known to us.

The next planet in order is Venus (N° 3.), which performs her annual course in 224 days 17 hours, and turns round her axis in 24 days 8 hours, or in $24\frac{1}{3}$ diurnal rotations of the earth. Her axis inclines 75 degrees from the axis of the ecliptic, and her north pole inclines towards the 20th degree of Aquarius, according to the observations of Bianchini. She shows all the phenomena described in Part II.

Next, without the orbit of Venus, is the earth (N° 4.) which turns round its axis, to any fixed point at a great distance, in 23 hours 56 minutes 4 seconds of mean solar time; but from the sun to the sun again, in 24 hours of the same time. N° 6. is a sidereal dial-plate under the earth, and N° 7. a solar dial-plate on the cover of the machine. The index of the former shows sidereal, and of the latter, solar time; and hence the former index gains one entire revolution on the latter every year, as 365 solar or natural days contain 366 sidereal days, or apparent revolutions of the stars. In the time that the earth makes $365\frac{1}{4}$ diurnal rotations on its axis, it goes once round the sun in the plane of the ecliptic; and always keeps opposite to a moving index (N° 10.) which shows the sun's daily change of place, and also the days of the months.

The earth is half covered with a black cap, for dividing the apparently enlightened half next the sun from the other half, which, when turned away from him, is in the dark. The edge of the cap represents the circle bounding light and darkness, and shows at what time the sun rises and sets to all places throughout the year. The earth's axis inclines $23\frac{1}{2}$ degrees from the axis of the ecliptic; the north pole inclines towards the beginning of Cancer, and keeps its parallelism throughout its annual course; so that in summer the northern parts of the earth incline towards the sun, and in winter from him: by which means, the different lengths of days and nights, and the cause of the various seasons, are demonstrated to sight.

There is a broad horizon, to the upper side of which is fixed a meridian semicircle in the north and south points, graduated on both sides from the horizon to 90° in the zenith or vertical point. The edge of the horizon is graduated from the east and west to the south and north points, and within these divisions are the points of the compass. From the lower side of this thin horizontal plate stand out four small wires, to which is fixed a twilight circle 18 degrees from the graduated side of the horizon all round. This horizon may be put upon the earth (when the cap is taken away), and rectified to the latitude of any place; and then by a small wire, called the *solar ray*, which may be put on so as to proceed directly from the sun's centre towards the earth's, but to come no farther than almost to touch the horizon, the beginning of twilight, time of sunrising, with his amplitude, meridian altitude, time of setting, amplitude then, and end of twilight, are shown for every day of the year, at that place to which the horizon is rectified.

The moon (N° 5.) goes round the earth, from between it and any fixed point at a great distance, in 27 days 7 hours 43 minutes, or through all the signs and degrees of her orbit, which is called her *periodical revolution;* but she goes round from the sun to the sun again, or from change to change, in 29 days 12 hours 35 minutes, which is her *synodical revolution;* and in that time she exhibits all the phases already described.

When the above-mentioned horizon is rectified to the latitude of any given place, the times of the moon's rising and setting, together with her amplitude, are shown to that place as well as the sun's; and all the various phenomena of the harvest-moon are made obvious to sight.

The moon's orbit (N° 9.) is inclined to the ecliptic (N° 11.) one half being above, and the other below it. The nodes, or points at o and o, lie in the plane of the ecliptic, as before described, and shift backward through all its sines and degrees in $18\frac{2}{3}$ years. The degrees of the moon's latitude to the highest at NL (north latitude) and lowest at SL (south latitude), are engraven both ways from her nodes at o and o, and as the moon rises and falls in her orbit according to its inclination, her latitude and distance from her nodes are shown for every day, having first rectified her orbit so as to set the nodes to their proper places in the ecliptic; and then as they come about at different and almost opposite times of the year, and then point towards the sun, all the eclipses may be shown for hundreds of years (without any new rectification) by turning the machinery backward for time past, or forward for time to come. At 17 degrees distance from each node, on both sides, is engraved a small sun; and at 12 degrees distance, a small moon which show the limits of solar and lunar eclipses; and when, at any change, the moon falls between either of these suns and the node, the sun will be eclipsed on the day pointed to by the annual index (N° 10); and as the moon has then north or south latitude, one may easily judge whether that eclipse will be visible in the northern or southern hemisphere: especially as the earth's axis inclines toward the sun or from him at that time. And when at any full the moon falls between either of the little moons and node, she will be eclipsed, and the annual index shows the day of that eclipse. There is a circle of $29\frac{1}{2}$ equal parts (N° 8.) on the cover of the machine, on which an index shows the days of the moon's age.

There are two semicircles (fig. 163.) fixed to an elliptical ring, which being put like a cap upon the earth, and the forked part F upon the moon, shows the tides as the earth turns round within them, and they are led round it by the moon. When the different places come to the semicircle A *a* E *b* B, they have tides of flood; and when they come to the semicircle CED, they have tides of ebb; the index on the hour-circle (fig. 162.) showing the times of these phenomena.

There is a jointed wire, of which one end being put into a hole in the upright stem that holds the earth's cap, and the wire laid into a small forked piece which may be occasionally put upon Venus or Mercury, shows the direct and retrograde motions of these two planets, with their stationary times and places as seen from the earth.

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The whole machinery is turned by a winch or handle (N° 12.); and is so easily moved, that a clock might turn it without any danger of stopping.

To give a plate of the wheel-work of this machine would answer no purpose, because many of the wheels lie so behind others as to hide them from sight in any view whatever.

The PLANETARIUM (fig. 164.) is an instrument contrived by Mr William Jones of Holborn, London, mathematical instrument maker, who has paid considerable attention to those sort of machines, in order to reduce them to their greatest degree of simplicity and perfection. It represents in a general manner, by various parts of its machinery, all the motions and phenomena of the planetary system. This machine consists of, the Sun (in the centre), with the planets, Mercury, Venus, the Earth and Moon, Mars, Jupiter and his four moons, Saturn and his five moons; and to it is occasionally applied an extra long arm for the Georgian planet and his two moons. To the earth and moon is applied a frame CD, containing only four wheels and two pinions, which serve to preserve the earth's axis in its proper parallelism in its motion round the sun, and to give the moon her due revolution about the earth at the same time. These wheels are connected with the wheel-work in the round box below, and the wheel is set in motion by the winch H. The arm M that carries round the moon, points out on the plate C her age and phases for any situation in her orbit, and which accordingly are engraved thereon. In the same manner the arm points out her place in the ecliptic B, in signs and degrees, called her geocentric place; that is, as seen from the earth. The moon's orbit is represented by the flat rim A; the two joints of which, and upon which it turns, denoting her nodes. This orbit is made to incline to any desired angle. The earth of this instrument is usually made of a three inch or $1\frac{1}{2}$ globe, papered, &c. for the purpose; and by means of the terminating wire that goes over it, points out the changes of the seasons, and the different lengths of days and nights more conspicuously. This machine is also made to represent the Ptolemaic System, or such as is vulgarly received: which places the earth in the centre, and the planets and sun revolving about it. (It is done by an auxiliary small sun and an earth, which change their places in the instrument). At the same time, it affords a most manifest confutation of it: for it is plainly observed in this construction, (1.) That the planets Mercury and Venus, being both within the orbit of the sun, cannot at any time be seen to go behind it; whereas in nature we observe them as often to go behind as before the sun in the heavens. (2.) It shows, that as the planets move in circular orbits about the central earth, they ought at all times to be of the same apparent magnitudes; whereas, on the contrary, we observe their apparent magnitude in the heavens to be very variable, and so far different, that, for instance, Mars will sometimes appear as big as Jupiter nearly, and at other times you will scarcely know him from a fixed star. (3.) It shows that any of the planets might be seen at all distances from the sun in the heavens; or, in other words, that when the sun is setting, Mercury or Venus may be seen not only in the south but even in the east; which circumstances were never yet observed. (4.) You see by this planetarium that the motions of the planets should always be regular and uniformly the same; whereas, on the contrary, we observe them always to move with a variable velocity, sometimes faster, then slower, and sometimes not at all, as will be presently shown. (5.) By the machine you see the planets move all the same way, viz. from west to east continually: but in the heavens we see them move sometimes direct from west to east, sometimes retrograde from east to west, and at other times to be stationary. All which phenomena plainly prove this system to be a false and absurd hypothesis.

The truth of the Copernican or Solar System of the world is hereby most clearly represented. For taking the earth from the *centre*, and placing thereon the usual large brass ball for the sun, and restoring the earth to its proper situation among the planets, then every thing will be right, and agree exactly with celestial observations. For turning the winch H, (1.) You will see the planets Mercury and Venus go both before and behind the sun, or have two conjunctions. (2.) You will observe Mercury never to be more than a certain angular distance, 21°, and Venus 47°, from the sun. (3.) That the planets, especially Mars, will be sometimes much nearer to the earth than at others, and therefore must appear larger at one time than at another. (4.) You will see that the planets cannot appear at the earth to move with an uniform velocity; for when nearest they appear to move faster, and slower when most remote. (5.) You will observe the planets will appear at the earth to move sometimes directly from west to east, and then to become retrograde from east to west, and between both to be stationary or without any apparent motion at all. Which particulars all correspond exactly with observations, and fully prove the truth of this excellent system. Fig. 165. represents an apparatus to show these latter particulars more evidently. An hollow wire, with a slit at top, is placed over the arm of the planet Mercury or Venus at E. The arm DG represents a ray of light coming from the planet at D to the earth, and is put over the centre which carries the earth at F. The planets being then put in motion, the planet D, as seen in the heavens from the earth at F, will undergo the several changes of position as above described. The wire prop that is over Mercury at E, may be placed over the other superior planets, Mars, &c. and the same phenomena be exhibited.

By this machine you at *once* see all the planets in motion about the sun, with the same respective velocities and periods of revolution which they have in the heavens; the wheel-work being calculated to a minute of time, from the latest discoveries.

You will see here a demonstration of the earth's motion about the sun, as well as those of the rest of the planets: for if the earth were to be at rest in the heavens, then the time between any two conjunctions of the same kind, or oppositions, would be the same with the periodical time of the planets, viz. 88 days in Mercury, 225 in Venus, &c.; whereas you here observe this time, instead of being 225 days, is no less than 583 days in Venus, occasioned by the earth's moving in the mean time about the sun the same way with the planet. And this space of 583 days always passes between two like conjunctions of Venus in the heavens.

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heavens. Hence the most important point of astronomy is satisfactorily demonstrated.

The diurnal rotation of the earth about its axis, and a demonstration of the cause of the different seasons of the year, and the different lengths of days and nights, are here answered completely: for as the earth is placed on an axis inclining to that of the ecliptic in an angle of $23\frac{1}{2}$ degrees, and is set in motion by the wheel-work, there will be evidently seen the different inclination of the sun's rays on the earth, the different quantity thereof which falls on a given space, the different quantity of the atmosphere they pass through, and the different continuance of the sun above the horizon at the same place in different times of the year; which particulars constitute the difference betwixt heat and cold in the summer and winter seasons.

As the globe of the earth is moveable about its inclined axis, so by having the horizon of London drawn upon the surface of it, and by means of the terminating wire going over it, by which is denoted, that on that side of the wire next the sun is the enlightened half of the earth, and the opposite side the darkened half, you will here see very naturally represented the cause of the different lengths of day and night, by observing the unequal portions of the circle which the island of Great Britain, or the city of London, or any other place, describes in the light and dark hemispheres at different times of the year, by turning the earth on its axis with the hand. But in some of the better orreries on this principle, the earth revolves about its axis by wheel-work.

As to the eclipses of the sun and moon, the true causes of them are here very clearly seen; for by placing the lamp (fig. 166.) upon the centre, in room of the brass ball denoting the sun, and turning the winch until the moon comes into a right line between the centres of the lamp (or sun) and earth, the shadow of the moon will fall upon the earth, and all who live on that part over which the shadow passes, will see the sun eclipsed more or less. On the other side, the moon passes (in the aforesaid case) through the shadow of the earth, and is by that means eclipsed. And the orbit A (fig. 164.) is so moveable on the two joints called nodes that any person may easily represent the due position of the nodes and intermediate spaces of the moon's orbit; and thence show when there will or will not be an eclipse of either luminary, and what the quantity of each will be.

While the moon is continuing to move round the earth, the lamp on the centre will so illumine the moon, that you will easily see all her phases, as new, dichotomized, gibbous, full, waning, &c. just as they appear in the heavens. You will moreover observe all the same phases of the earth as they appear at the moon.

The satellites of Jupiter and Saturn are moveable only by the hand; yet may all their phenomena be easily represented, excepting the true relative motions and distances. Thus, if that gilt globe which before represented the sun be made now to denote Jupiter, and four of the primary planets only be retained, then will the Jovian system be represented; and, by candle light only, you will see (the machine being in motion) the immersions and emersions of the satellites into and out of Jupiter's shadow. You will see plainly the manner in which they transit his body, and their occultations behind it. You will observe the various ways in which one or more of these moons may at times disappear. And if the machine be set by a white wall, &c. then by the projection of their shadows will be seen the reasons why those moons always appear on each side of Jupiter in a right line, why those which are most remote may appear nearest, and *è contrario*. And the same may be done for Saturn's five moons and his ring.

The Method of Rectifying the Orrery, and the proper Manner of placing the Planets in their true Situations.

Having dwelt thus much on the description of orreries, it may be useful to young readers, to point out the method by which the orrery should be first rectified, previous to the exhibition or using of it: and the following is extracted from Mr William Jones's description of his new *Portable Orrery*. "The method of showing the places, and relative aspects of the planets on any day of the year in the planetarium, must be done by the assistance of an *ephemeris* or *almanack*, which among other almanacks is published annually by the Stationers Company.

"The ephemeris contains a diary or daily account of the planets places in the heavens, in signs, degrees, and minutes, both as they appear to the eye supposed to be at the sun, and at the earth, throughout the year. The first of these positions is called the *heliocentric place*, and the latter, the *geocentric place*. The heliocentric place is that made use of in orreries; the geocentric place, that in globes. As an example for finding their places, and setting them right in the orrery, we will suppose the ephemeris (by *White*, which for this purpose is considered the best) at hand, wherein at the bottom of the *left-hand* page for every month is the heliocentric longitudes (or places) of all the planets to every six days of the month; which is near enough for common use: A copy of one of these tables for March 1784 is here inserted for the information of the tyro.

Days.	Day increas.	Helioc. long. ♄	Helioc. long. ♃	Helioc. long. ♂	Helioc. long. ⊖	Helioc. long. ♀	Helioc. long. ☿
1	3 11	16 ♑ 56	17 ♒ 11	1 ♋ 30	11 ♍ 37	0 ♐ 35	7 ♍ 58
7	3 35	16 56	17 43	4 23	17 37	10 7	25 23
31	3 59	17 7	18 15	7 15	23 36	19 38	11 ♐ 9
91	4 23	17 17	18 47	10 6	29 33	29 8	28 33
52	4 47	17 28	19 19	12 55	5 ♎ 30	8 ♑ 38	15 ♑ 49

"Now

"Now as an example, we will suppose, that in order to set the planets of the orrery, we want their heliocentric places for the 21st of this month. Looking into the table, we take the 19th day, which is the nearest to the day wanted: then, accordingly, we find the place of Saturn (♄), is in 17° 17′, or 17 degrees (rejecting the minutes, being in this case useless) of Capricornus (♑); of Jupiter (♃) in 18° of Aquarius (♒); Mars (♀) in 10° of Cancer (♋); the earth (⊖) in 29° of Virgo (♍); Venus (♂) in 29° of Sagittarius, (♐); Mercury (☿) in 28 degrees of the same sign; and in the same manner for any other day therein specified. Upon even this circumstance depends a very pleasing astronomical praxis, by which the young tyro may at any time be able to entertain himself in a most rational and agreeable manner, viz. he may in a minute or two represent the true appearance of the planetary system just as it really is in the heavens, and for any day he pleases, by assigning to each planet its proper place in its orbit; as in the following manner: For the 19th of March, as before, the place of Saturn is in 17° of Capricornus (♑); now laying hold of the arm of Saturn in the orrery, you place it over or against the 17° of Capricorn on the ecliptic circle, constantly placed on or surrounding the instrument; thus doing the same for the other planets, they will have the proper heliocentric places for that day.

"Now, in this situation of the planets, we observe, that if a person was placed on the earth, he would see Venus and Jupiter in the same line and place of the ecliptic, consequently in the heavens they would appear together or in conjunction; Mercury a little to the left or eastward of them, and nearer to the sun; Saturn to the right, or westward, farther from the sun; Mars directly opposite to Saturn; so that when Saturn appears in the west, Mars appears in the east, and *vice versa*. Several other curious and entertaining particulars, as depending on the above, may be easily represented and shown by the learner; particularly the foregoing when the winch is turned, and all the planets set into their respective motions."

We cannot close this detail on orreries more agreeably than by the following account of an instrument of that sort invented by Mr James Ferguson, to which he gives the name of a *Mechanical Paradox*, and which is actuated by means of what many, as he observes, even good mechanics, would be ready to pronounce impossible, viz. That the teeth of one wheel, taking equally deep into the teeth of three others, should affect them in such a manner, that in turning it any way round its axis, it should turn one of them the *same way*, another the *contrary way*, and the third *no way at all*.

The solution of the paradox is given under the article MECHANICS; after which our author proceeds to give the following account of its uses. "This machine is so much of an orrery, as is sufficient to show the different lengths of days and nights, the vicissitudes of the seasons, the retrograde motion of the nodes of the moon's orbit, the direct motion of the apogeal point of her orbit, and the months in which the sun and moon must be eclipsed.

"On the great immoveable plate A (see fig. 167.) are the months and days of the year, and the signs and degrees of the zodiac so placed, that when the annual index *h* is brought to any given day of the year, it will point to the degree of the sign in which the sun is on that day. The index is fixed to the moveable frame BC, and is carried round the immoveable plate, with it, by means of the knob *n*. The carrying this frame and index round the immoveable plate, answers to the earth's annual motion round the sun, and to the sun's apparent motion round the ecliptic in a year.

"The central wheel D (being fixed on the axis *a*, which is fixed in the centre of the immoveable plate) turns the thick wheel E round its own axis by the motion of the frame; and the teeth of the wheel E take into the teeth of the three wheels F, G, H, whose axes turn with one another, like the axes of the hour, minute, and second hands of a clock or watch, where the seconds are shown from the centre of the dial-plate.

"On the upper ends of these axes, are the round plates I, K, L; the plate I being on the axis of the wheel F, K on the axis of G, and L on the axis of H. So that whichever way these wheels are affected, their respective plates, and what they support, must be affected in the same manner; each wheel and plate being independent of the others.

"The two upright wires M and N are fixed into the plate I; and they support the small ecliptic OP, on which, in the machine, the signs and degrees of the ecliptic are marked. This plate also supports the small terrestrial globe *e*, on its inclining axis *f*, which is fixed into the plate near the foot of the wire N. This axis inclines $23\frac{1}{2}$ degrees from a right line, supposed to be perpendicular to the surface of the plate I, and also to the plane of the small ecliptic OP, which is parallel to that plate.

"On the earth *e* is the crescent *g*, which goes more than half way round the earth, and stands perpendicular to the plane of the small ecliptic OP, directly facing the sun Z: Its use is to divide the enlightened half of the earth next the sun from the other half which is then in the dark; so that it represents the boundary of light and darkness, and therefore ought to go quite round the earth; but cannot in a machine, because in some positions the earth's axis would fall upon it. The earth may be freely turned round on its axis by hand, within the crescent, which is supported by the crooked wire *w*, fixed to it, and into the upper plate of the moveable frame BC.

"In the plate K are fixed the two upright wires Q and R: they support the moon's inclined orbits ST in its nodes, which are the two opposite points of the moon's orbit where it intersects the ecliptic OP. The ascending node is marked ☊, to which the descending node is opposite below *e*, but hid from view by the globe *e*. The half ☊ T *e* of this orbit is on the north side of the ecliptic OP, and the other half *e* S ☊ is on the south side of the ecliptic. The moon is not in this machine; but when she is in either of the nodes of her orbit in the heavens, she is then in the plane of the ecliptic: when she is at T in her orbit, she is in her greatest north latitude; and when she is at S, she is in her greatest south latitude.

"In the plate L is fixed the crooked wire U U, which points downward to the small ecliptic OP, and shows the motion of the moon's apogee therein, and its place at any given time.

"The

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"The ball Z represents the sun, which is supported by the crooked wire XY, fixed into the upper plate of the frame at X. A straight wire W proceeds from the sun Z, and points always towards the centre of the earth *e*; but toward different points of its surface at different times of the year, on account of the obliquity of its axis, which keeps its parallelism during the earth's annual course round the sun Z; and therefore must incline sometimes toward the sun, at other times from him, and twice in the year neither toward nor from the sun, but sidewise to him. The wire W is called *the solar ray*.

"As the annual-index *h* shows the sun's place in the ecliptic for every day of the year, by turning the frame round the axis of the immoveable plate A, according to the order of the months and signs, the solar ray does the same in the small ecliptic OP: for as this ecliptic has no motion on its axis, its signs and degrees still keep parallel to those on the immoveable plate. At the same time, the nodes of the moon's orbit ST (or points where it intersects the ecliptic OP) are moved backward, or contrary to the order of signs, at the rate of 19⅓ degrees every Julian year; and the moon's apogeal wire UU is moved forward, or according to the order of the signs of the ecliptic, nearly at the rate of 41 degrees every Julian year; the year being denoted by a revolution of the earth *e* round the sun Z; in which time the annual index *h* goes round the circles of months and signs on the immoveable plate A.

"Take hold of the knob *n*, and turn the frame round thereby; and in doing this, you will perceive that the north pole of the earth *e* is constantly before the crescent *g*, in the enlightened part of the earth toward the sun, from the 20th of March to the 23d of September; and the south pole all that time behind the crescent in the dark; and from the 23d of September to the 20th of March, the north pole as constantly in the dark behind the crescent, and the south pole in the light before it; which shows, that there is but one day and one night at each pole, in the whole year; and that when it is day at either pole, it is night at the other.

"From the 20th of March to the 23d of September, the days are longer than the nights in all those places of the northern hemisphere of the earth which revolve through the light and dark, and shorter in those of the southern hemisphere. From the 23d of September to the 20th of March, the reverse.

"There are 24 meridian semicircles drawn on the globe, all meeting in its poles: and as one rotation or turn of the earth on its axis is performed in 24 hours, each of these meridians is an hour distant from the other, in every parallel of latitude. Therefore, if you bring the annual index *h* to any given day of the year, on the immoveable plate, you may see how long the day then is at any place of the earth, by counting how many of these meridians are in the light, or before the crescent, in the parallel of latitude of that place; and this number being subtracted from 24 hours, will leave remaining the length of the night. And if you turn the earth round its axis, all those places will pass directly under the point of the solar ray, which the sun passes vertically over on that day, because they are just as many degrees north or south of the equator as the sun's declination is then from the equinoctial.

"At the two equinoxes, viz. on the 20th of March and 23d of September, the sun is in the equinoctial, and consequently has no declination. On these days, the solar ray points directly toward the equator, the earth's poles lie under the inner edge of the crescent, or boundary of light and darkness; and in every parallel of latitude there are 12 of the meridians or hour-circles before the crescent, and 12 behind it, which shows that the days and nights then are each 12 hours long at all places of the earth. And if the earth be turned round its axis, you will see that all places on it go equally through the light and the dark hemispheres.

"On the 21st of June, the whole space within the north polar circle is enlightened, which is 23½ degrees from the pole, all around; because the earth's axis then inclines 23½ degrees toward the sun: but the whole space within the south polar circle is in the dark; and the solar ray points toward the tropic of Cancer on the earth, which is 23½ degrees north from the equator. On the 20th of December the reverse happens, and the solar ray points toward the tropic of Capricorn, which is 24½ degrees south from the equator.

"If you bring the annual-index *h* to the beginning of January, and turn the moon's orbit ST by its supporting wires Q and R till the ascending node (marked ☊) comes to its place in the ecliptic OP, as found by an ephemeris, or by astronomical tables, for the beginning of any given year; and then move the annual index by means of the knob *n*, till the index comes to any given day of the year afterward, the nodes will stand against their places in the ecliptic on that day; and if you move on the index till either of the nodes comes directly against the point of the solar ray, the index will then be at the day of the year on which the sun is in conjunction with that node. At the times of those new moons, which happen within seventeen days of the conjunction of the sun with either of the nodes, the sun will be eclipsed; and at the times of those full moons, which happen within twelve days of either of these conjunctions, the moon will be eclipsed. Without these limits there can be no eclipses either of the sun or moon; because, in nature, the moon's latitude or declination from the ecliptic is too great for the moon's shadow to fall on any part of the earth, or for the earth's shadow to touch the moon.

"Bring the annual-index to the beginning of January, and set the moon's apogeal wire UU to its place in the ecliptic for that time, as found by astronomical tables; then move the index forward to any given day of the year, and the wire will point on the small ecliptic to the place of the moon's apogee for that time.

"The earth's axis *f* inclines always toward the beginning of the sign Cancer on the small ecliptic OP. And if you set either of the moon's nodes, and her apogeal wire to the beginning of that sign, and turn the plate A about, until the earth's axis inclines toward any side of the room (suppose the north side), and then move the annual-index round and round the immoveable plate A, according to the order of the months

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months and signs upon it, you will see that the earth's axis and beginning of Cancer will still keep towards the same side of the room, without the least deviation from it; but the nodes of the moon's orbit ST will turn progressively towards all the sides of the room, contrary to the order of signs in the small ecliptic OP, or from east, by south, to west, and so on; and the apogeal wire UU will turn the contrary way to the motion of the nodes, or according to the order of the signs in the small ecliptic, from west, by south, to east, and so on quite round. A clear proof that the wheel F, which governs the earth's axis and the small ecliptic, does not turn any way round its own centre; that the wheel G, which governs the moon's orbit OP, turns round its own centre backward, or contrary both to the motion of the frame BC and thick wheel E; and that the wheel H, which governs the moon's apogeal wire UU, turns round its own centre forward, or in direction both of the motion of the frame and of the thick wheel E, by which the three wheels F, G, and H, are affected.

"The wheels D, E, and F, have each 39 teeth in the machine; the wheel G has 37, and H 44.

"The parallelism of the earth's axis is perfect in this machine; the motion of the apogee very nearly so; the motion of the nodes not quite so near the truth, though they will not vary sensibly therefrom in one year. But they cannot be brought nearer, unless larger wheels, with higher numbers of teeth, are used.

"In nature, the moon's apogee goes quite round the ecliptic in 8 years and 312 days, in the direction of the earth's annual motion; and the nodes go round the ecliptic, in a contrary direction, in 18 years and 225 days. In the machine, the apogee goes round the ecliptic OP in eight years and four-fifths of a year, and the nodes in 18 years and a half."

423 Cometarium.

The COMETARIUM, (fig. 168.). This curious machine shows the motion of a comet or eccentric body moving round the sun, describing equal areas in equal times, and may be so contrived as to show such a motion for any degrees of eccentricity. It was invented by the late Dr Desaguliers.

The dark elliptical groove round the letters *a b c d e f g h i k l m* is the orbit of the comet Y; this comet is carried round in the groove according to the order of letters, by the wire W fixed in the sun S, and slides on the wire as it approaches nearer to or recedes farther from the sun, being nearest of all in the perihelion *a*, and farthest in the aphelion *g*. The areas, *a* S *b*, *b* S *c*, *c* S *d*, &c. or contents of these several triangles, are all equal; and in every turn of the winch N, the comet Y is carried over one of these areas; consequently, in as much time as it moves from *f* to *g*, or from *g* to *h*, it moves from *m* to *a*, or from *a* to *b*; and so of the rest, being quickest of all at *a*, and slowest at *g*. Thus the comet's velocity in its orbit continually decreases from the perihelion *a* to the aphelion *g*; and increases in the same proportion from *g* to *a*.

The ecliptic orbit is divided into 12 equal parts or signs, with their respective degrees, and so is the circle *n o p q r s t u*, which represents a great circle in the heavens, and to which the comet's motion is referred by a small knob on the point of the wire W. Whilst the comet moves from *f* to *g* in its orbit, it appears to move only about five degrees in this circle, as is shown by the small knob on the end of the wire W; but in as short time as the comet moves from *m* to *a*, or from *a* to *b*, it appears to describe the large space *t n* or *n o* in the heavens, either of which spaces contains 120 degrees, or four signs. Were the eccentricity of its orbit greater, the greater still would be the difference of its motion, and *vice versa*.

ABCDEFGHIKLM is a circular orbit for showing the equable motion of a body round the sun S, describing equal areas ASB, BSC, &c. in equal times with those of the body Y in its elliptical orbit above mentioned; but with this difference, that the circular motion describes the equal arcs AB, BC, &c. in the same equal times that the elliptical motion describes the unequal arcs *a b*, *b c*, &c.

Now suppose the two bodies Y and 1 to start from the points *a* and A at the same moment of time, and, each having gone round its respective orbit, to arrive at these points again at the same instant, the body Y will be forwarder in its orbit than the body 1 all the way from *a* to *g*, and from A to G: but 1 will be forwarder than Y through all the other half of the orbit; and the difference is equal to the equation of the body Y in its orbit. At the points *a* A, and *g* G, that is, in the perihelion and aphelion, they will be equal; and then the equation vanishes. This shows why the equation of a body moving in an elliptic orbit is added to the mean or supposed circular motion from the perihelion to the aphelion, and subtracted from the aphelion to the perihelion, in bodies moving round the sun, or from the perigee to the apogee, and from the apogee to the perigee in the moon's motion round the earth.

This motion is performed in the following manner by the machine, fig. 169. ABC is a wooden bar (in the box containing the wheel-work), above which are the wheels D and E, and below it the elliptic plates FF and GG; each plate being fixed on an axis in one of its focuses, at E and K; and the wheel E is fixed on the same axis with the plate FF. These plates have grooves round their edges precisely of equal diameters to one another, and in these grooves is the cat-gut string *gg*, *gg* crossing between the plates at *h*. On H, the axis of the handle or winch N in fig. 216, is an endless screw in fig. 217. working in the wheels D and E, whose numbers of teeth being equal, and should be equal to the number of lines, *a* S, *b* S, *c* S, &c. in fig. 168. they turn round their axis in equal times to one another, and to the motion of the elliptic plates. For, the wheels D and E having equal numbers of teeth, the plate FF being fixed on the same axis with the wheel E, and turning the equally big plate GG by a cat-gut string round them both, they must all go round their axis in as many turns of the handle N as either of the wheels has teeth.

It is easy to see, that the end *h* of the elliptical plate FF being farther from its axis E than the opposite end I is, must describe a circle so much the larger in proportion, and therefore move through so much more space in the same time; and for that reason the end *h* moves so much faster than the end I, although it goes no sooner round the centre E. But then the quick-moving end *h* of the plate FF leads about the short end *h* K of the plate GG with the same velocity; and

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and the slow-moving end I of the plate FF coming half round as to B, must then lead the long end k of the plate GG as slowly about: so that the elliptical plate FF and its axis E move uniformly and equally quick in every part of its revolution: but the elliptical plate GG, together with its axis K, must move very unequally in different parts of its revolution; the difference being always inversely as the distance of any point of the circumference of GG from its axis at K: or in other words, to instance in two points, if the distance K k be four, five, or six times as great as the distance K h, the point h will move in that position, four, five, or six times as fast as the point k does, when the plate GG has gone half round; and so on for any other eccentricity or difference of the distances K k and K h. The tooth I on the plate FF falls in between the two teeth at k on the plate GG; by which means the revolution of the latter is so adjusted to that of the former, that they can never vary from one another.

On the top of the axis of the equally-moving wheel D in fig. 169. is the sun S in fig. 168.: which sun, by the wire fixed to it, carries the ball I round the circle ABCD, &c. with an equable motion, according to the order of the letters: and on the top of the axis K of the unequally-moving ellipses GG, in fig. 169. is the sun S in fig. 168. carrying the ball Y unequally round in the elliptical groove *a b c d*, &c. N. B. This elliptical groove must be precisely equal and similar to the verge of the plate GG, which is also equal to that of FF.

In this manner machines may be made to show the true motion of the moon about the earth, or of any planet above the sun, by making the elliptical plates of the same eccentricities, in proportion to the radius, as the orbits of the planets are, whose motions they represent; and so their different equations in different parts of their orbits may be made plain to sight, and clearer ideas of these motions and equations acquired in half an hour, than could be gained from reading half a day about such motions and equations.

429 Celestial globe.

The IMPROVED CELESTIAL GLOBE, fig. 170. On the north pole of the axis, above the hour-circle, is fixed an arch MKH of $23\frac{1}{2}$ degrees; and at the end H is fixed an upright pin HG, which stands directly over the north pole of the ecliptic, and perpendicular to that part of the surface of the globe. On this pin are two moveable collets at E and H, to which are fixed the quadrantile wires N and O, having two little balls on their ends for the sun and moon, as in the figure. The collet D is fixed to the circular plate F, whereon the $29\frac{1}{2}$ days of the moon's age are engraven, beginning just under the sun's wire N; and as this wire is moved round the globe, the plate F turns round with it. These wires are easily turned, if the screw G be slackened; and when they are set to their proper places, the screw serves to fix them there, so as in turning the ball of the globe, the wires with the sun and moon go round with it; and these two little balls rise and set at the same times, and on the same points of the horizon, for the day to which they are rectified, as the sun and moon do in the heavens.

Because the moon keeps not her course in the ecliptic (as the sun appears to do) but has a declination of $5\frac{1}{3}$ degrees on each side from it in every lunation, her ball may be screwed as many degrees to either side of the ecliptic as her latitude or declination from the ecliptic amounts to at any given time.

The horizon is supported by two semicircular arches, because pillars would stop the progress of the balls when they go below the horizon in an oblique sphere.

To rectify this globe. Elevate the pole to the latitude of the place; then bring the sun's place in the ecliptic for the given day to the brazen meridian, and set the hour index at 12 at noon, that is, to the upper 12 on the hour circle; keeping the globe in that situation, slacken the screw G, and set the sun directly over his place on the meridian; which done, set the moon's wire under the number that expresses her age for that day on the plate F, and she will then stand over her place in the ecliptic, and show what constellation she is in. Lastly, fasten the screw G, and adjust the moon to her latitude, and the globe will be rectified.

Having thus rectified the globe, turn it round, and observe on what point of the horizon the sun and moon balls rise and set, for these agree with the points of the compass on which the sun and moon rise and set in the heavens on the given day; and the hour index shows the time of their rising and setting: and likewise the time of the moon's passing over the meridian.

This simple apparatus shows all the varieties that can happen in the rising and setting of the sun and moon; and makes the forementioned phenomena of the harvest moon plain to the eye. It is also very useful in reading lectures on the globes, because a large company can see this sun and moon go round, rising above and setting below the horizon at different times, according to the seasons of the year: and making their appulses to different fixed stars. But in the usual way, where there is only the places of the sun and moon in the ecliptic to keep the eye upon, they are easily lost sight of, unless they be covered with patches. 430

Trajectorium lunare.

The TRAJECTORIUM LUNARE, fig. 171. This machine is for delineating the paths of the earth and moon, showing what sort of curves they make in the ethereal regions. S is the sun, and E the earth, whose centres are 95 inches distant from each other; every inch answering to 1000,000 of miles. M is the moon, whose centre is $\frac{24}{100}$ parts of an inch from the earth's in this machine, this being in just proportion to the moon's distance from the earth. AA is a bar of wood, to be moved by hand round the axis g which is fixed in the wheel Y. The circumference of this wheel is to the circumference of the small wheel L (below the other end of the bar) as $365\frac{1}{4}$ days is to $29\frac{1}{2}$, or as a year is to a lunation. The wheels are grooved round their edges, and in the grooves is the cat-gut string GG crossing between the wheels at X. On the axis of the wheel L is the index F, in which is fixed the moon's axis M for carrying her round the earth E (fixed on the axis of the wheel L) in the time that the index goes round a circle of $29\frac{1}{2}$ equal parts, which are the days of the moon's age. The wheel Y has the months and days of the year all round its limb; and in the bar AA is fixed the index l, which points out the days of the months answering the days of the moon's age, shown by the index F, in the circle of $29\frac{1}{2}$ equal parts at the other end of the bar. On the

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the axis of the wheel L is put the piece D, below the cock C, in which this axis turns round; and in D are put the pencils *e* and *m* directly under the earth E and moon M; so that *m* is carried round *e* as M is round E.

Lay the machine on an even floor, pressing gently on the wheel Y, to cause its spiked feet (of which two appear at P and P, the third being supposed to be hid from sight by the wheel) enter a little into the floor to secure the wheel from turning. Then lay a paper about four feet long under the pencils *e* and *m*, crosswise to the bar; which done, move the bar slowly round the axis *g* of the wheel Y; and as the earth D goes round the sun S, the moon M will go round the earth with a duly proportioned velocity; and the friction wheel W running on the floor, will keep the bar from bearing too heavily on the pencils *e* and *m*, which will delineate the paths of the earth and moon. As the index I points out the days of the months, the index F shows the moon's age on these days, in the circle of $29\frac{1}{2}$ equal parts. And as this last index points to the different days in its circle, the like numerical figures may be set to those parts of the curves of the earth's path and moon's where the pencils *e* and *m* are at those times respectively, to show the places of the earth and moon. If the pencil *e* be pushed a very little off, as if from the pencil *m*, to about $\frac{1}{40}$ part of their distance, and the pencil *m* pushed as much towards *e*, to bring them to the same distances again, though not to the same points of space; then, as *m* goes round *e*, *e* will go as it were round the centre of gravity between the earth *e* and moon *m*; but this motion will not sensibly alter the figure of the earth's path or the moon's.

If a pin, as *p*, be put through the pencil *m*, with its head towards that of the pin *q* in the pencil *e*, its head will always keep thereto as *m* goes round *e*, or as the same side of the moon is still obverted to the earth. But the pin *p*, which may be considered as an equatorial diameter of the moon, will turn quite round the point *m*, making all possible angles with the line of its progress, or line of the moon's path. This is an ocular proof of the moon's turning round her axis.

III. *A Description of the principal Astronomical Instruments by which Astronomers make the most accurate Observations.*

By practical astronomy is implied the knowledge of observing the celestial bodies with respect to their position and time of the year, and of deducing from those observations certain conclusions useful in calculating the time when any proposed position of these bodies shall happen.

For this purpose, it is necessary to have a room or place conveniently situated, suitably contrived, and furnished with proper astronomical instruments. It should have an uninterrupted view from the zenith down to (or even below) the horizon, at least towards its cardinal points; and for this purpose, that part of the roof which lies in the direction of the meridian, in particular, should have moveable covers, which may easily be moved and put on again; by which means an instrument may be directed to any point of the heavens between the horizon and the zenith, as well to the northward as southward.

This place, called an Observatory, should contain some, if not all, of the following instruments:

I. A Pendulum Clock, for showing equal time. This should show time in hours, minutes and seconds; and with which the observer, by hearing the beats of the pendulum, may count them by his ear, while his eye is employed on the motion of the celestial object he is observing. Just before the object arrives at the position described, the observer should look on the clock and remark the time, suppose it 9 hours 15 minutes 25 seconds: then saying, 25, 26, 27, 28, &c. responsive to the beat of the pendulum, till he sees through the instrument the object arrived at the position expected; which suppose to happen when he says 38, he then writes down 9 h. 15 min. 38 sec. for the time of observation, annexing the year and the day of the month. If two persons are concerned in making the observation, one may read the time audibly while the other observes through the instrument, the observer repeating the last second read when the desired position happens.

II. An Achromatic Refracting Telescope, or a reflecting one, of two feet at least in length, for observing particular phenomena. These instruments are particularly described under Optics.

III. A Micrometer, for measuring small angular distances. See Micrometer.

IV. Astronomical Quadrants, both mural and portable, for observing meridian and other altitudes of the celestial bodies. 431 Quadrants.

1. The *mural quadrant* is in the form of a quarter of a circle, contained under two radii at right angles to one another, and an arch equal to one fourth part of the circumference of the circle. It is the most useful and valuable of all the astronomical instruments; and as it is sometimes fixed to the side of a stone or brick wall, and the plane of it erected exactly in the plane of the meridian, it in this case receives the name of *mural quadrant* or *arch*.

Tycho Brahe was the first person who contrived this mural arch, viz. who first applied it to a wall; and Mr Flamstead, the first in England who, with indefatigable pains, fixed one up in the royal observatory at Greenwich.

These instruments have usually been made from five to eight feet radius, and executed by those late celebrated artists Sisson, Graham, Bird, and other eminent mathematical instrument makers in London. The construction of them being generally the same in all the sizes, we shall here describe one made by the late Joh. Sisson, under the direction of the late Mr Graham. Fig. 172. represents the instrument as already fixed to the wall. It is of copper, and of about five feet radius. The frame is formed of flat bars, and strengthened by edge bars affixed underneath perpendicularly to them. The radii HB, HA, being divided each into four equal parts, serve to find out the points D and E, by which the quadrant is freely suspended on its props or iron supports that are fastened securely in the wall.

One of the supports E is represented separately in *e* on one side of the quadrant. It is moveable by means of a long slender rod EF or *e f*, which goes into a hol-

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low screw in order to restore the instrument to its situation when it is discovered to be a little deranged. This may be known by the very fine perpendicular thread HA, which ought always to coincide with the same point A of the limb, and carefully examined to be so by a small magnifying telescope at every observation. In order to prevent the unsteadiness of so great a machine, there should be placed behind the limb four copper ears with double cocks, I, K, I, K. There are others along the radii HA and HB. Each of these cocks contains two screws, into which are fastened the ears that are fixed behind the quadrant.

Over the wall or stone which supports the instrument, and at the same height as the centre, is placed horizontally the axis PO, which is perpendicular to the plane of the instrument, and which would pass through the centre if it was continued. The axis turns on two pivots P. On this axis is fixed at right angles another branch ON, loaded at its extremity with a weight N capable of equipoising with its weight that of the telescope LM; whilst the axis, by its extremity nearest the quadrant, carries the wooden frame PRM, which is fastened to the telescope in M. The counterpoise takes off from the observer the weight of the telescope when he raises it, and hinders him from either forcing or straining the instrument.

The lower extremity (V) of the telescope is furnished with two small wheels, which takes the limb of the quadrant on its two sides. The telescope hardly bears any more upon the limb than the small friction of these two wheels; which renders its motion so extremely easy and pleasant, that by giving it with the hand only a small motion, the telescope will run of itself over a great part of the limb, balanced by the counterpoise N.

When the telescope is to be stopped at a certain position, the copper hand T is to be made use of, which embraces the limb and springs at the bottom. It is fixed by setting a screw, which fastens it to the limb. Then, in turning the regulating screw, the telescope will be advanced; which is continued until the star or other object whose altitude is observing be on the horizontal fine thread in the telescope. Then on the plate X supporting the telescope, and carrying a vernier or nonius, will be seen the number of degrees and minutes, and even quarters of minutes, that the angular height of the object observed is equal to. The remainder is easily estimated within two or three seconds nearly.

There are several methods of subdividing the divisions of a mural quadrant, which are usually from five to ten minutes each; but that which is most commonly adopted is by the vernier or nonius, the contrivance of Peter Vernier a Frenchman. This vernier consists of a piece of copper or brass CDAB (fig. 173.), which is a small portion of X (fig. 172.) represented separately. The length CD is divided into 20 equal parts, and placed contiguously on a portion of the division of the limb of the quadrant containing 21 divisions, and thereby dividing this length into 20 equal parts. Thus the first division of the vernier piece marked 15, beginning at the point D, is a little matter backward, or to the left of the first division of the limb equal to 15. The second division of the vernier is to the left of the second division of the limb double of the first difference, or 30″; and so on unto the 20th and last division on the left of the vernier piece; where the 20 differences being accumulated each of the 20th part of the division of the limb, this last division will be found to agree exactly with the 21st division on the limb of the quadrant.

The index must be pushed the 20th part of a division, or 15″, to the right; for to make the second division on the vernier coincide with one of the divisions of the limb, in like manner is moving two 20ths, or 30″, we must look at the second division of the index, and there will be a coincidence with a division of the limb. Thus may be conceived that the beginning D of the vernier, which is always the line of reckoning, has advanced two divisions, or 30″, to the right, when the second division, marked 30 on the vernier, is seen to correspond exactly with one of the lines of the quadrant.

By means of this vernier may be readily distinguished the exactitude of 15″ of the limb of a quadrant five feet radius, and simply divided into 5′. By an estimation by the eye, afterwards, the accuracy of two or three seconds may be easily judged. On the side of the quadrant is placed the plate of copper which carries the telescope. This plate carries two verniers. The outer line CD divides five minutes into 20 parts, or 15″ each. The interior line AB answers to the parts of another division not having 90°, but 96 parts, of the quadrant. It is usually adopted by English astronomers on account of the facility of its subdivisions. Each of the 96 portions of the quadrant is equivalent to 56′ 15″ of the usual divisions. It is divided on the limb into 16 parts, and the arch of the vernier AB contains 25 of these divisions; and being divided itself into 24, immediately gives parts, the value of each of which is 8″ 47½‴. From this mode a table of reduction may easily be constructed, which will serve to find the value of this second mode of dividing in degrees, minutes, and seconds, reckoning in the usual manner, and to have even the advantage of two different modes; which makes an excellent verification of the divisions on the limb of the quadrant and observed heights by the vernier.

2. The *Portable Astronomical Quadrant*, is that instrument of all others which astronomers make the greatest use of, and have the most esteem for. They are generally made from 12 to 23 inches. Fig. 174. is a representation of the improved modern one, as made by the late Mr Sisson and by the present mathematical instrument makers. This is capable of being carried to any part of the world, and put up for observation in an easy and accurate manner. It is made of brass, and strongly framed together by crossed perpendicular bars. The arch AC, and telescope EF, are divided and constructed in a similar manner to the mural quadrant, but generally without the division of 96 parts. The counterpoise to the telescope T is represented at P, and also another counterpoise to the quadrant itself at P. The quadrant is fixed to a long axis, which goes into the pillar KR. Upon this axis is fixed an index, which points to and subdivides by a vernier the divisions of the azimuth circle K. This azimuth circle is extremely useful for taking the azimuth of a celestial body at the same time its altitude is observed. The

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The upper end of the axis is firmly connected with the adjusting frame GH; and the pillar is supported on the crossed feet at the bottom of the pillar KR with the adjusting screws *a*, *b*, *c*, *d*.

When this instrument is set up for use or observation, it is necessary that two adjustments be very accurately made: One, that the plane or surface of the instrument be truly perpendicular to the horizon; the other, that the line supposed to be drawn from the centre to the first line of the limb, be truly on a level or parallel with the horizon. The first of these particulars is done by means of the thread and plummet *p*; the thread of which is usually of very fine silver wire, and it is placed opposite to a mark made upon the end of the limb of the instrument. The four screws at the foot, *a*, *b*, *c*, *d*, are to be turned until a perfect coincidence is observed of the thread upon the mark, which is accurately observed by means of a small telescope T, that fits to the limb. The other adjustment is effected by means of the spirit level L, which applies on the frame GH, and the small screws turned as before until the bubble of air in the level settles in the middle of the tube. The dotted tube EB is a kind of prover to the instrument: for by observing at what mark the centre of it appears against, or by putting up a mark against it, it will at any time discover if the instrument has been displaced. The screw S at the index, is the regulating or adjusting screw, to move the telescope and index, during the observation, with the utmost nicety.

432 Equatorial sector.

V. Astronomical *or* Equatorial Sector. This is an instrument for finding the difference in right ascension and declination between two objects, the distance of which is too great to be observed by the micrometer. It was the invention of the late ingenious Mr George Graham, F. R. S. and is constructed from the following particulars. Let AB (fig. 175.) represent an arch of a circle containing 10 or 12 degrees well divided, having a strong plate CD for its radius, fixed to the middle of the arch at D: let this radius be applied to the side of an axis HFI, and be moveable about a joint fixed to it at F, so that the plane of the sector may be always parallel to the axis HI; which being parallel to the axis of the earth, the plane of the sector will always be parallel to the plane of some hour-circle. Let a telescope CE be moveable about the centre C of the arch AB, from one end of it to the other, by turning a screw at G; and let the line of sight be parallel to the plane of the sector. Now, by turning the whole instrument about the axis HI, till the plane of it be successively directed, first to one of the stars and then to another, it is easy to move the sector about the joint F, into such a position, that the arch AB, when fixed, shall take in both the stars in their passage, by the plane of it, provided the difference of their declinations does not exceed the arch AB. Then, having fixed the plane of the sector a little to the westward of both the stars, move the telescope CE by the screw G; and observe by a clock the time of each transit over the cross hairs, and also the degrees and minutes upon the arch AB, cut by the index at each transit; then in the difference of the arches, the difference of the declinations, and by the difference of the times, we have the difference of the right ascensions of the stars.

The dimensions of this instrument are these: The length of the telescope, or the radius of the sector, is $2\frac{1}{2}$ feet; the breadth of the radius, near the end C, is $1\frac{1}{4}$ inch; and at the end D two inches. The breadth of the limb AB is $1\frac{1}{2}$ inch; and its length six inches, containing ten degrees divided into quarters, and numbered from either end to the other. The telescope carries a nonius or subdividing plate, whose length, being equal to sixteen quarters of a degree, is divided into fifteen equal parts; which, in effect, divides the limb into minutes, and, by estimation, into smaller parts. The length of the square axis HIF is eighteen inches, and of the part HI twelve inches; and its thickness is about a quarter of an inch: the diameters of the circles are each five inches: the thickness of the plates, and the other measures, may be taken at the direction of a workman.

This instrument may be rectified, for making observations, in this manner: By placing the intersection of the cross hairs at the same distance from the plane of the sector, as the centre of the object-glass, the plane described by the line of sight, during the circular motion of the telescope upon the limb, will be sufficiently true, or free from conical curvity; which may be examined by suspending a long plumb-line at a convenient distance from the instrument; and by fixing the plane of the sector in a vertical position, and then by observing, while the telescope is moved by the screw along the limb, whether the cross hairs appear to move along the plumb-line.

The axis *hfo* may be elevated nearly parallel to the axis of the earth, by means of a small common quadrant; and its error may be corrected, by making the line of sight follow the circular motion of any of the circumpolar stars, while the whole instrument is moved about its axis *hfo*, the telescope being fixed to the limb; for this purpose, let the telescope *kl* be directed to the star *a*, when it passes over the highest point of its diurnal circle, and let the division cut by the nonius be then noted; then, after twelve hours, when the star comes to the lowest point of its circle, having turned the instrument half round its axis, to bring the telescope into the position *mn*; if the cross hairs cover the same star supposed at *b*, the elevation of the axis *hfo* is exactly right; but if it be necessary to move the telescope into the position *uv*, in order to point to this star at *c*, the arch *mu*, which measures the angle *mfu* or *bfc*, will be known; and then the axis *hfo* must be depressed half the quantity of this given angle if the star passed below *b*, or must be raised so much higher if above it; and then the trial must be repeated till the true elevation of the axis be obtained. By making the like observations upon the same star on each side the pole, in the six-o'clock hour circle, the error of the axis, toward the east or west, may also be found and corrected, till the cross hairs follow the star quite round the pole; for supposing *aopbc* to be an arch of the meridian (or in the second practice of the six-o'clock hour circle), make the angle *afp* equal to half the angle *afc*, and the line *fp* will point to the pole; and the angle *ofp*, which is the error of the axis, will be equal to half the angle *bfo*, or *mfu*, found by the observation; because the difference of the two angles *afb*, *afc*, is double the difference of their halves *afo* and *afp*. Unless the star be very

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very near the pole, allowance must be made for refractions.

VI. Transit and Equal Altitude Instruments.

433 Transit Instruments.

1. *The Transit Instrument* is used for observing objects as they pass over the meridian. It consists of a telescope fixed at right angles to a horizontal axis; which axis must be so supported that what is called the line of collimation, or line of sight of the telescope, may move in the plane of the meridian. This instrument was first made by the celebrated Mr Roemer in the year 1689, and has since received great improvements. It is made of various sizes, and of large dimensions in our great observatories; but the following is one of a size sufficiently large and accurate for all the useful purposes.

The axis AB (fig. 176.), to which the middle of the telescope is fixed, is about $2\frac{1}{2}$ feet long, tapering gradually towards its ends, which terminate in cylinders well turned and smoothed. The telescope CD, which is about four feet long, and $1\frac{1}{2}$ inch diameter, is connected with the axis by means of a strong cube or die G, and in which the two cones MQ, forming the axis, are fixed. This cube or stock G serves as the principal part of the whole machine. It not only keeps together the two cones, but holds the two sockets KH, of 15 inches length, for the two telescopic tubes. Each of these sockets has a square base, and is fixed to the cube by four screws. These sockets are cut down in the sides about eight inches, to admit more easily the tube of the telescope; but when the tube is inserted, it is kept in firm by screwing up the tightening screws at the end of the sockets at K and H. These two sockets are very useful in keeping the telescope in its greatest possible degree of steadiness. They also afford a better opportunity of balancing the telescope and rectifying its vertical thread, than by any other means.

In order to direct the telescope to the given height that a star would be observed at, there is fixed a semicircle AN on one of the supporters, of about $8\frac{1}{2}$ inches diameter, and divided into degrees. The index is fixed on the axis, at the end of which is a vernier, which subdivides the degrees into 12 parts, or five minutes. This index is moveable on the axis, and may be closely applied to the divisions by means of a tightening screw.

Two upright posts of wood or stone YY, firmly fixed at a proper distance, are to sustain the supporters of this instrument. These supporters are two thick brass plates RR, having well smoothed angular notches in their upper ends, to receive the cylindrical arms of the axis. Each of these notched plates is contrived to be moveable by a screw, which slides them upon the surfaces of two other plates immoveably fixed upon the two upright pillars; one plate moving in a horizontal, and the other in a vertical direction; or, which is more simple, these two modes are sometimes applied only on one side, as at V and P, the horizontal motion by the screw P, and the vertical by the screw V. These two motions serve to adjust the telescope to the planes of the horizon and meridian: to the plane of the horizon by the spirit-level EF, hung by DC on the axis MQ, in a parallel direction: and to the plane of the meridian in the following manner:

Observe by the clock when a circumpolar star seen through this instrument transits both above and below the pole; and if the times of describing the eastern and western parts of its circuit are equal, the telescope is then in the plane of the meridian: otherwise the screw P must be gently turned that it may move the telescope so much that the time of the star's revolution be bisected by both the upper and lower transits, taking care at the same time that the axis remains perfectly horizontal. When the telescope is thus adjusted, a mark must be set at a considerable distance (the greater the better) in the horizontal direction of the intersection of the cross wires, and in a place where it can be illuminated in the night-time by a lanthorn hanging near it; which mark being on a fixed object, will serve at all times afterwards to examine the position of the telescope by, the axis of the instrument being first adjusted by means of the level.

To adjust the Clock by the Sun's Transit over the Meridian. Note the times by the clock when the preceding and following edges of the sun's limb touch the cross wire. The difference between the middle time and 12 hours, shows how much the mean, or time by the clock, is faster or slower than the apparent or solar time for that day: to which the equation of time being applied, will show the time of mean noon for that day, by which the clock may be adjusted.

2. *The Equal Altitude Instrument*, is an instrument that is used to observe a celestial object when it has the same altitude on both the east and west sides of the meridian, or in the morning and afternoon. It principally consists of a telescope about 30 inches long, fixed to a sextantal or semicircular divided arch; the centre of which is fixed to a long vertical axis: but the particulars of this instrument the reader will see explained in Optics.

3. *Compound Transit Instrument.* Some instruments have been contrived to answer both kinds of observations, viz. either a transit or equal altitudes. Fig. 178. represents such an instrument, made first of all for Mr le Monnier, the French astronomer, by the late Mr Sisson, under the direction of Mr Graham, mounted and fixed up ready for observation.

AB is a telescope, which may be 3, 4, 5, or 6 feet long, whose cylindrical tube fits exactly into another hollow cylinder *a b*, perpendicular to the axis: these several pieces are of the best hammered plate brass. The cylindrical extremity of this axis MN are of solid bell metal, and wrought exquisitely true, and exactly the same size, in a lathe; and it is on the perfection to which the cylinders or trunnions are turned that the justness of the instrument depends. In the common focus of the object-glass and eye-glass is placed a reticle (fig. 177.), consisting of three horizontal and parallel fine-stretched silver wires, fixed by pins or screws to a brass circle, the middle one passing through its centre, with a fourth vertical wire likewise passing through the centre, exactly perpendicular to the former three.

The horizontal axis MN (fig. 178.) is placed on a strong brass frame, into the middle of which a steel cylinder GH is fixed perpendicularly, being turned truly round, and terminating in a conical point at its lower extremity; where it is let into a small hole drilled in the middle of the dove-tail slider; which slider is supported

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supported by a hollow tube fixed to the supporting piece IK, consisting of two strong plates of brass joined together at right angles, to which are fixed two iron cramps L, L, by which it is fastened to the stone wall of a south window.

The upper part G of the steel spindle is embraced by a collar *def*, being in contact with the blunt extremity of three screws, whose particular use will be explained by and by. O is another cylindrical collar closely embracing the steel spindle at about a third part of its length from the top; by the means of a small screw it may be loosened or pinched close as occasion requires. From the bottom of this collar proceeds an arm or lever acted on by the two screws *g h*, whereby the whole instrument, excepting the supporting piece, may be moved laterally, so that the telescope may be made to point at a distant mark fixed in the vertical of the meridian. *i k* is a graduated semicircle of thin brass screwed to the telescope, whereby it may be elevated so as to point to a known celestial object in the day-time. *l m* is a spirit-level parallel to the axis of rotation on the telescope, on which two trunnions hang by two hooks at M and N. Along the upper side of the glass tube of the level slides a pointer to be set to the end of the air-bubble; and when the position of the axis of rotation is so adjusted by the screws that the air-bubble keeps to the pointer for a whole revolution of the instrument, the spindle GH is certainly perpendicular to the horizon, and then the line of collimation of the telescope describes a circle of equal altitude in the heavens. When the level is suspended on the axis, raise or depress the tube of the level by twisting the neb of the screw *n* till you bring either the end of the air-bubble to rest at any point towards the middle of the tube, to which slide the index: then lift off the level, and, turning the ends of it contrary ways, hang it again on the trunnions; and if the air-bubble rests exactly again, the index as before, the axis of rotation is truly horizontal: If not, depress that end of the axis which lies on the same side of the pointer as the bubble does, by turning the neb of the screw at N, till the bubble returns about halfway towards the pointer; then having moved the pointer to the place where it now rests, invert the ends of the level again, and repeat the same practice till the bubble rests exactly at the pointer in both positions of the level. If, after the telescope is turned upside down, that is, after the trunnions are inverted end for end, you perceive that the same point of a remote fixed object is covered by the vertical wire in the focus of the telescope, that was covered by it before the inversion, it is certain that the line of sight or collimation is perpendicular to the transverse axis; but if the said vertical wire covers any other point, the brass circle that carries the hairs must be moved by a screw-key introduced through the perforation in the side of the tube at X, till it appears to bisect the line joining these two points as near as you can judge; then, by reverting the axis to its former position, you will find whether the wires be exactly adjusted. N. B. The ball *o* is a counterpoise to the centre of gravity of the semicircle *ik*, without which the telescope would not rest in an oblique elevation without being fixed by a screw or some other contrivance.

The several before-mentioned verifications being accomplished, if the telescope be elevated to any angle with the horizon, and there stopped, all fixed stars which pass over the three horizontal wires of the reticle on the eastern side of the meridian in ascending, will have precisely the same altitudes when in descending they again cross the same respective wires on the west side, and the middle between the times of each respective equal altitude will be the exact moment of the star's culminating or passing the meridian. By the help of a good pendulum-clock, the hour of their true meridional transits will be known, and consequently the difference of right ascension of different stars. Now, since it will be sufficient to observe a star which has north declination two or three hours before and after its passing the meridian, in order to deduce the times of its arrival at that circle; it follows, that having once found the difference of right ascension of two stars about 60 degrees asunder, and you again observe the first of these stand at the same altitude both in the east and west side, you infer with certainty the moment by the clock at which the second star will be on the meridian that same night, and by this means the transit instrument may be fixed in the true plane of the meridian till the next day; when, by depressing it to some distant land objects, a mark may be discovered whereby it may ever after be rectified very readily, so as to take the transits of any of the heavenly bodies to great exactness, whether by night or day.

When such a mark is thus found, the telescope being directed carefully to it, must be fixed in that position by pinching fast the end of the arm or lever between the two opposite screws *g h;* and if at any future time, whether from the effect of heat or cold on the wall to which the instrument is fixed, or by any settling of the wall itself, the mark appears no longer well bisected by the vertical wire, the telescope may easily be made to bisect it again, by giving a small motion to the pinching screws.

The transit instrument is now considered as one of the most essential particulars of the apparatus of an astronomical observatory.

Besides the above, may be mentioned,

The EQUATORIAL, *or* PORTABLE OBSERVATORY; an instrument designed to answer a number of useful purposes in practical astronomy, independent of any particular observatory. It may be made use of in any steady room or place, and performs most of the useful problems in the science. The following is a description of one lately invented by Mr Ramsden, from whom it has received the name of the *Universal Equatorial.* 434 Portable observatory.

The principal parts of this instrument (fig. 179.) are, 1. The azimuth or horizontal circle A, which represents the horizon of the place, and moves on a long axis B, called the *vertical axis.* 2. The equatorial or hour circle C, representing the equator, placed at right angles to the polar axis D, or the axis of the earth, upon which it moves. 3. The semicircle of declination E, on which the telescope is placed, and moving on the axis of declination, or the axis of motion of the line of collimation F. These circles are measured and divided as in the following table:

Measures

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Measures of the several circles and divisions on them.	Radius indec.		Limb divided to	Nonius of 30 gives seconds.	Divided on limb into parts of inc.	Divided by Nonius into parts of inc.
Azimuth or horizontal circle	5	1	15′	30″	45th	1350th
Equatorial or hour circle	5	1	15′ / 1′ in time	30′ / 2″	45th	1350th
Vertical semicircle for declination or latitude.	5	5	15′	30″	42d	1260th

4. The telescope, which is an achromatic refractor with a triple object-glass, whose focal distance is 17 inches, and aperture 2.45 inches, and furnished with six different eye-tubes; so that its magnifying powers extend from 44 to 168. The telescope in this equatorial may be brought parallel to the polar axis, as in the figure, so as to point to the pole star in any part of its diurnal revolution; and thus it has been observed near noon, when the sun has shone very bright. 5. The apparatus for correcting the error in altitude occasioned by refraction, which is applied to the eye-end of the telescope, and consists of a slide G moving in a groove or dove-tail, and carrying the several eye-tubes of the telescope, on which slide there is an index corresponding to five small divisions engraved on the dove-tail; a very small circle, called the refraction circle H, moveable by a finger-screw at the extremity of the eye-end of the telescope; which circle is divided into half minutes, one entire revolution of it being equal to 3′ 18″, and by its motion raises the centre of the cross hairs on a circle of altitude; and likewise a quadrant I of $1\frac{1}{2}$ inch radius, with divisions on each side, one expressing the degree of altitude of the object viewed, and the other expressing the minutes and seconds of error occasioned by refraction, corresponding to that degree of altitude: to this quadrant is joined a small round level K, which is adjusted partly by the pinion that turns the whole of this apparatus, and partly by the index of the quadrant; for which purpose the refraction circle is set to the same minute, &c. which the index points to on the limb of the quadrant; and if the minute, &c. given by the quadrant exceed the 3′ 18″ contained in one entire revolution of the refraction circle, this must be set to the excess above one or more of its entire revolutions; then the centre of the cross hairs will appear to be raised on a circle of altitude to the additional height which the error of refraction will occasion at that altitude.

This instrument stands on three feet L distant from each other 14.4 inches: and when all the parts are horizontal is about 29 inches high: the weight of the equatorial and apparatus is only 59 lb. avoirdupois, which are contained in a mahogany case weighing 58 lb.

The principal adjustment in this instrument is that of making the line of collimation to describe a portion of an hour-circle in the heavens; in order to which, the azimuth circle must be truly level; the line of collimation, or some corresponding line represented by the small brass rod M parallel to it, must be perpendicular to the axis of its own proper motion; and this last axis must be perpendicular to the polar axis: on the brass rod M there is occasionally placed a hanging level N, the use of which will appear in the following adjustments:

The azimuth circle may be made level by turning the instrument till one of the levels is parallel to an imaginary line joining two of the feet screws; then adjust that level with these two feet screws; turn the circle half round, i. e. 180°; and if the bubble be not then right, correct half the error by the screw belonging to the level, and the other half error by the two foot screws; repeat this till the bubble comes right; then turn the circle 90° from the two former positions, and set the bubble right, if it be wrong, by the foot screw at the end of the level; when this is done, adjust the other level by its own screw, and the azimuth circle will be truly level. The hanging level must then be fixed to the brass rod by two hooks of equal length, and made truly parallel to it: for this purpose make the polar axis perpendicular or nearly perpendicular to the horizon; then adjust the level by the pinion of the declination-semicircle; reverse the level, and if it be wrong, correct half the error by a small steel screw that lies under one end of the level, and the other half-error by the pinion of the declination-semicircle; repeat this till the bubble be right in both positions. In order to make the brass rod on which the level is suspended at right angles to the axis of motion of the telescope or line of collimation, make the polar axis horizontal, or nearly so: set the declination-semicircle to 0°, turn the hour-circle till the bubble comes right; then turn the declination-circle to 90°; adjust the bubble by raising or depressing the polar axis (first by hand till it be nearly right, afterwards tighten with an ivory key the socket which runs on the arch with the polar axis, and then apply the same ivory key to the adjusting screw at the end of the said arch till the bubble comes quite right); then turn the declination-circle to the opposite 90°; if the level be not then right, correct half the error by the aforesaid adjusting screw at the end of the arch, and the other half error by the two screws which raise or depress the end of the brass rod. The polar axis remaining nearly horizontal as before, and the declination-semicircle at 0°, adjust the bubble by the hour-circle; then turn the declination-semicircle to 90°, and adjust the bubble by raising or depressing the polar axis; then turn the hour-circle 12 hours; and if the bubble be wrong, correct half the error by the polar axis, and the other half error by the two pair of capstan screws at the feet of the two supports on one side of the axis of motion

Fig. 1.

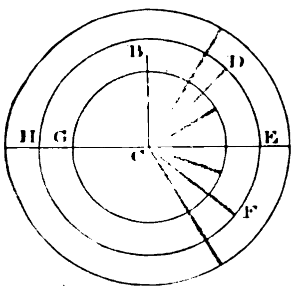


Fig. 2.

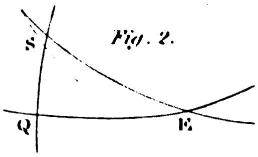


Fig. 3.

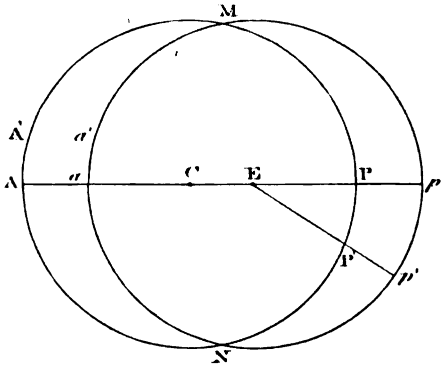


Fig. 4.

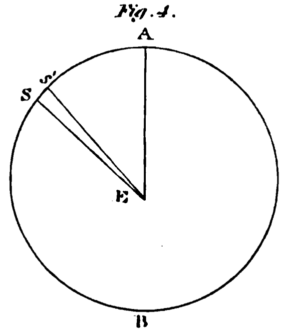


Fig. 5.

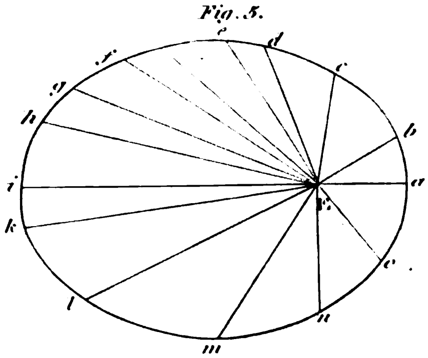


Fig. 6.

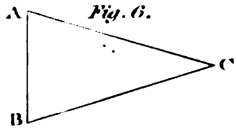


Fig. 8.

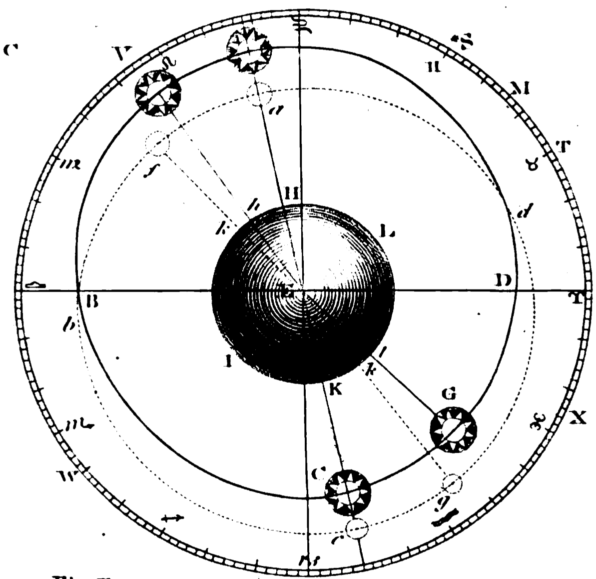
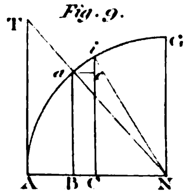


Fig. 9.



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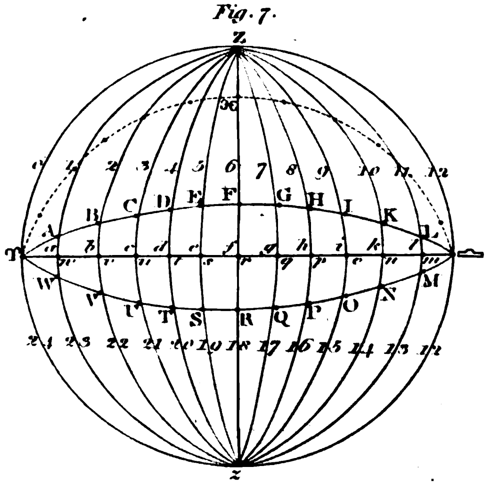

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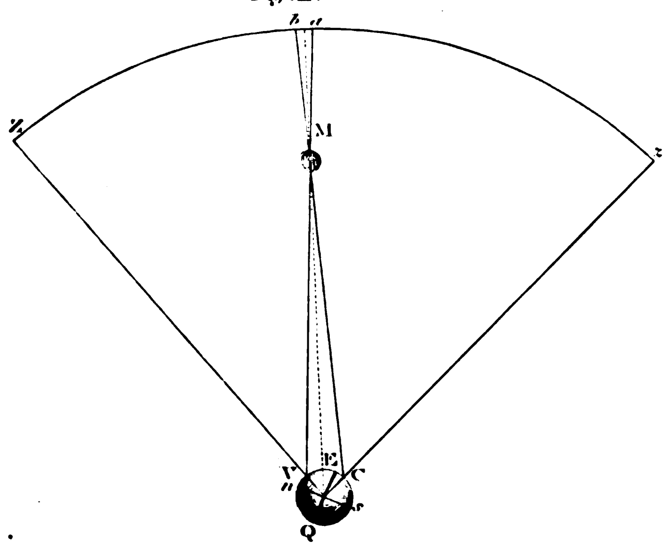

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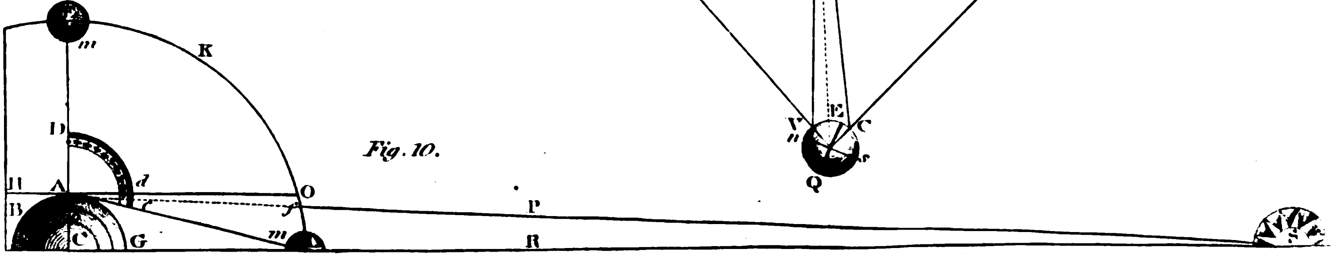

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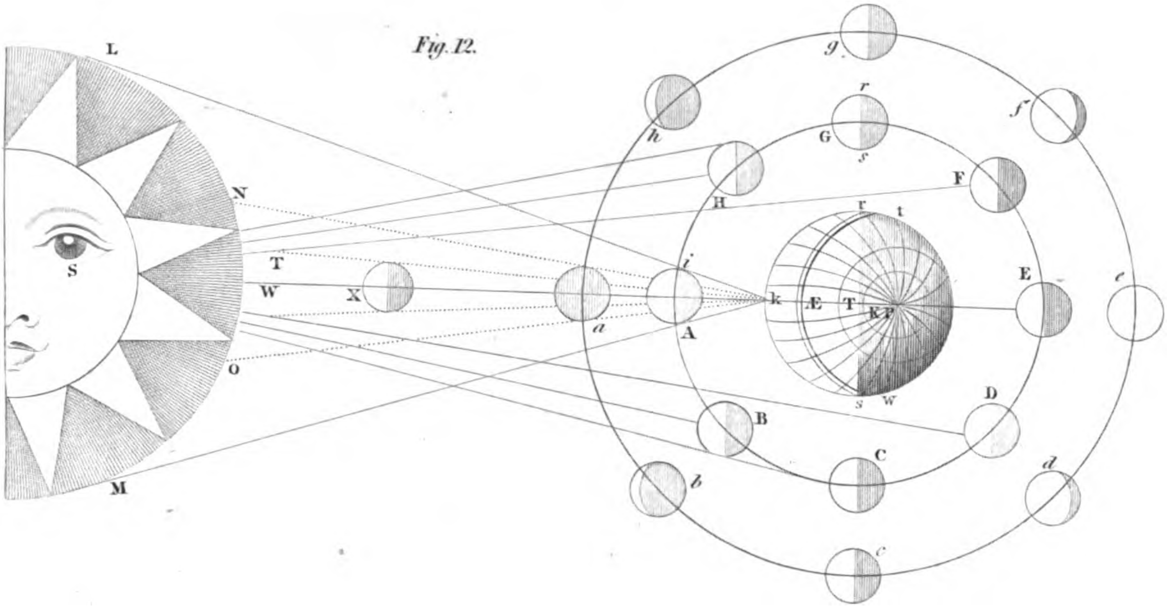

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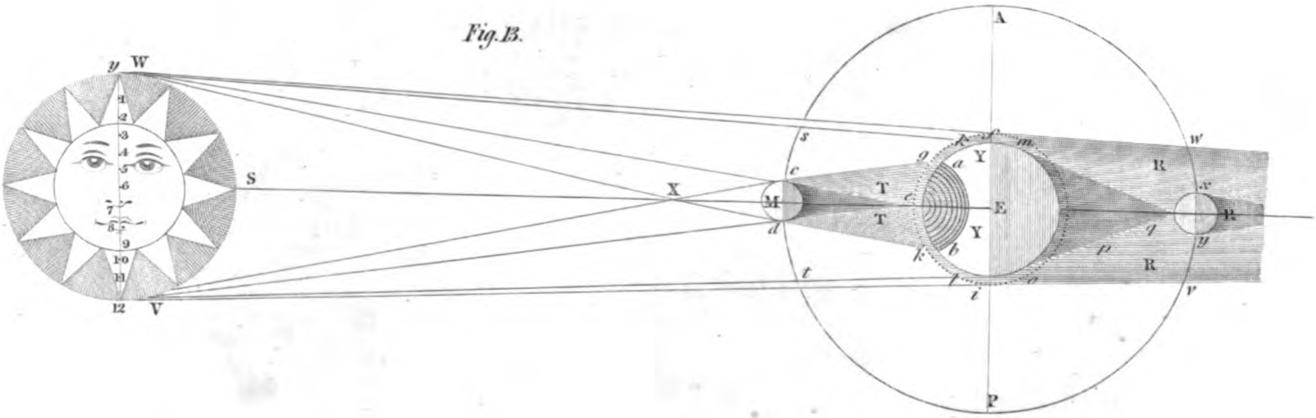

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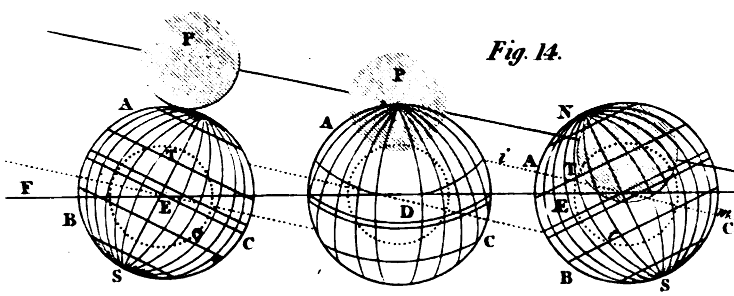

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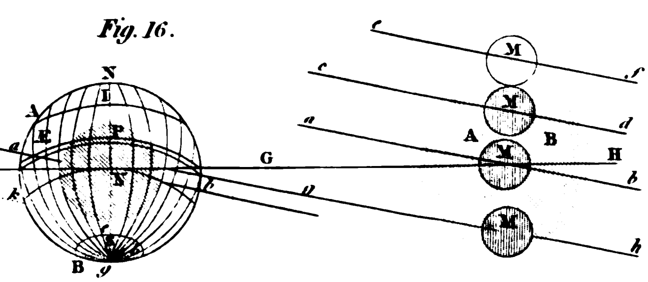

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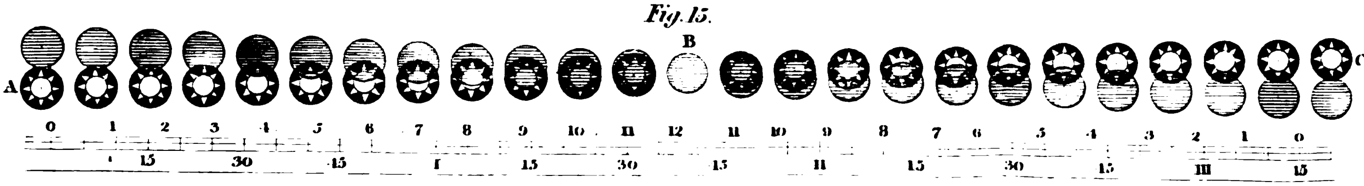

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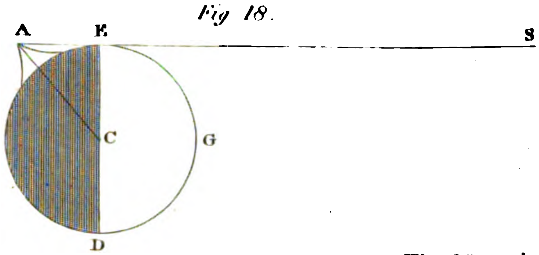

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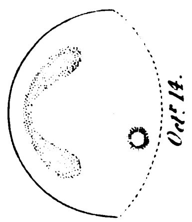


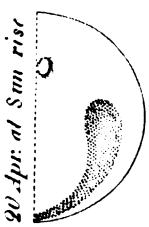
Fig. 20.

Fig. 17.

The Moon in her mean libration
with the Spots according to Riccioli Cassini &c.

South

Fig. 21.



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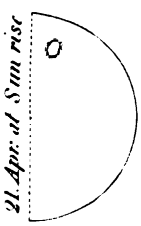

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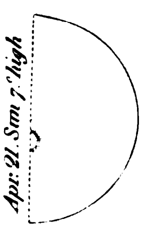

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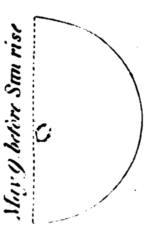

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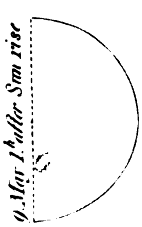

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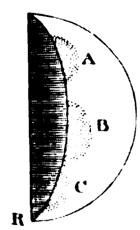

E. Mitchell sculp.

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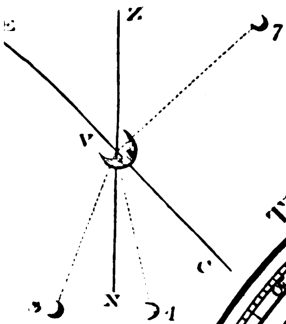
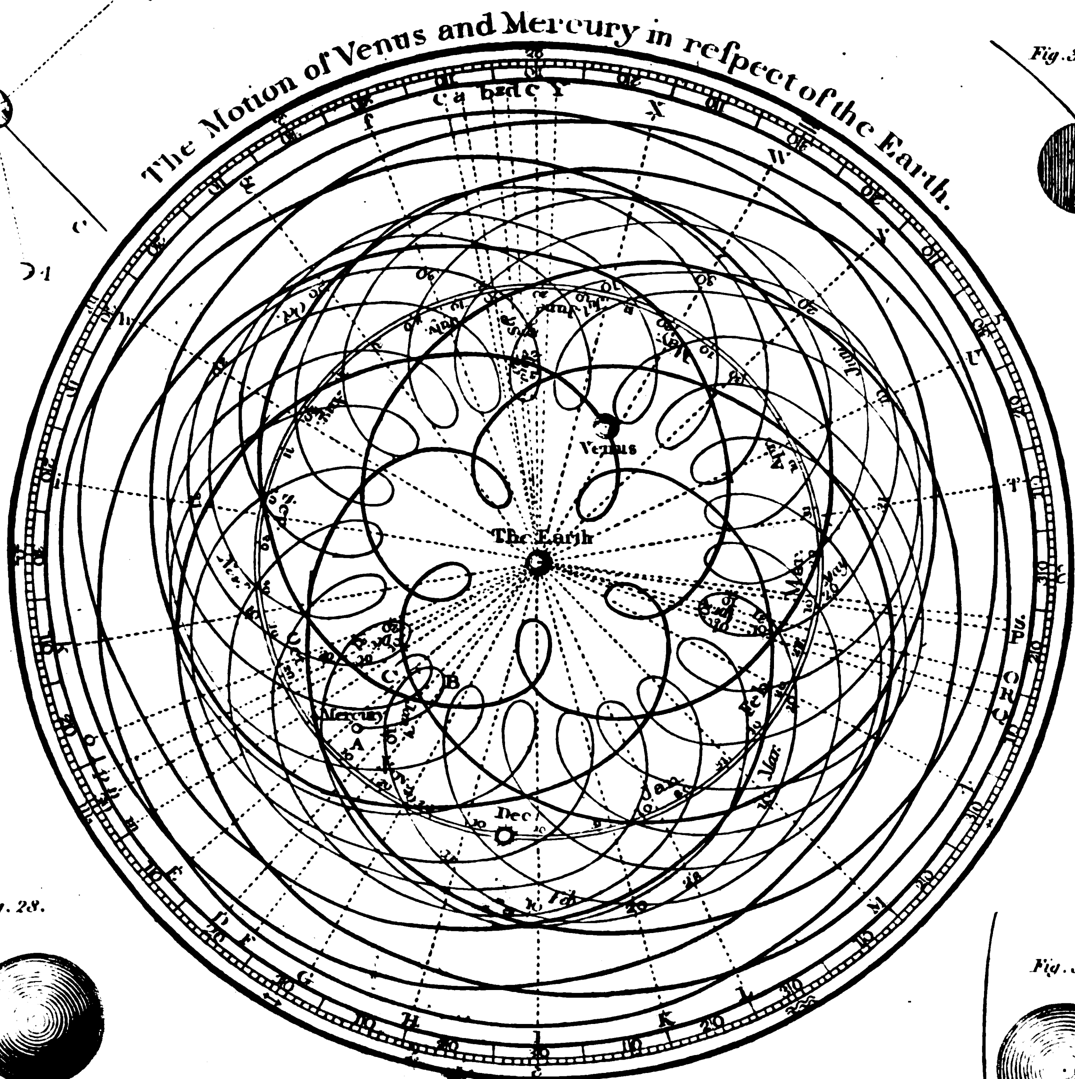
Fig. 27.





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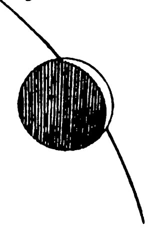

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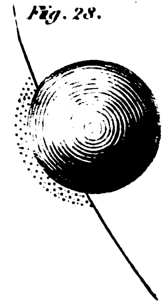

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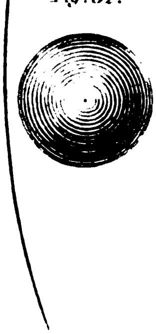

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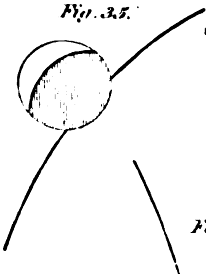

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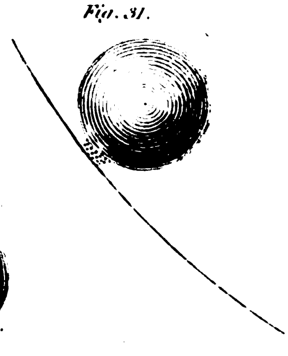

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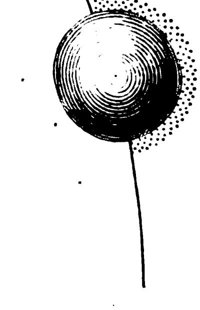

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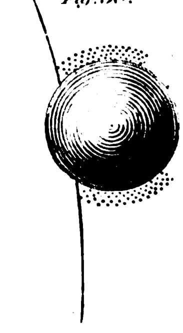

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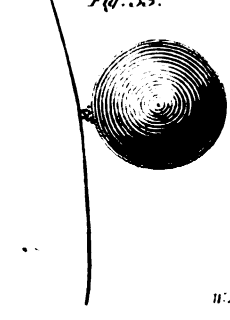

W. Archibald sculp.

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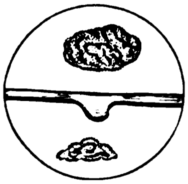
Fig. 36.



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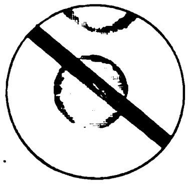

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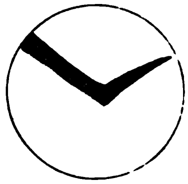

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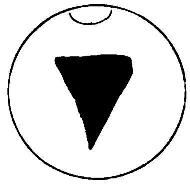

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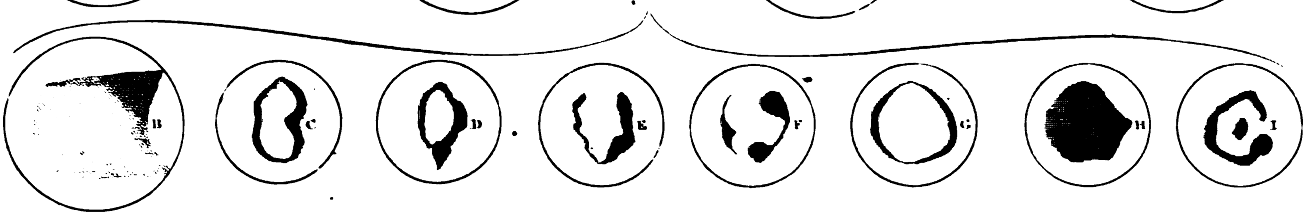


Fig. 41.

Fig. 42.

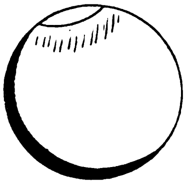
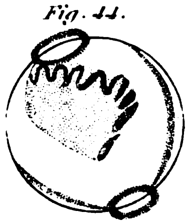


Fig. 43.

Fig. 44.



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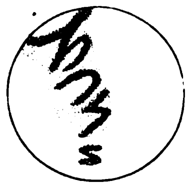

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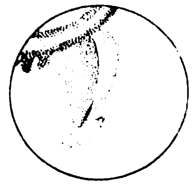

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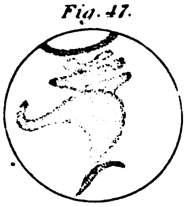
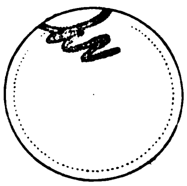


Fig. 48.

Fig. 49.



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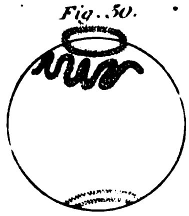
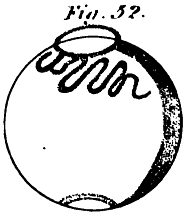


Fig. 51.

Fig. 52.



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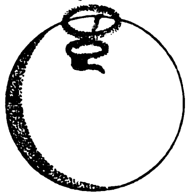

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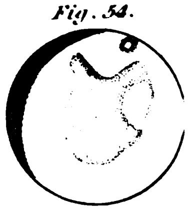
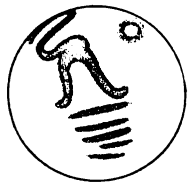


Fig. 55.

Fig. 56.



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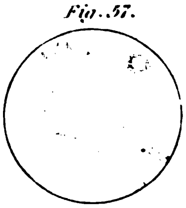

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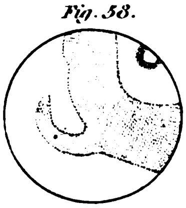

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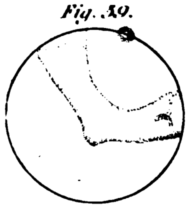

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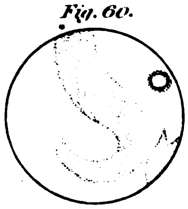

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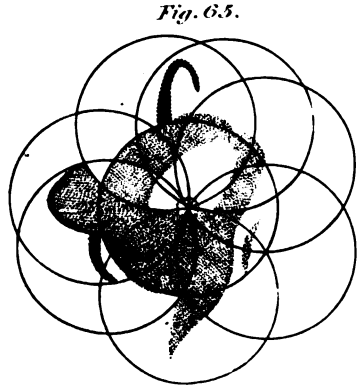

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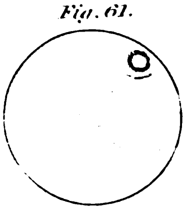
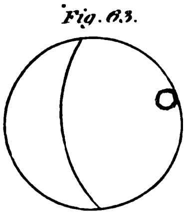


Fig. 62.

Fig. 63.



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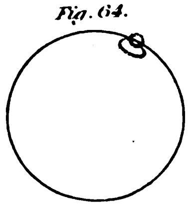

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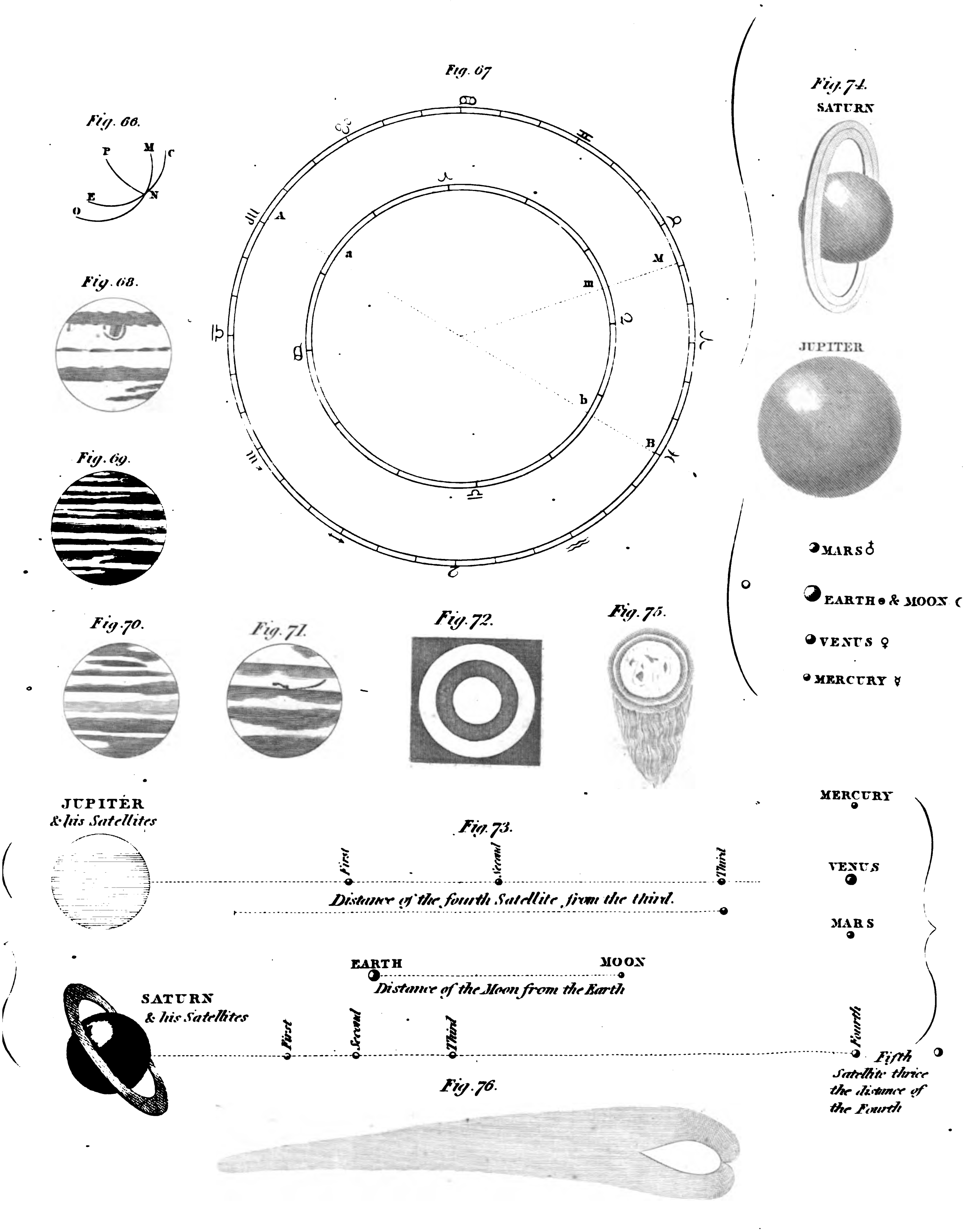

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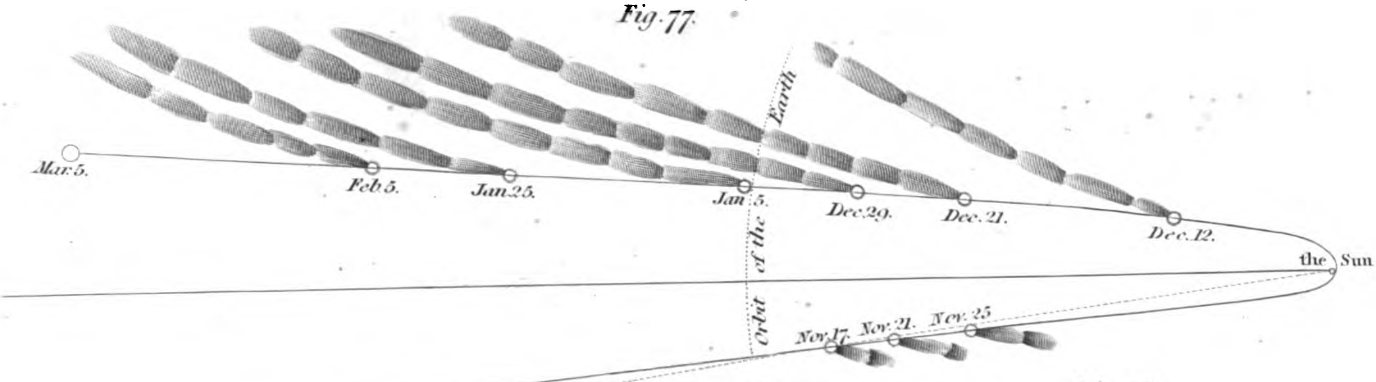
Fig. 77.



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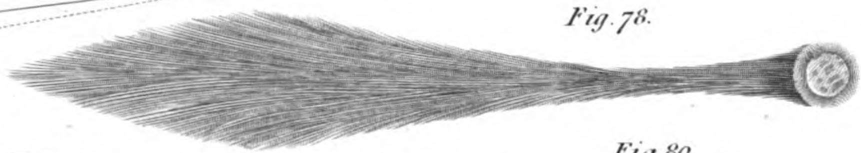

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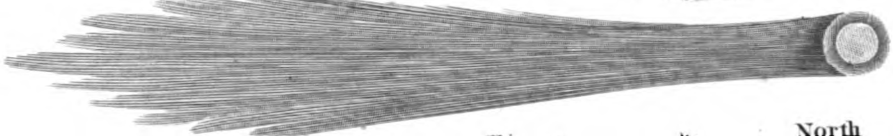

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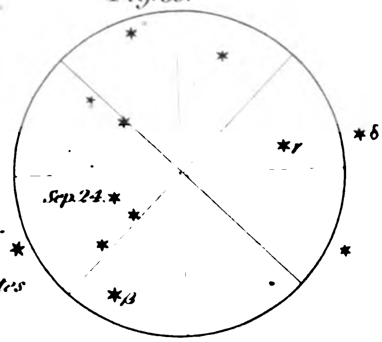

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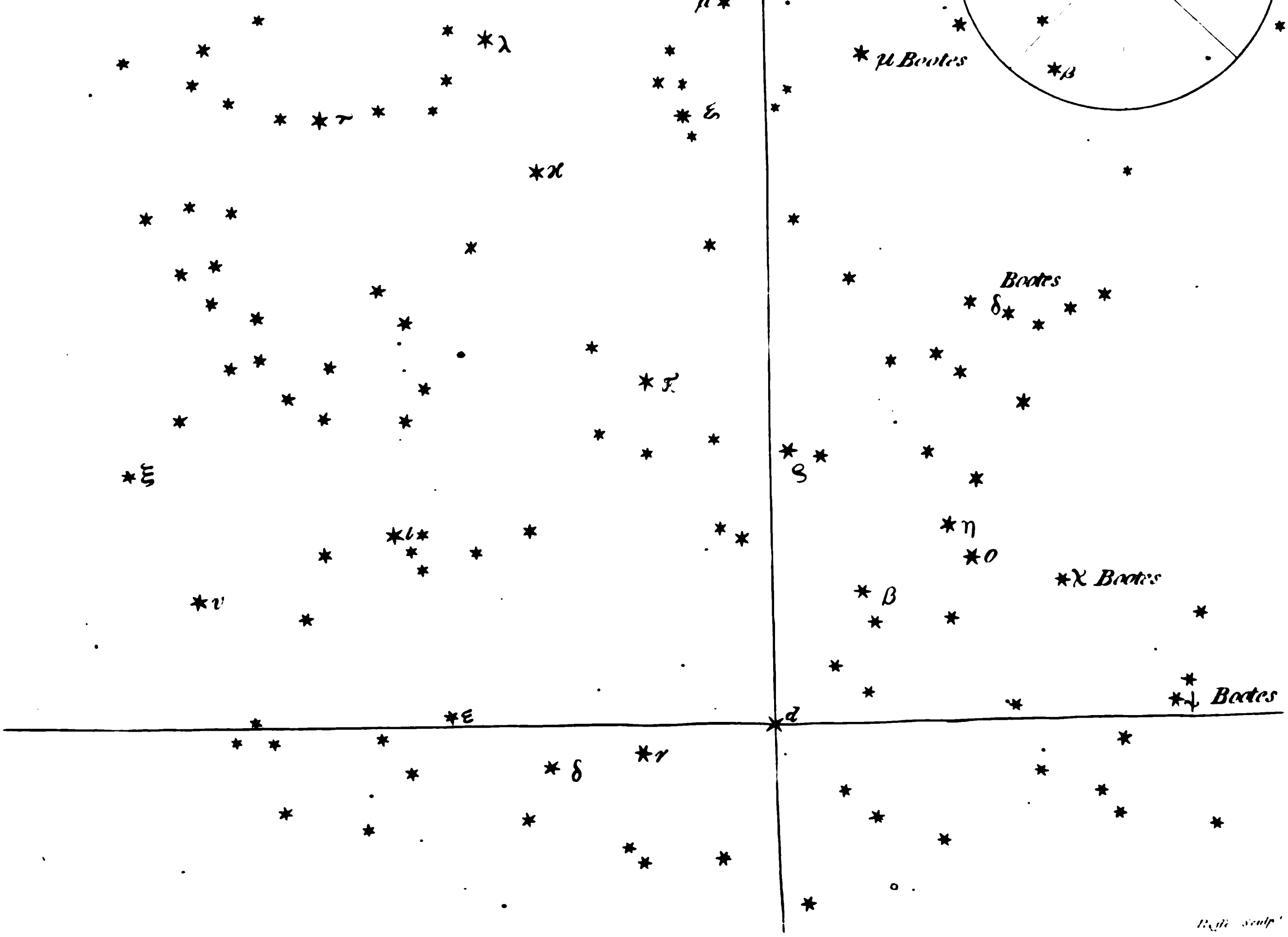

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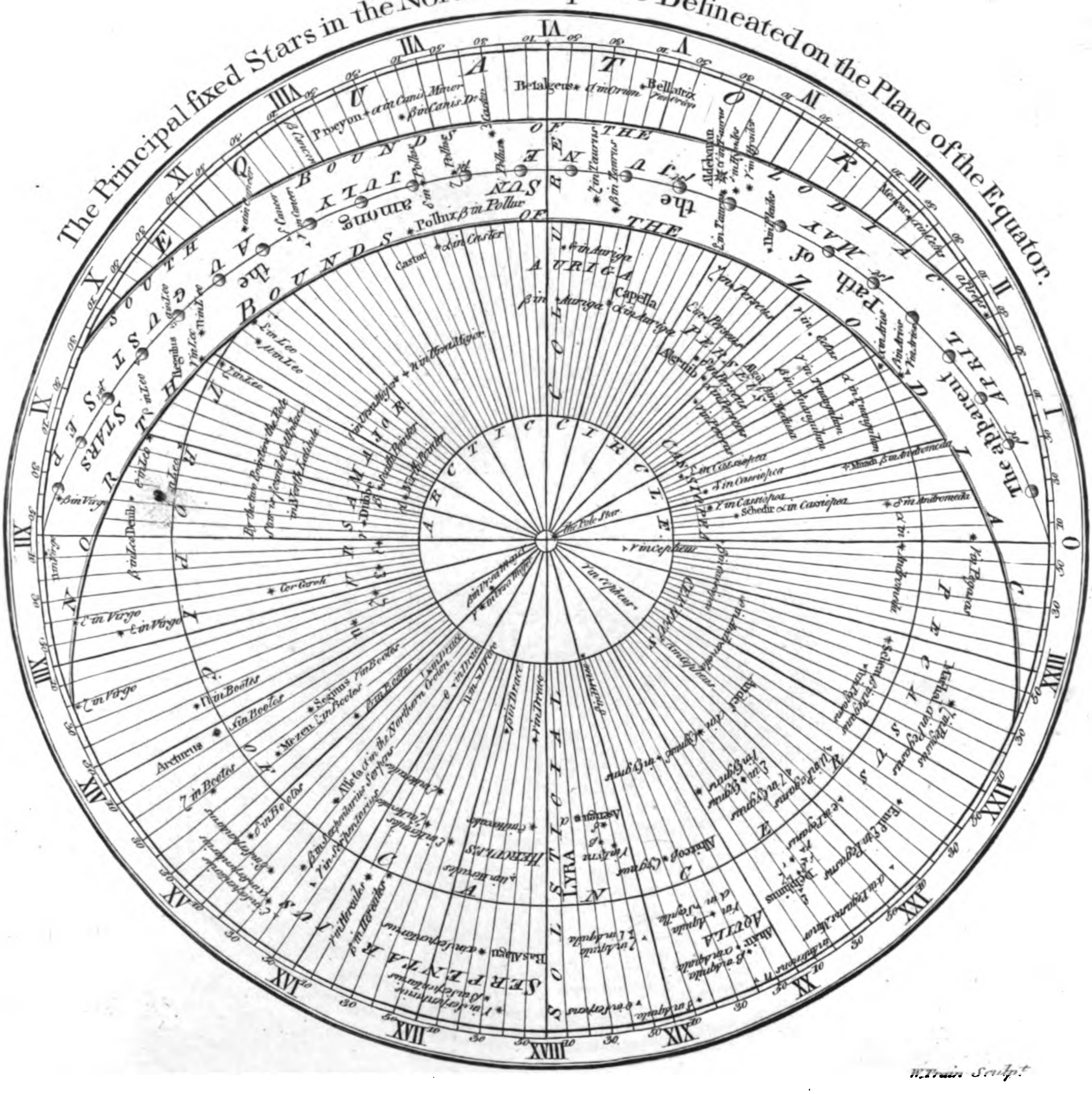
Fig. 82.

The Principal fixed Stars in the North Hemisphere Delineated on the Plane of the Equator.



W. Train Sculp.t

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Fig. 82. a

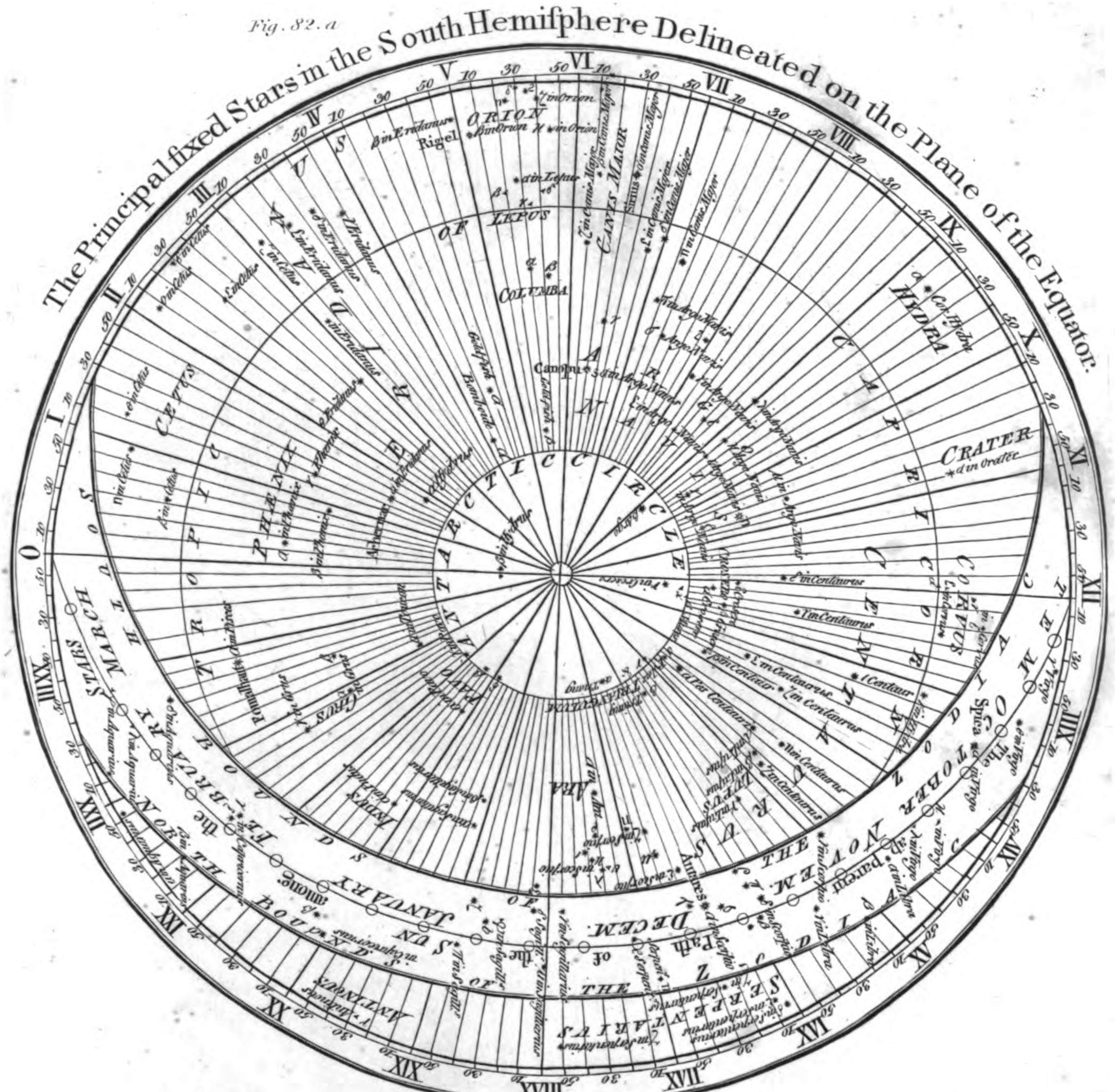

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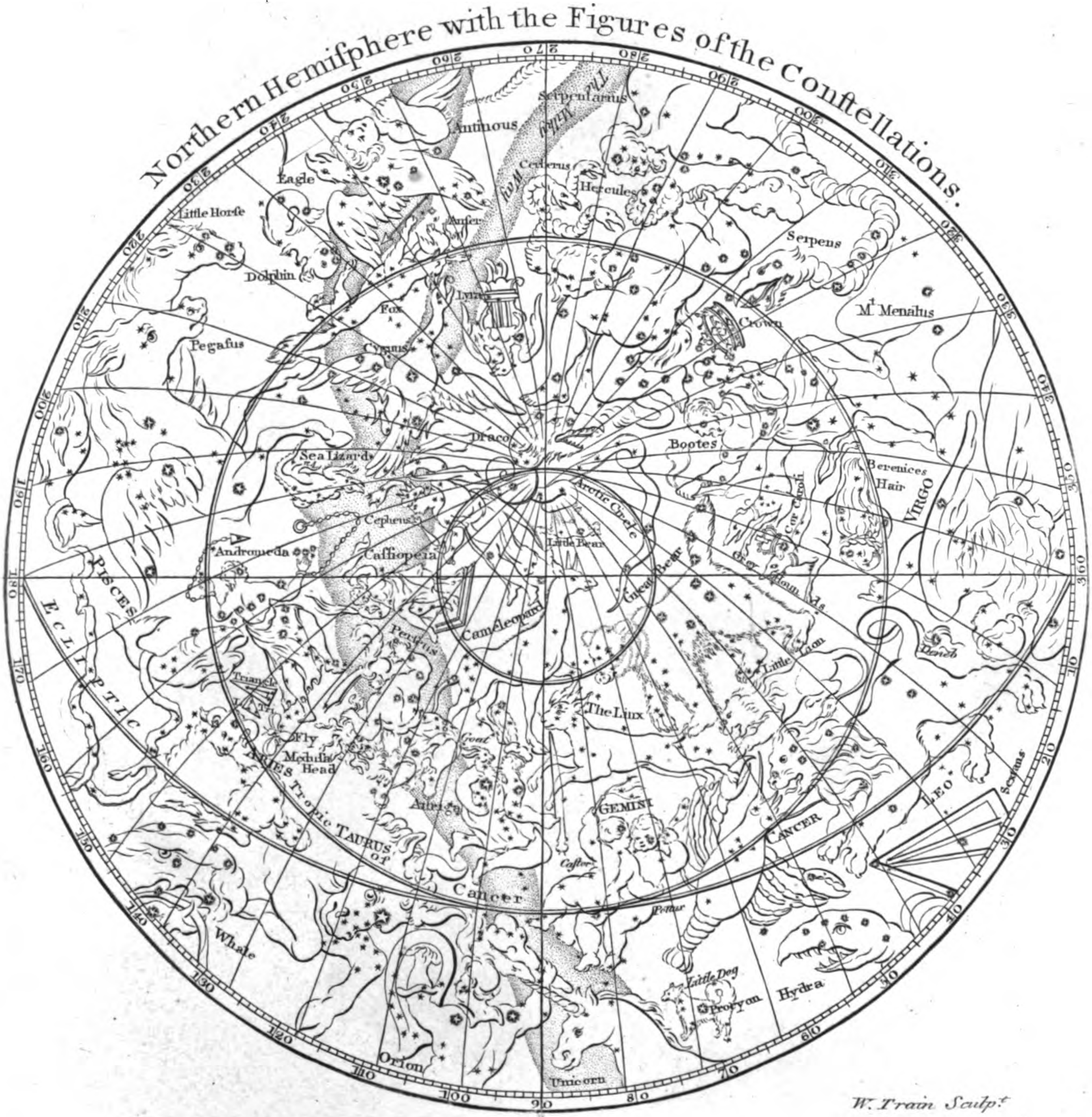
Fig. 82. b



W. Train Sculp.t

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Fig. 82. c


Southern Hemisphere with the Figures of the Constellations.
Serpens
Serpentarius
Antinous
The Sobieski's Shield
Sagittarius
Capricornus
Aquarius
Libra
Scorpio
Milky Way
Ecliptic
The Wolf
The Alter
S Crown
Cross
Indus
Peacock
The Crane
Crow
Centaur
Tropic of Capricorn
Apus
Toucan
Antarctic Circle
Chameleon
Hydrus
Phoenix
Virgo
Royal Oak
Flying Fish
The Cup
Xiphias
The Whale
The Ship
Eridanus
Hydra
Sextans
Noah's Dove
Great Dog
The Hare
Unicorn
Orion
W. Train Sculpt.

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Fig. 83.

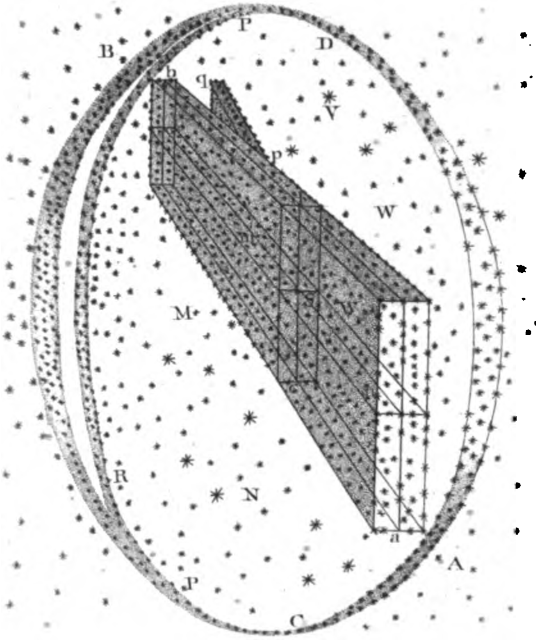


Fig. 84.

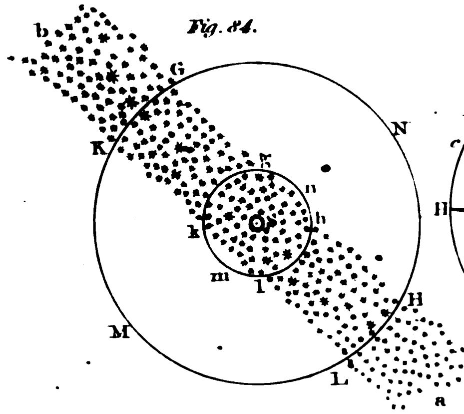


Fig. 86.

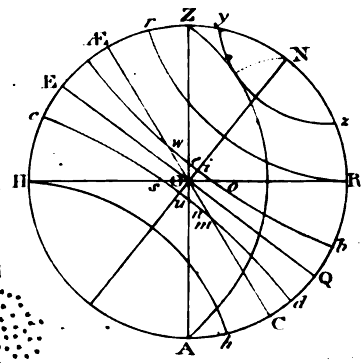
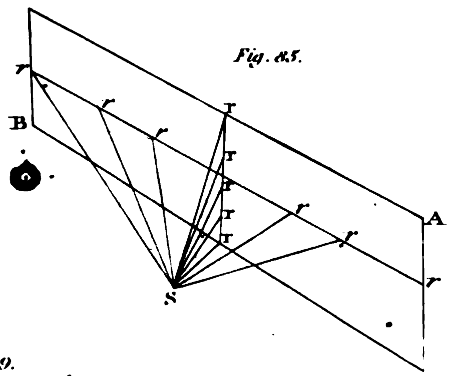


Fig. 85.



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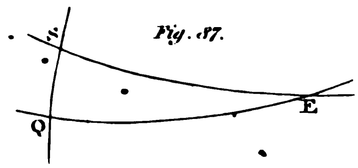


Fig. 88.

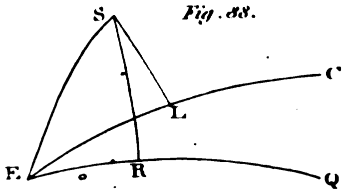


Fig. 89.

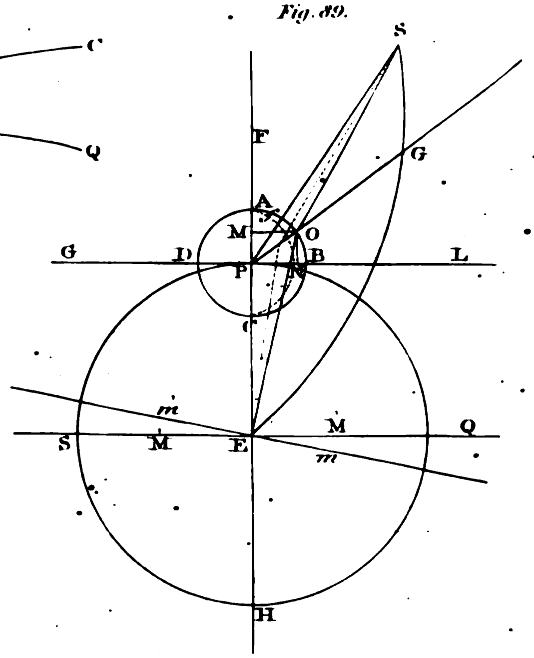


Fig. 90.

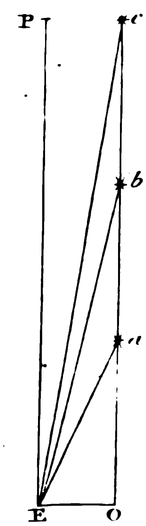
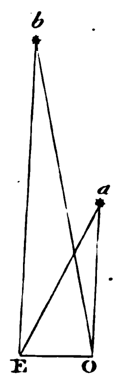


Fig. 91.



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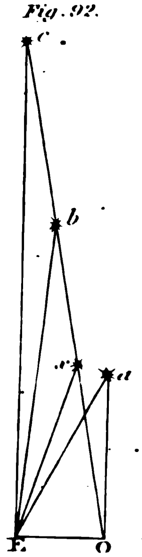

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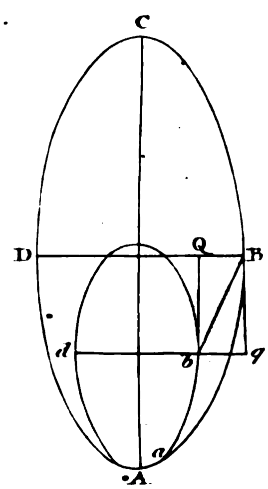

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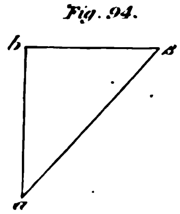

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Fig. 96. & 103.

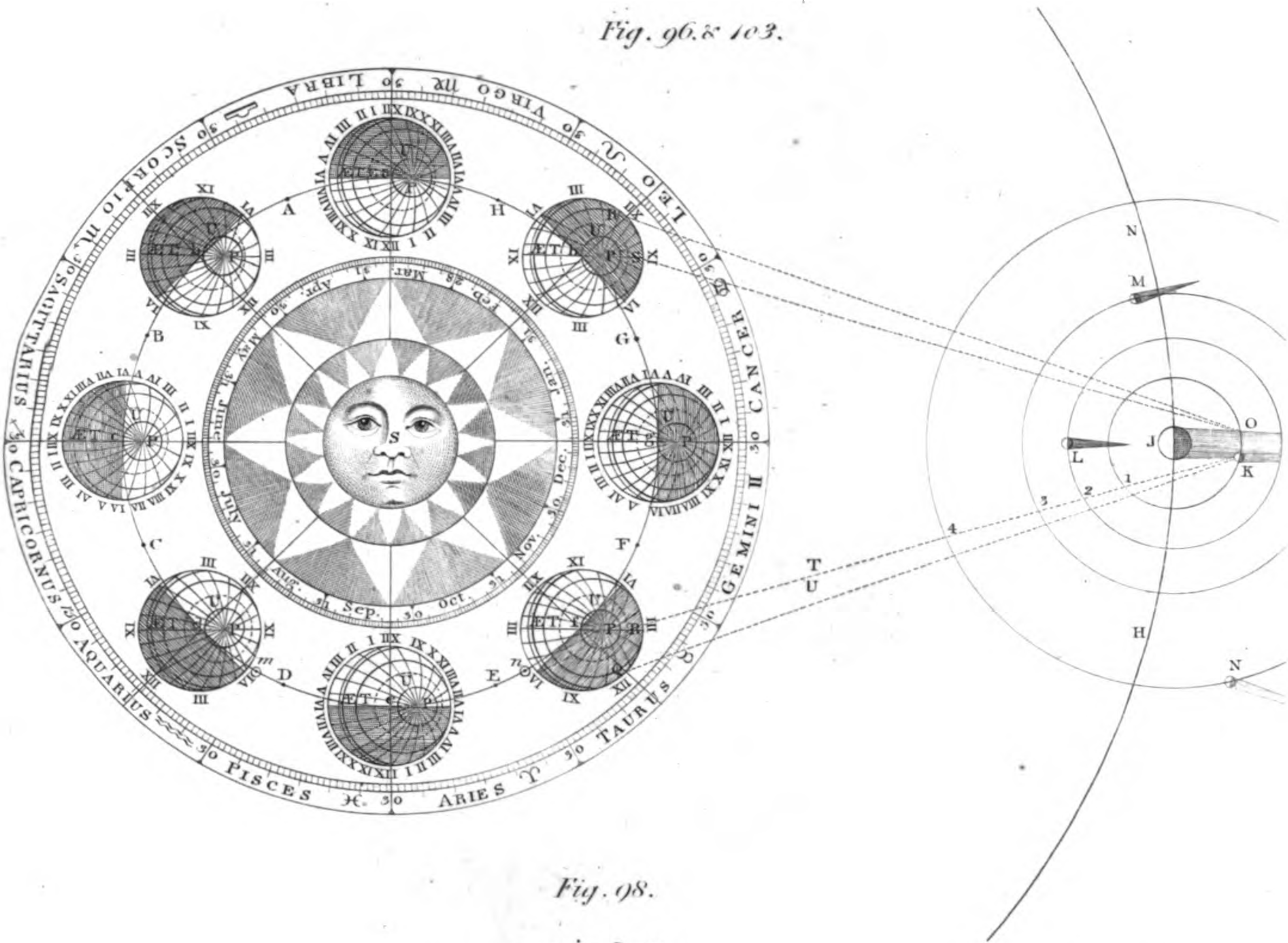
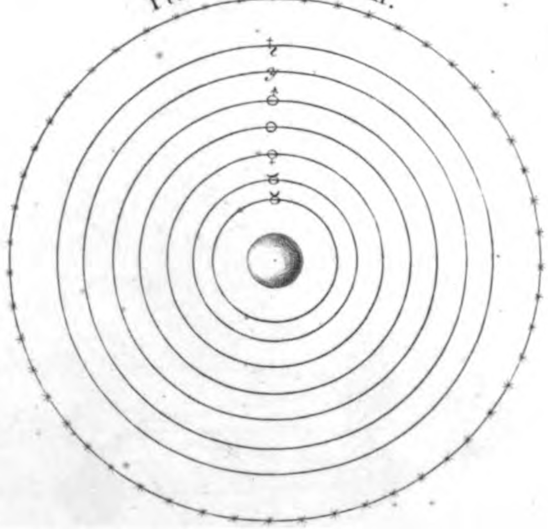


Fig. 98.

Ptolemaic System.



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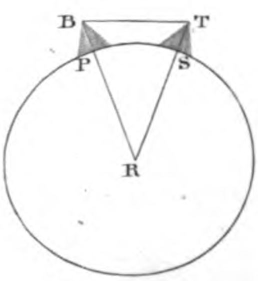

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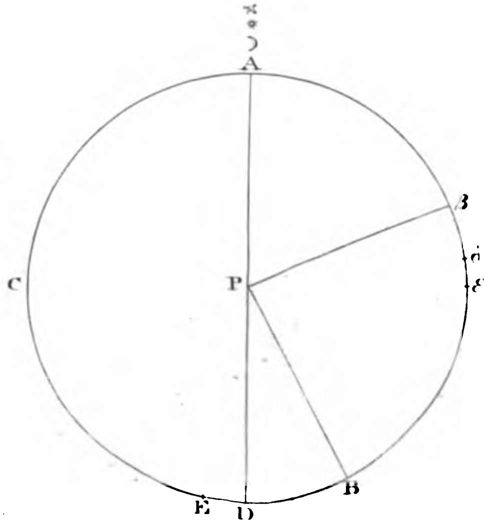

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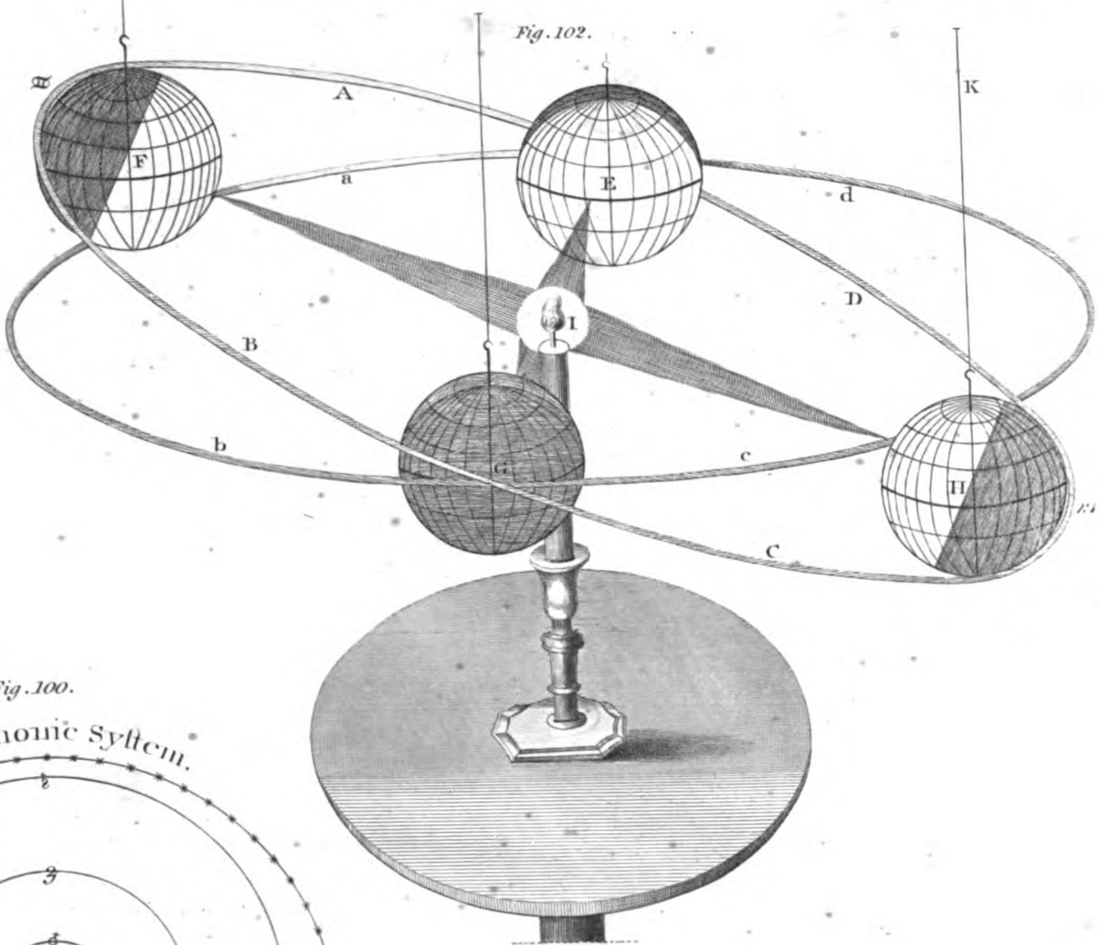

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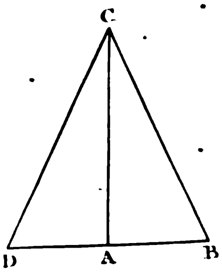
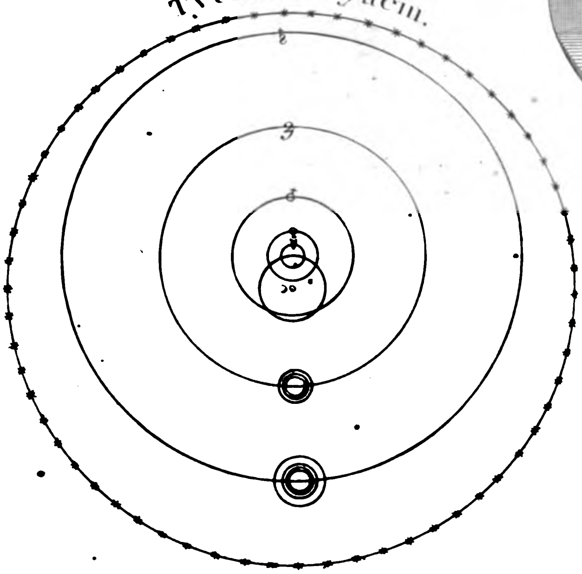


Fig. 100.

Tychonic Syſtem.



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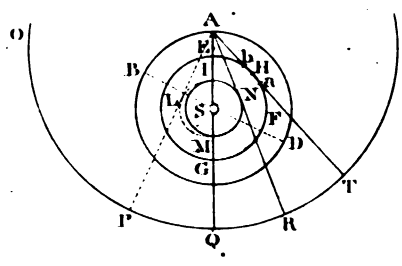

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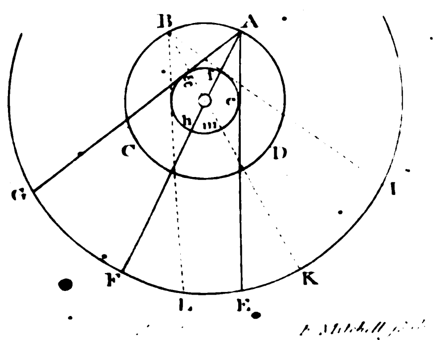

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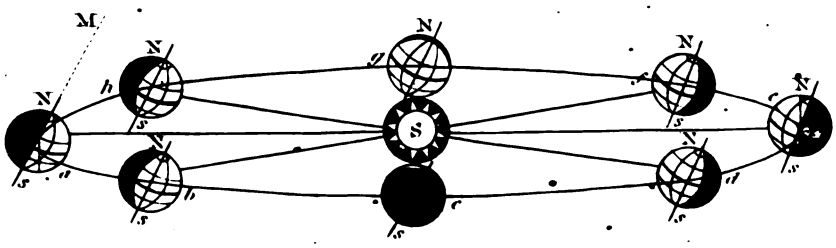

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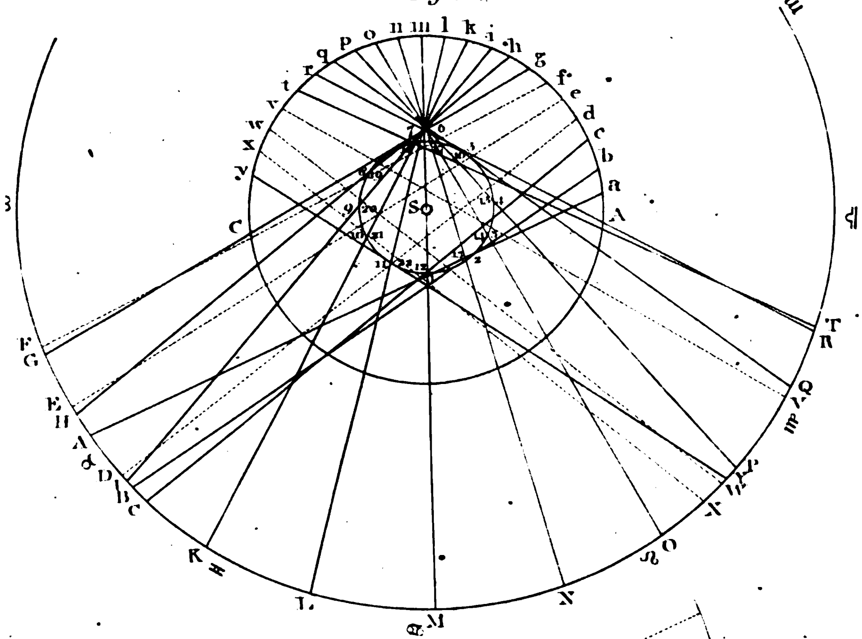
Fig. 107.



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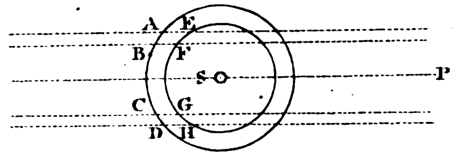

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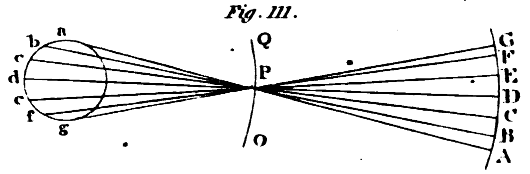

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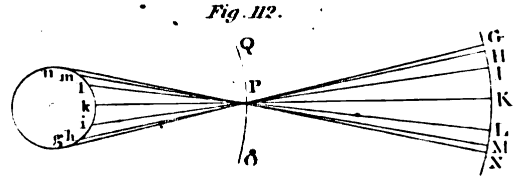

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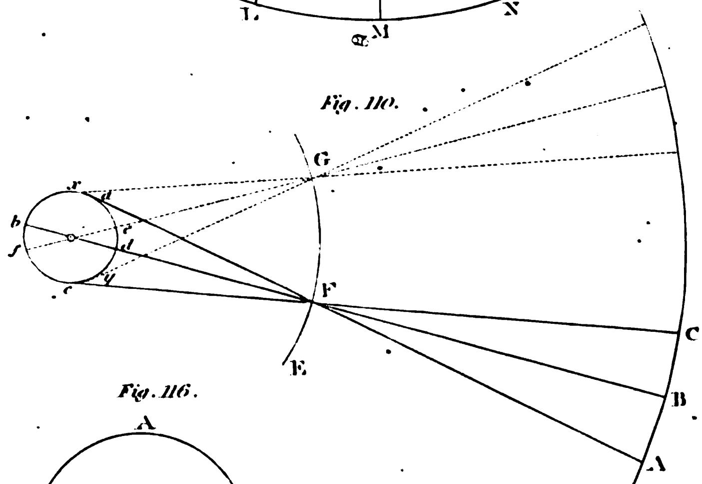

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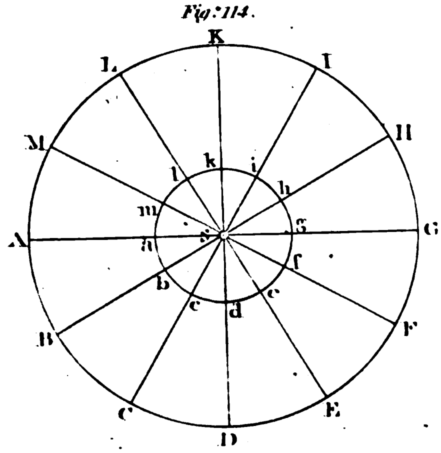

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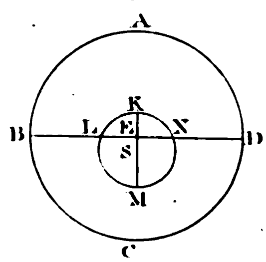

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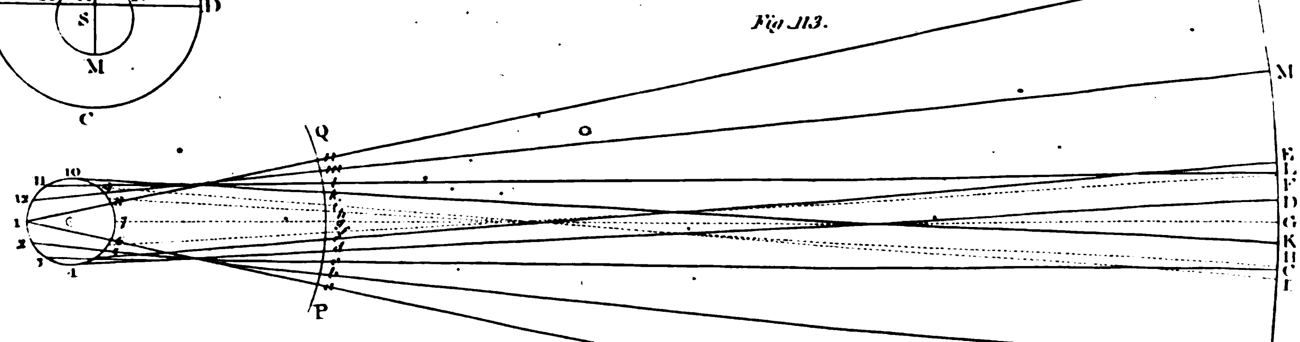

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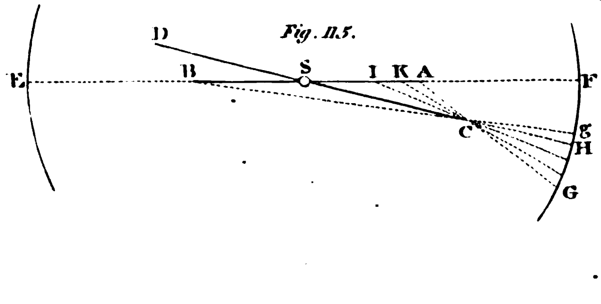

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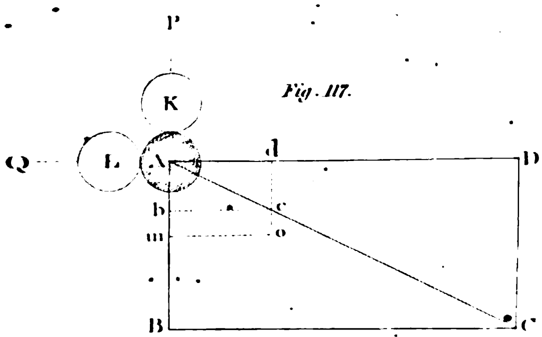
Fig. 117.



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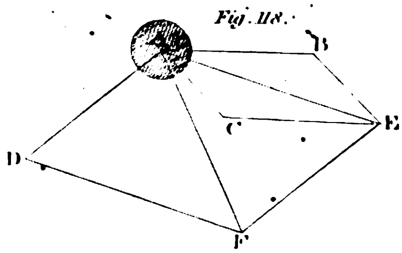

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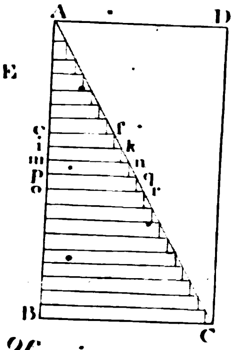

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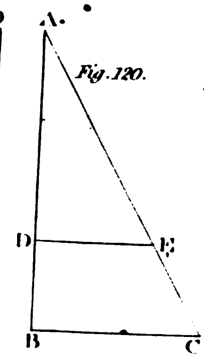

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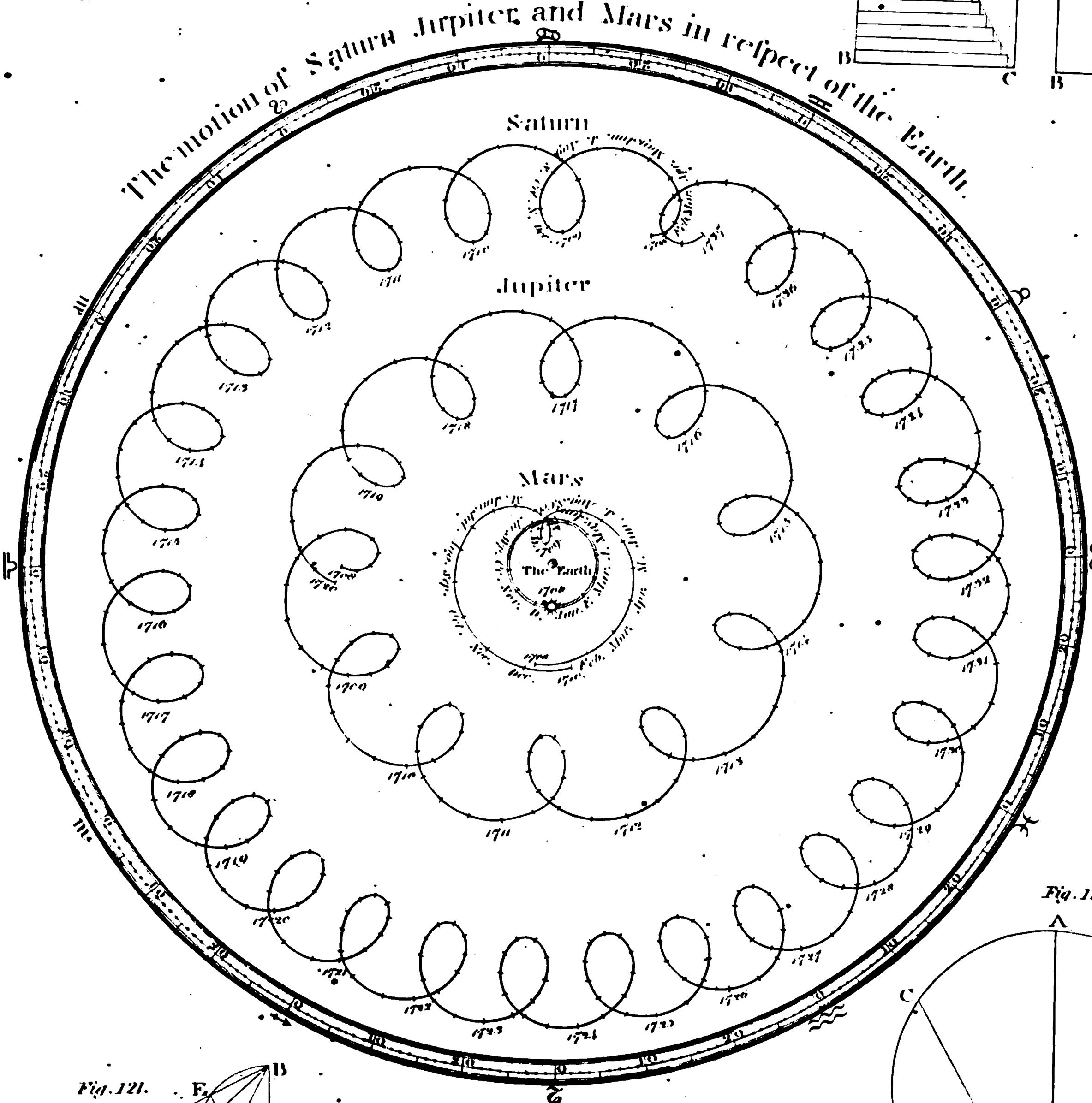

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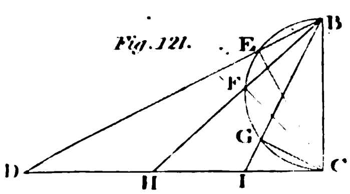

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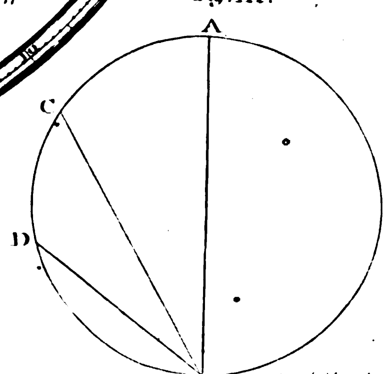

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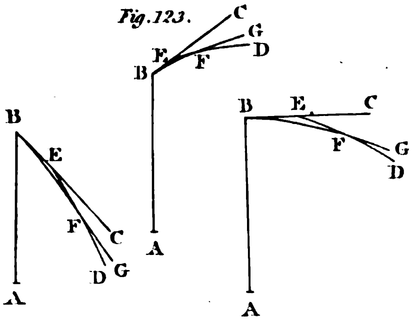

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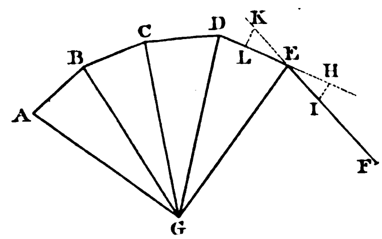

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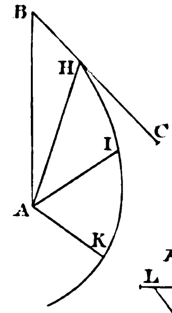

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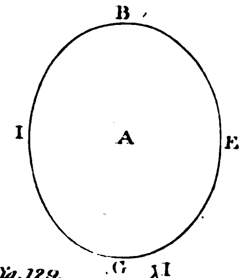

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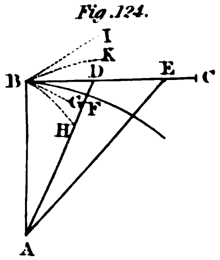

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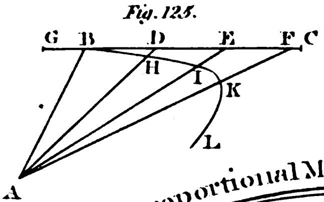

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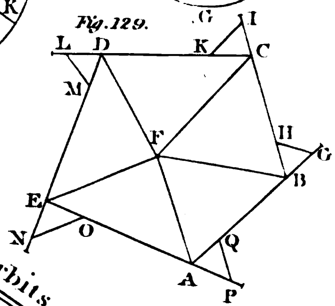

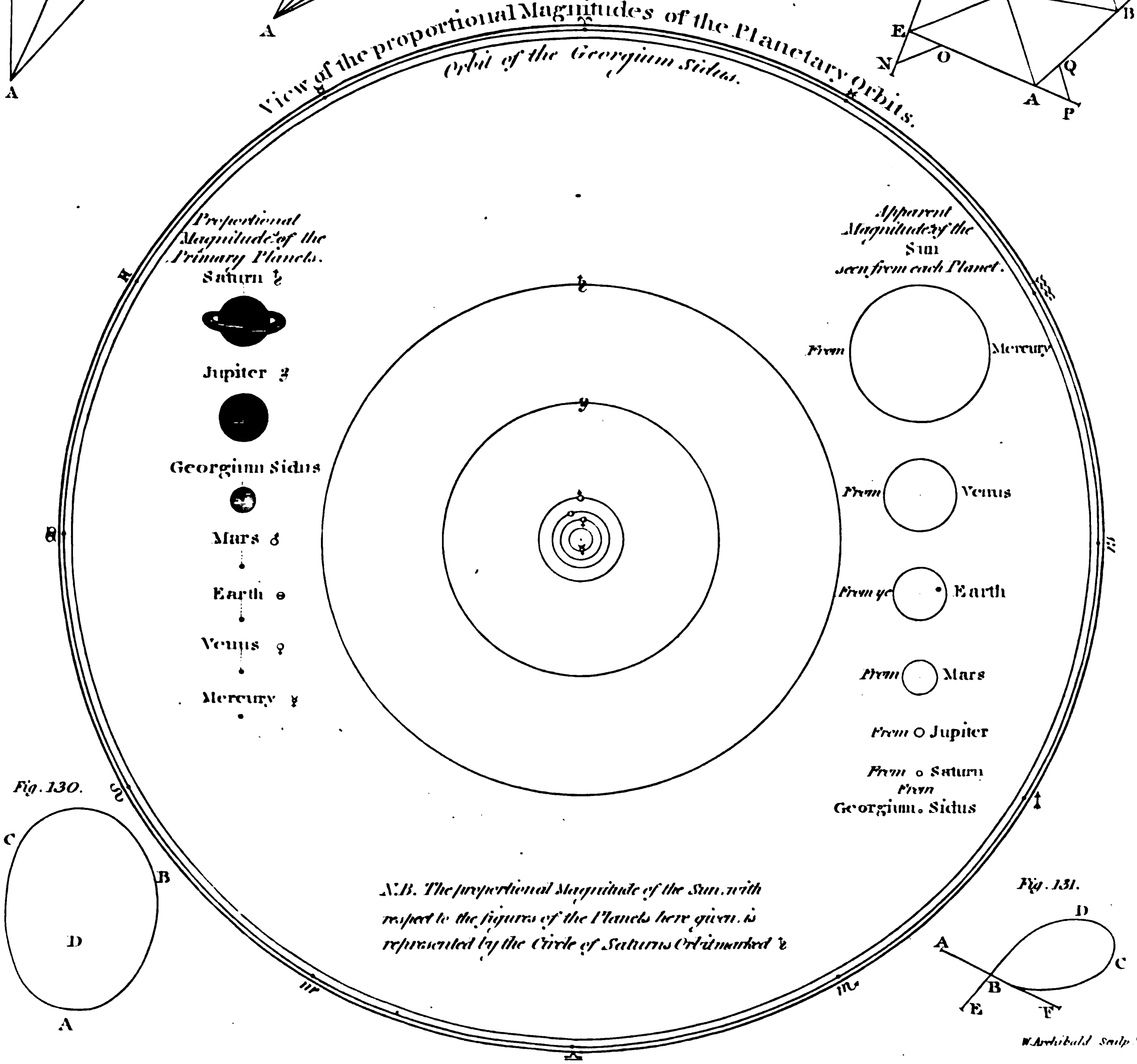

Fig. 130.

Fig. 131.

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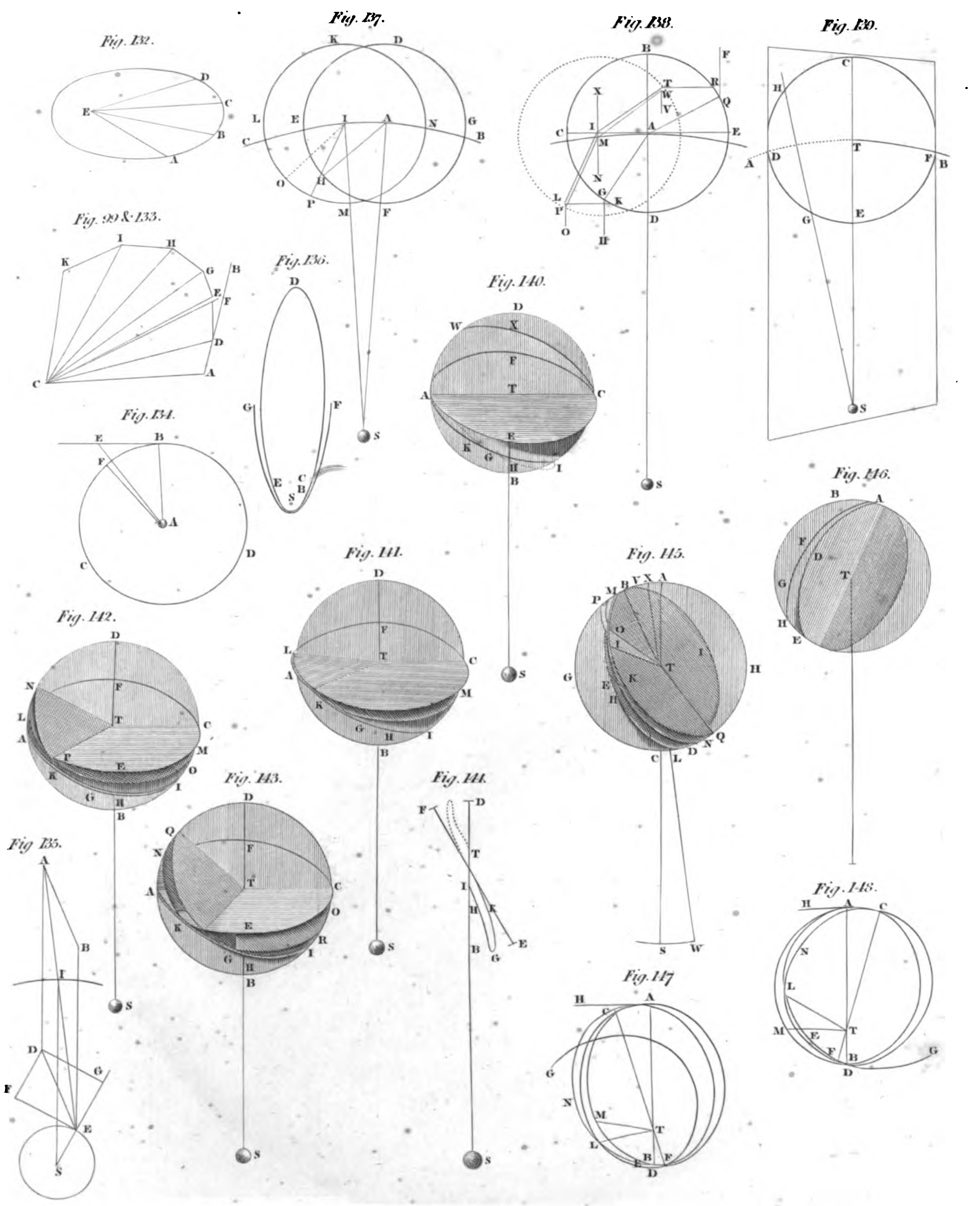

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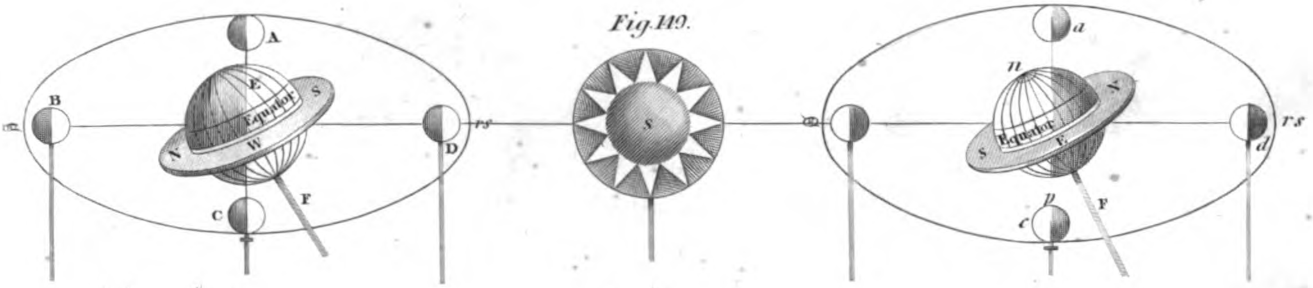

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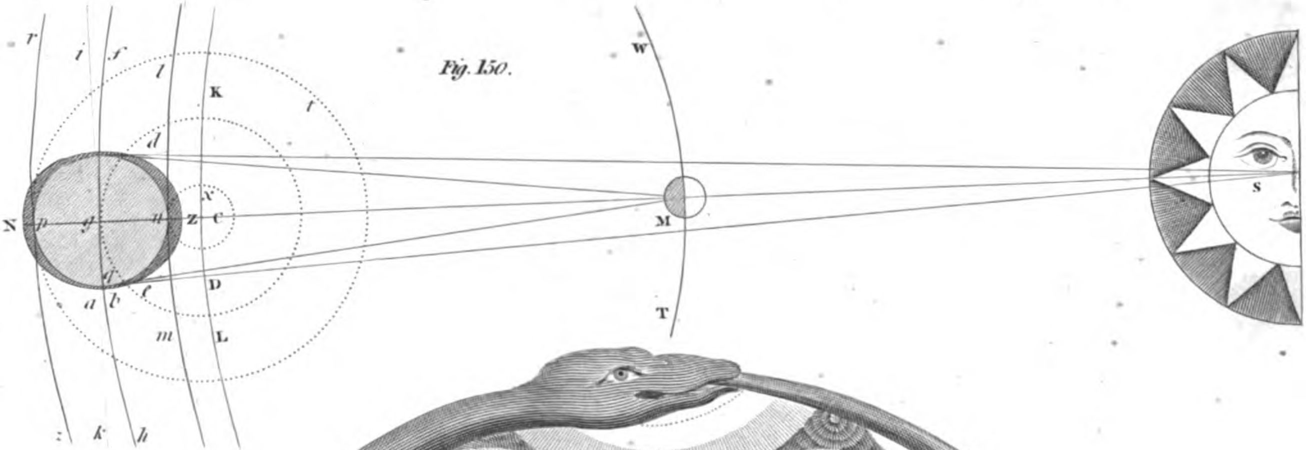

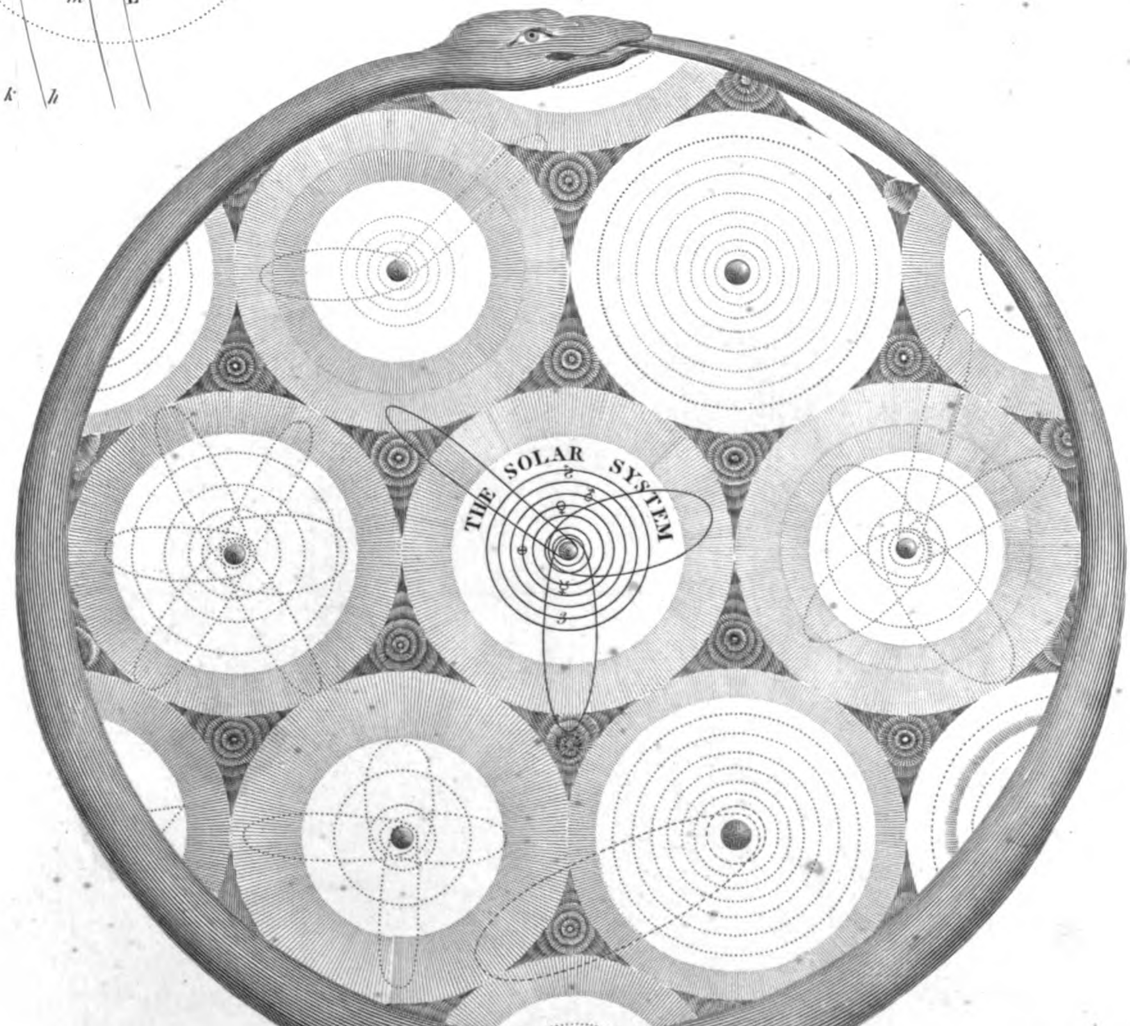

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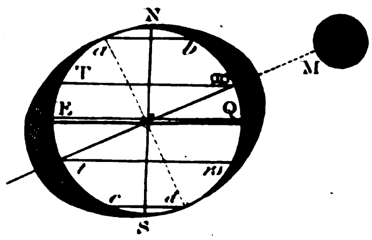

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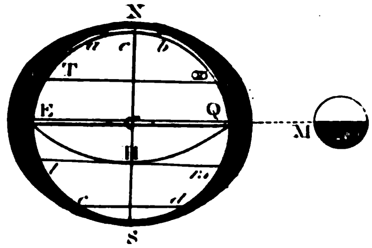

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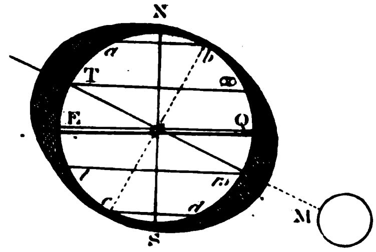

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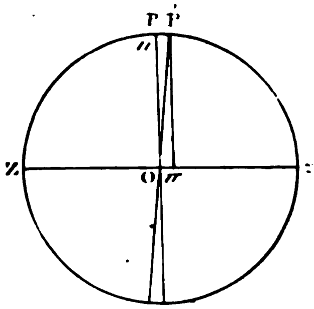

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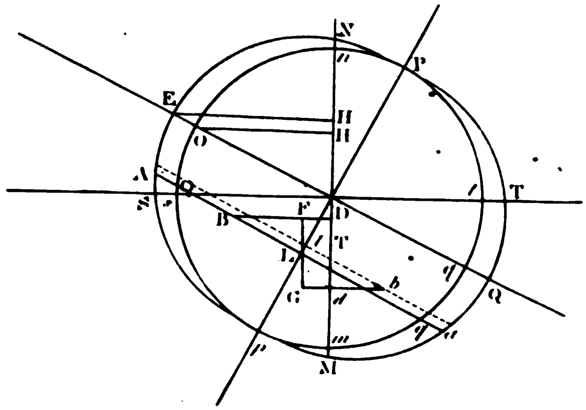

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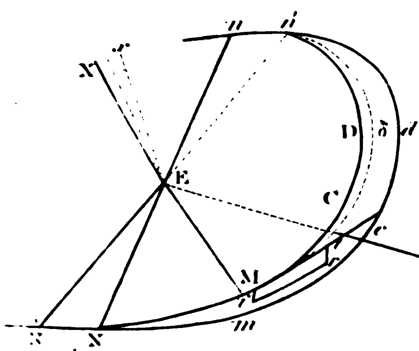

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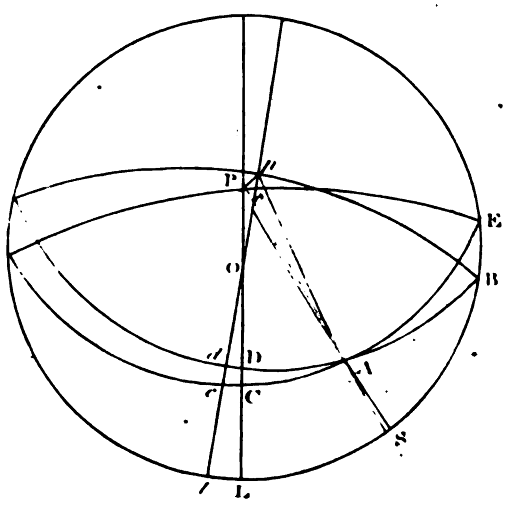

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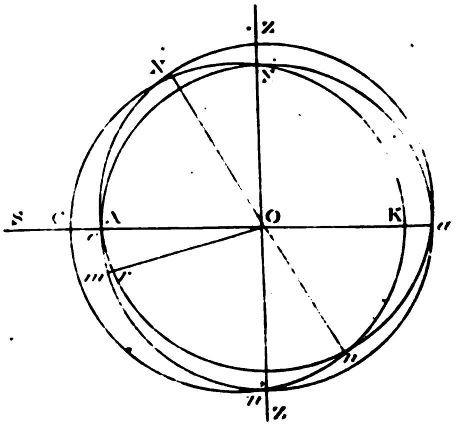

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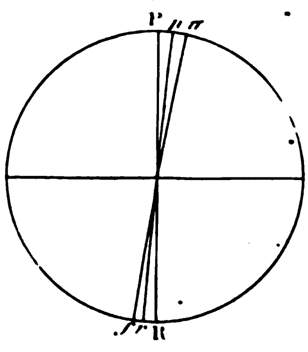

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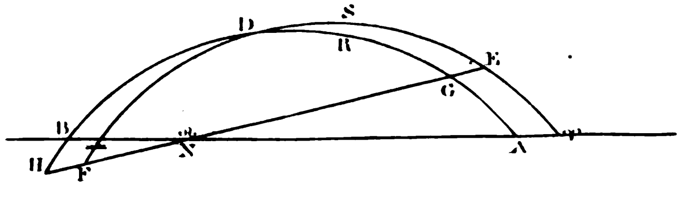

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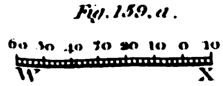

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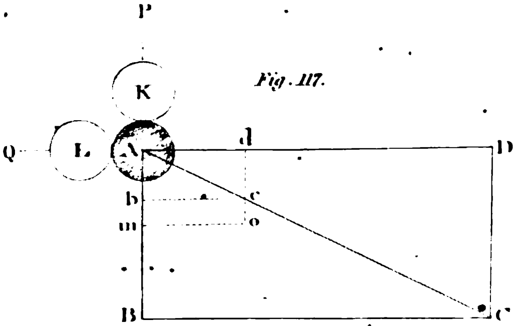
Fig. 117.



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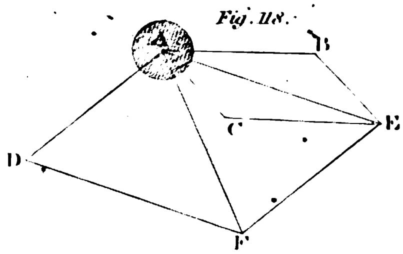

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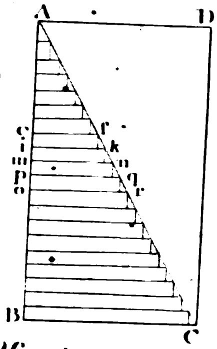

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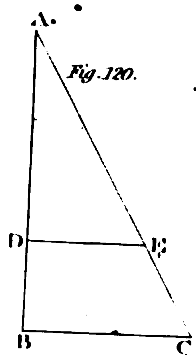

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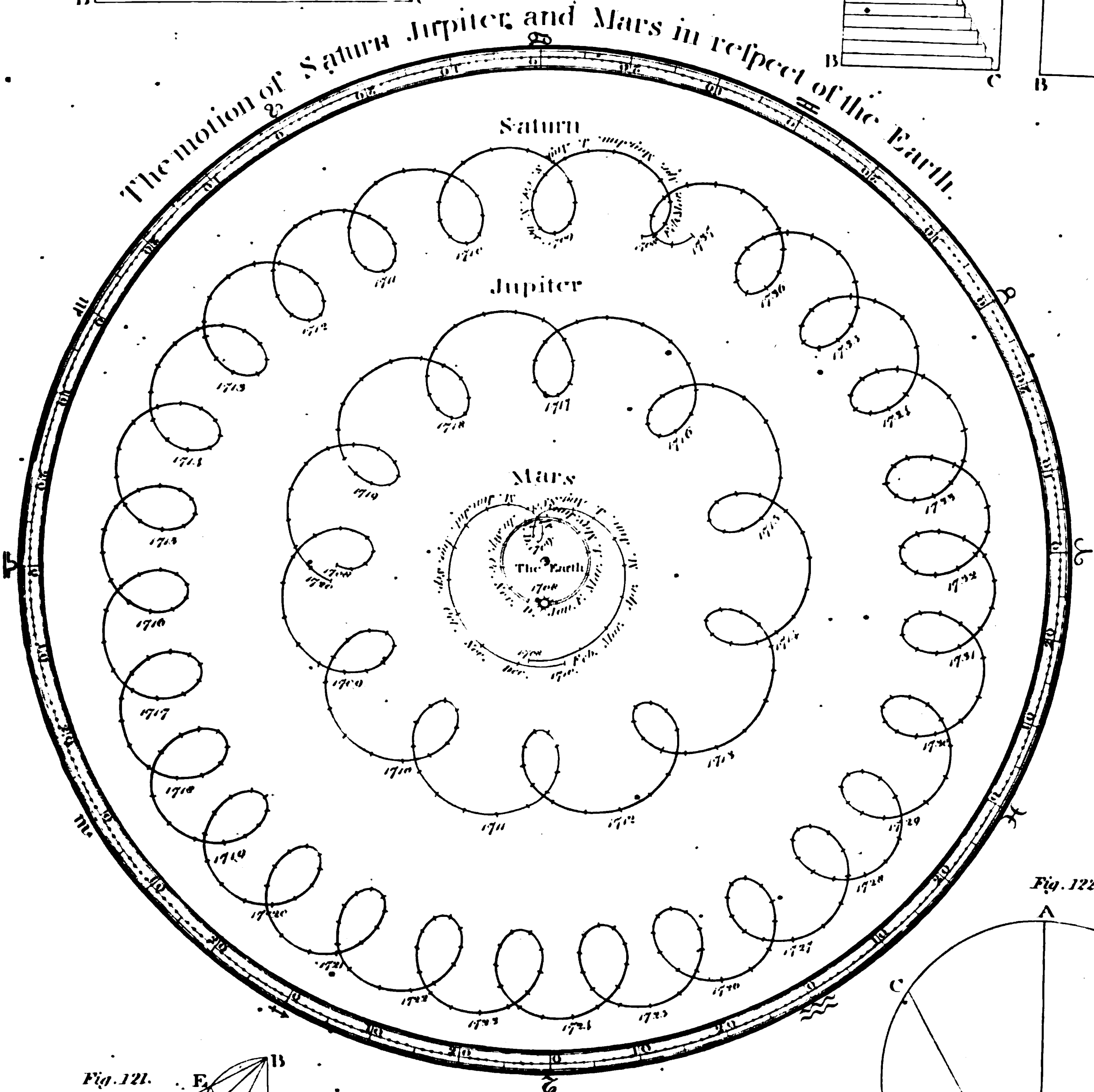

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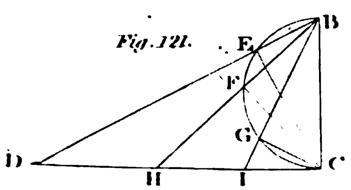

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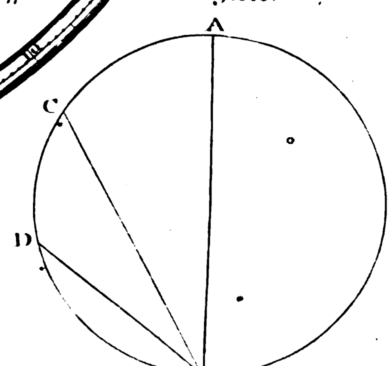

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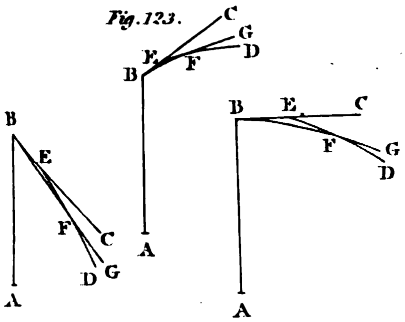
Fig. 123.



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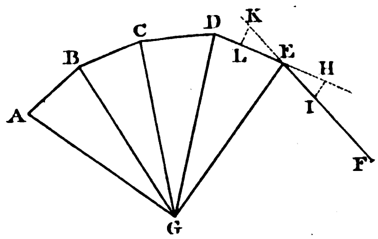

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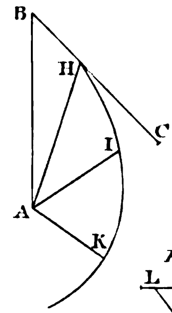

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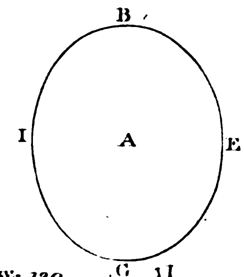

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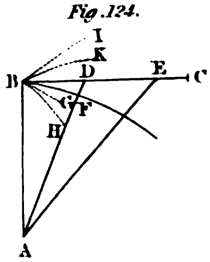

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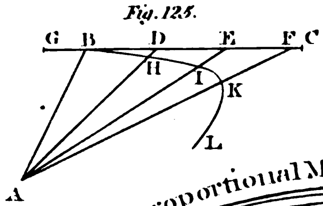

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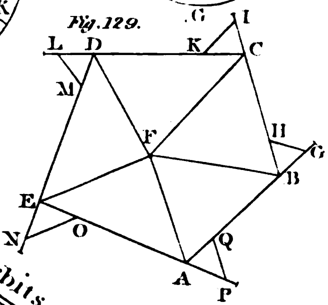

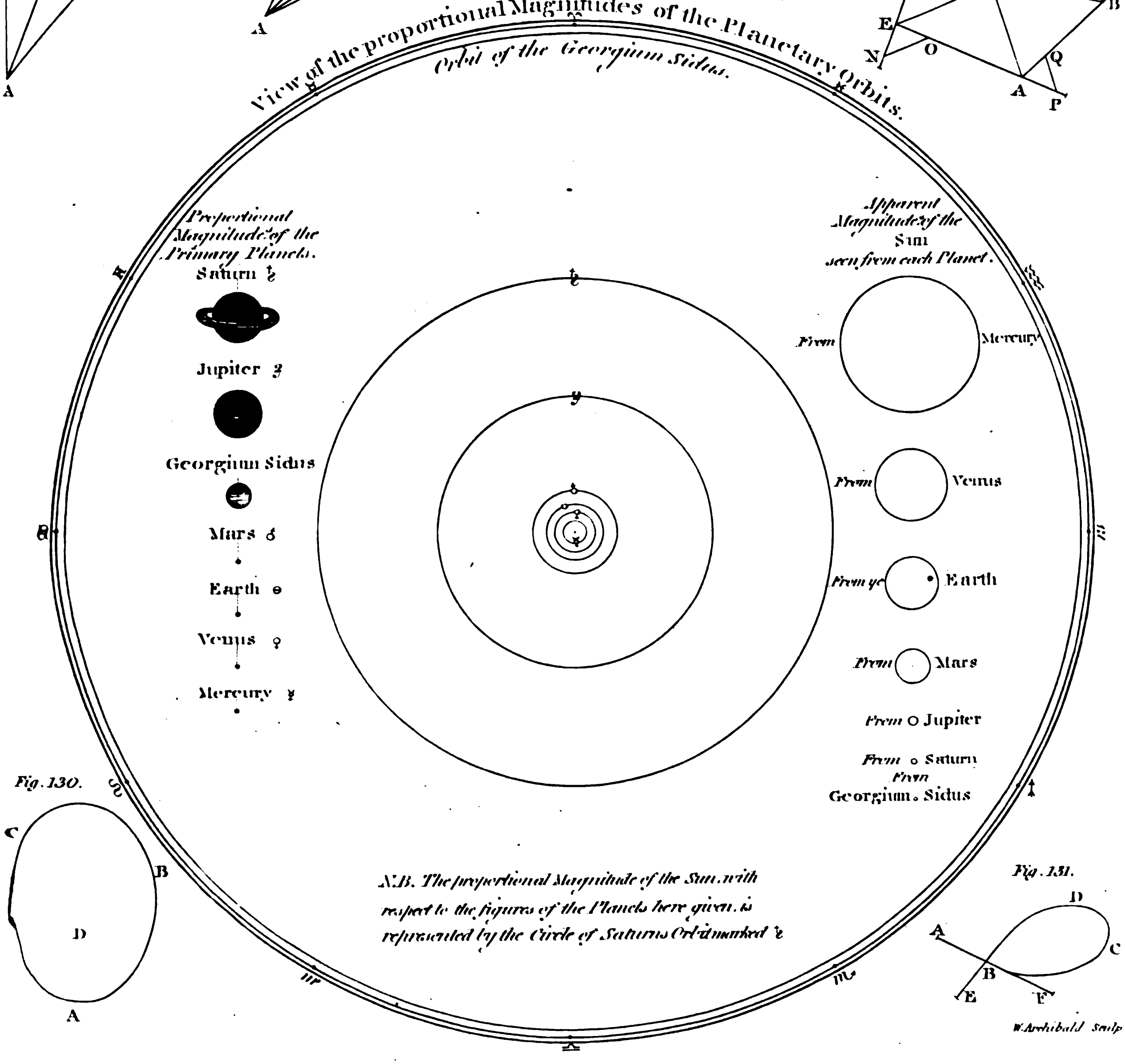

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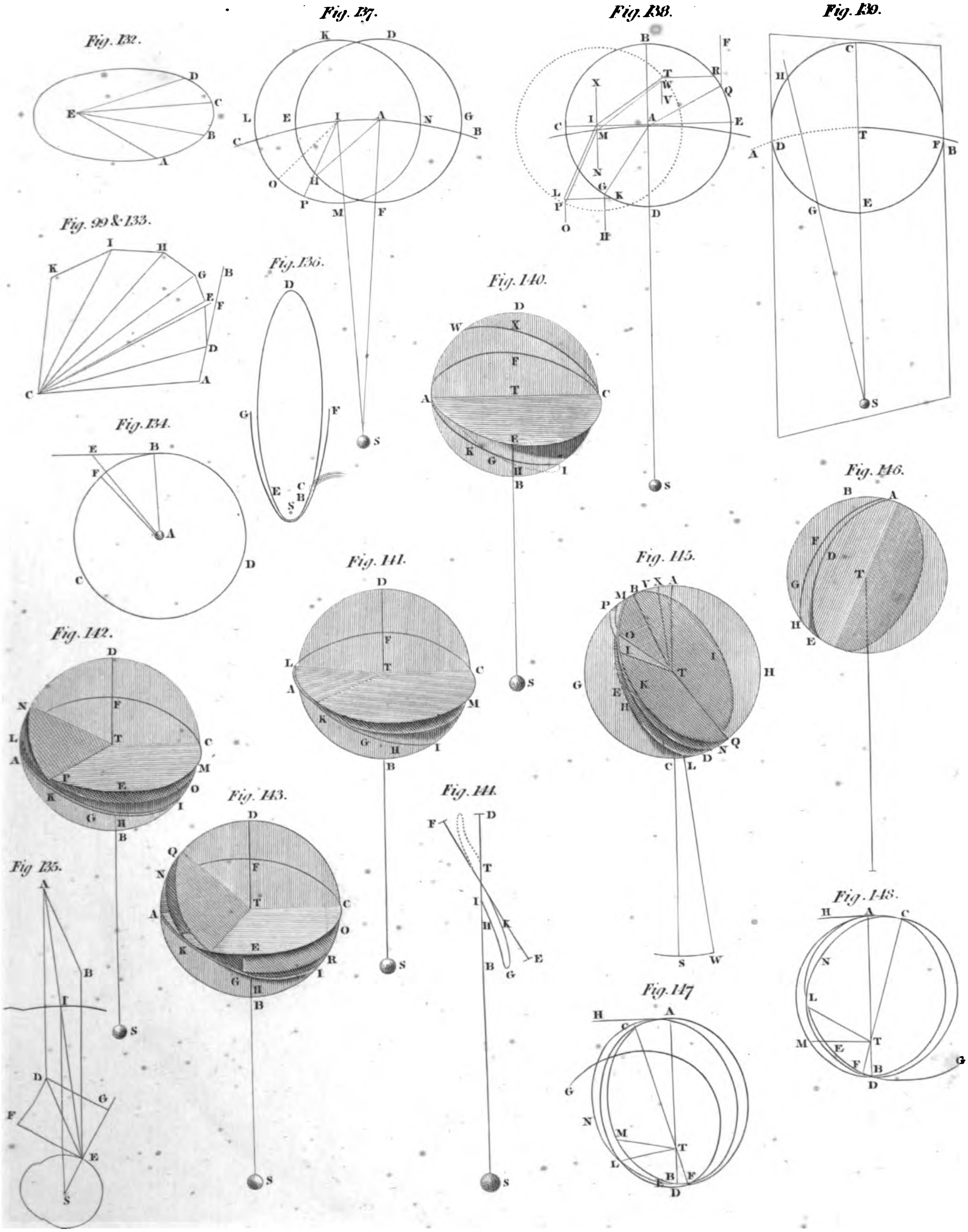

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Fig. 149.

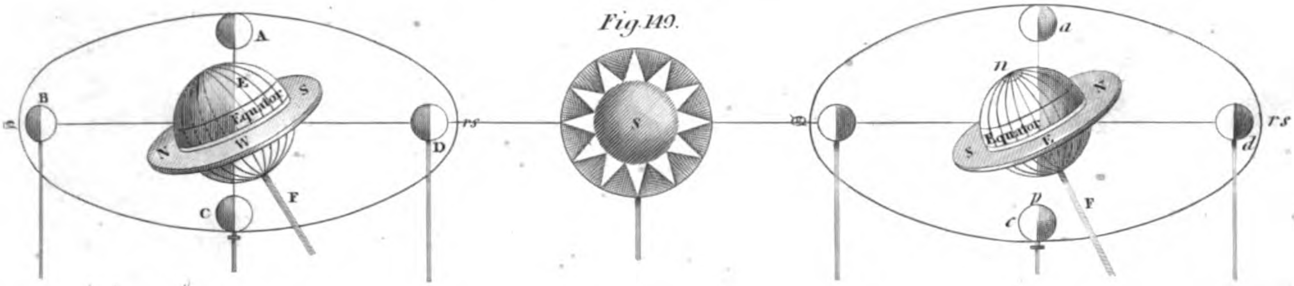
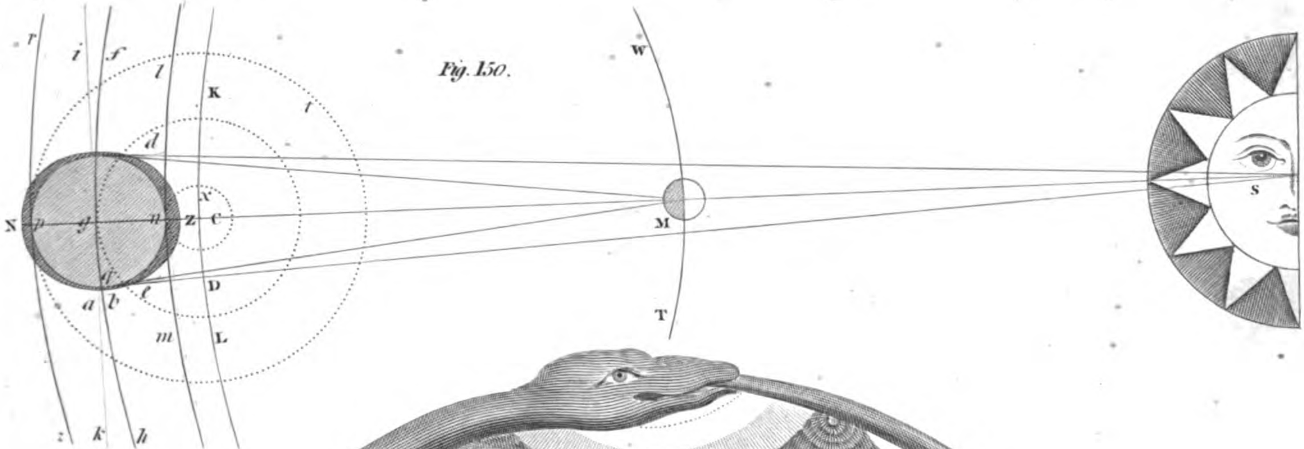
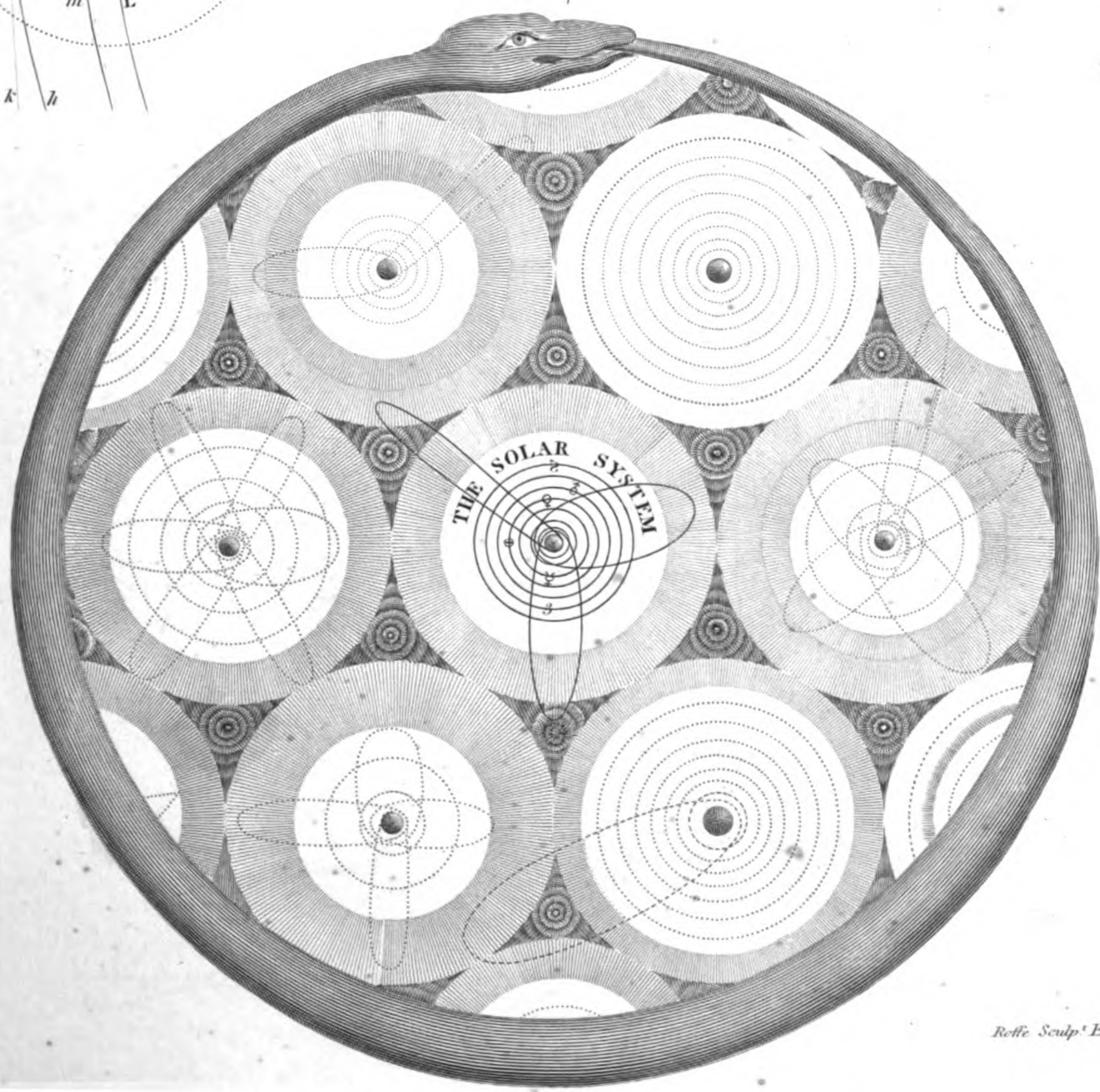


Fig. 150.





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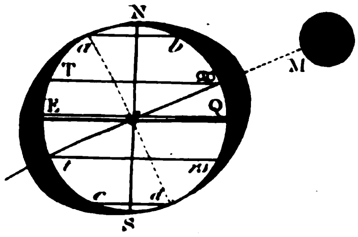

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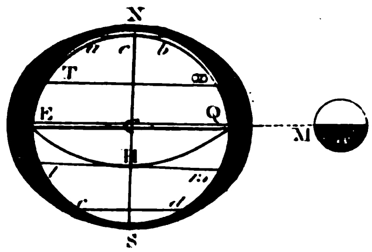

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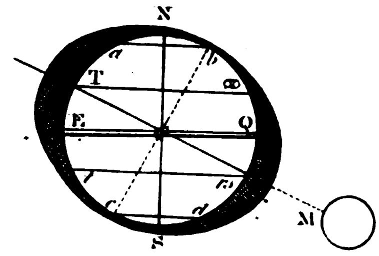

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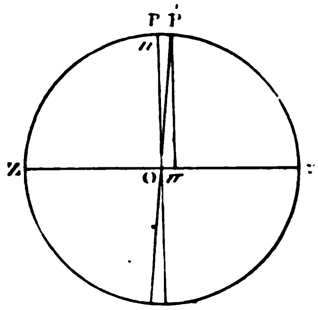

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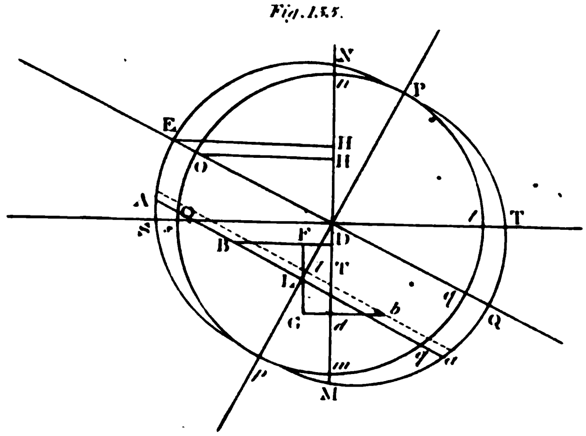

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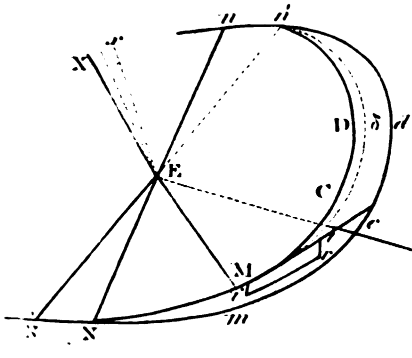

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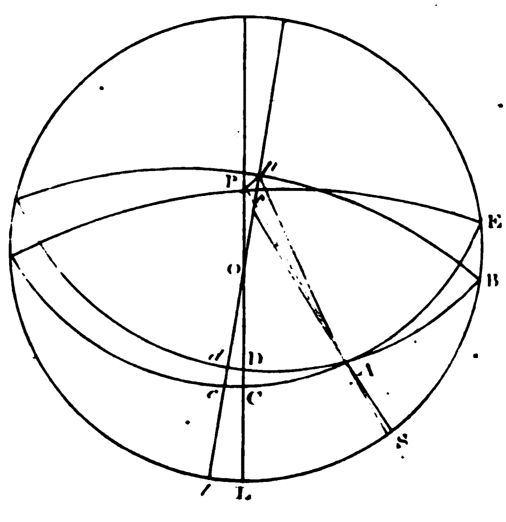

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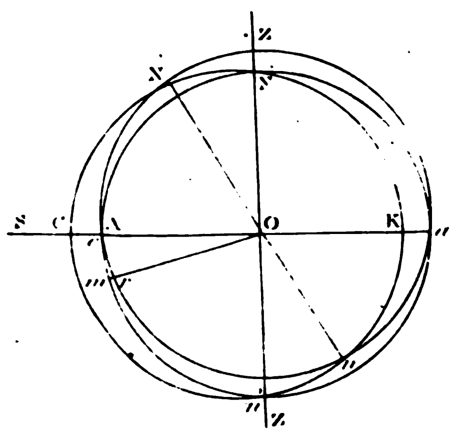

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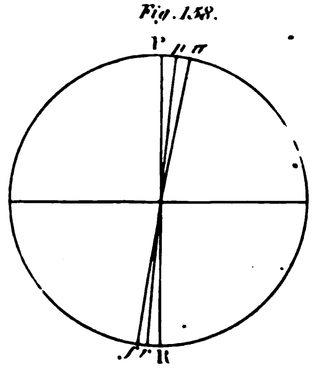

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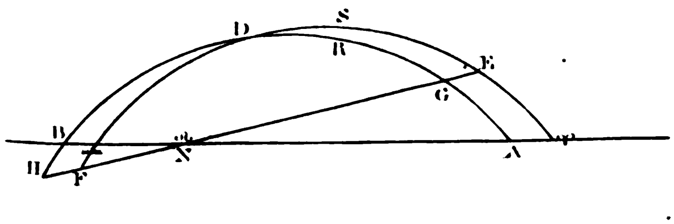

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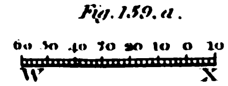

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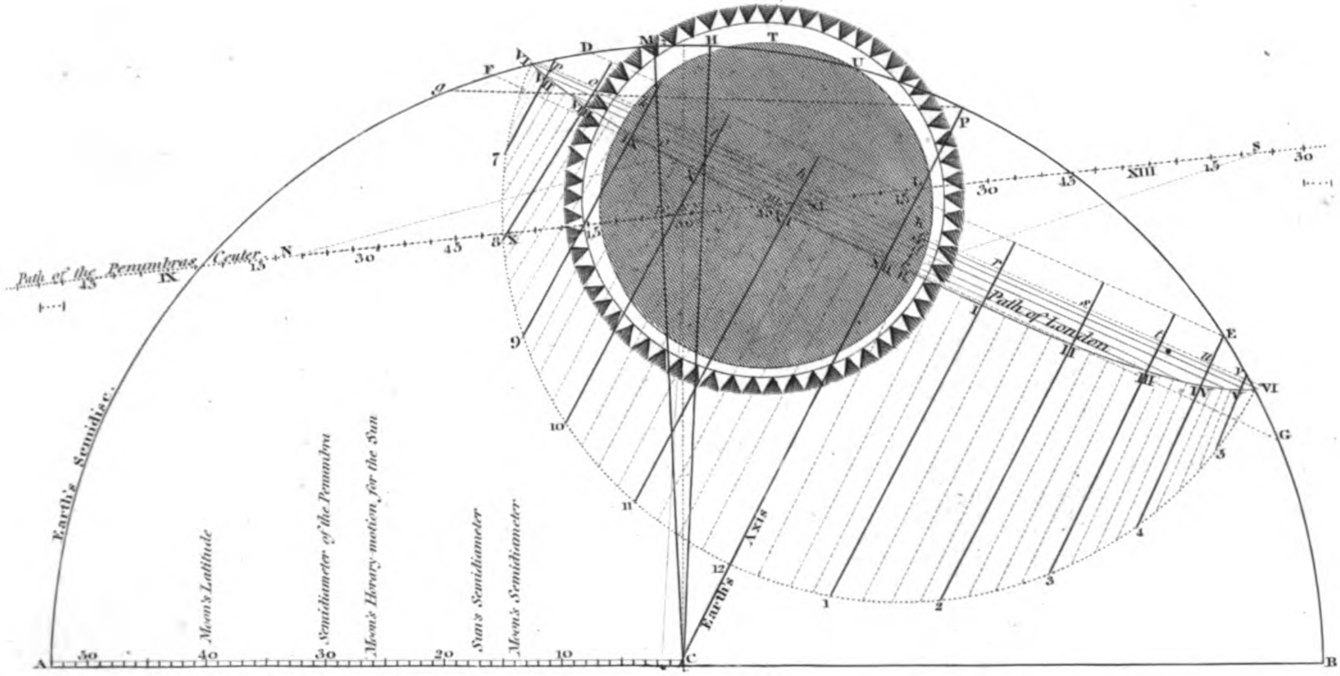

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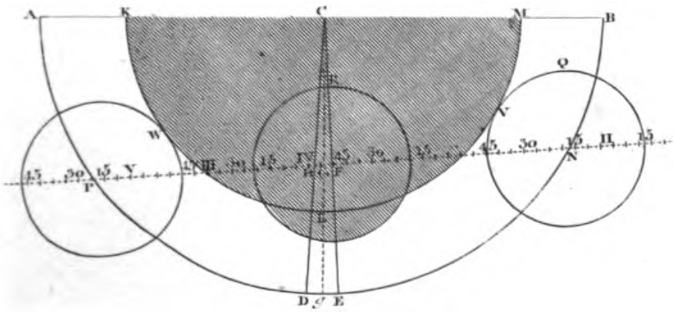

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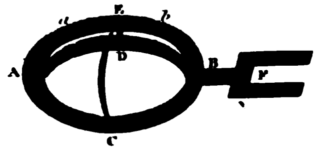

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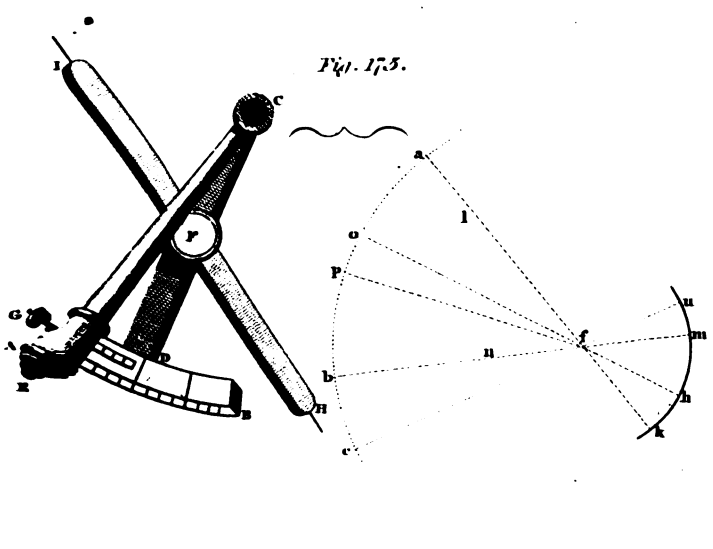

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Fig. 161. The GRAND ORRERY by Rowley.

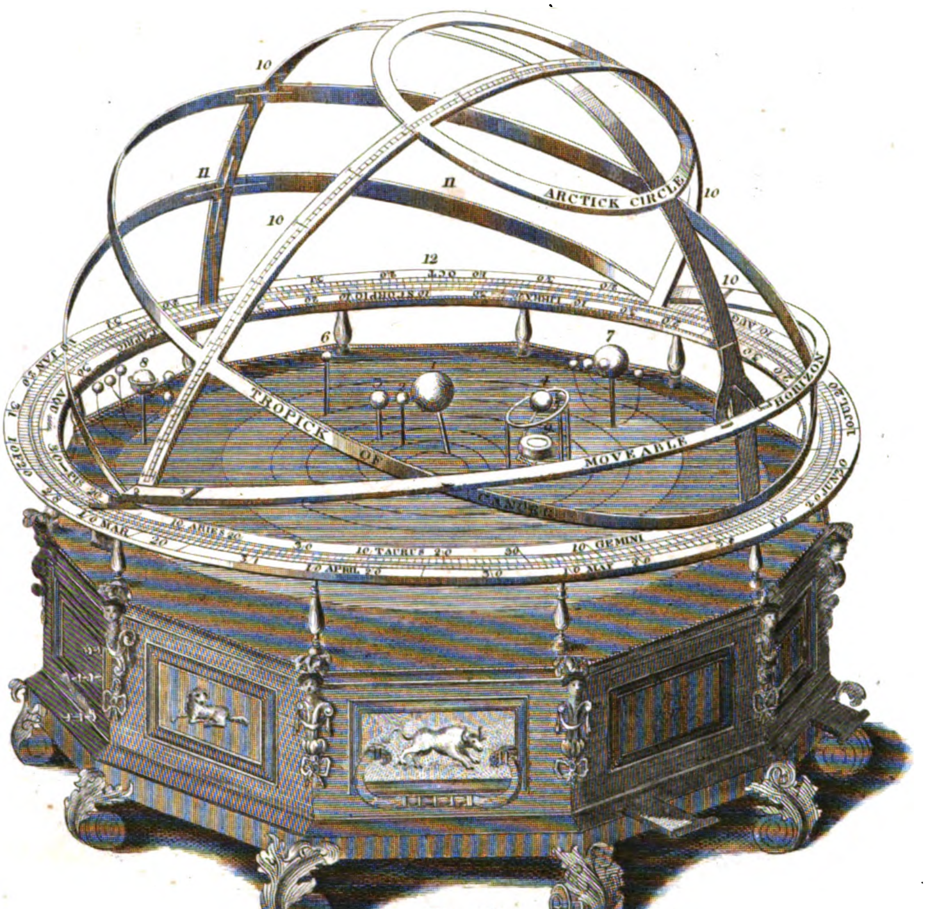
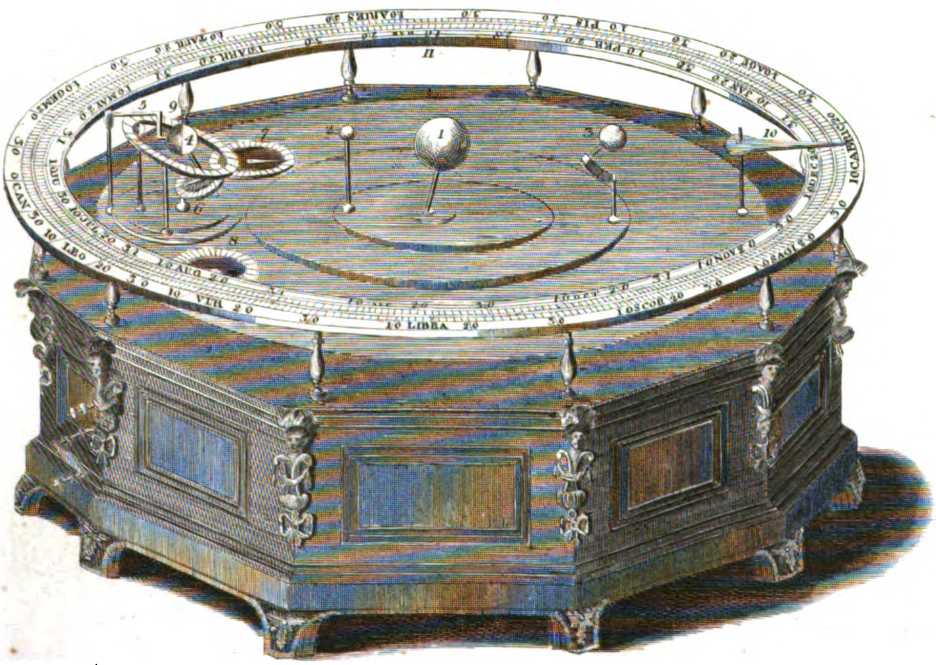


Fig. 162.

FERGUSONS ORRERY



E. Mitchell sculp.

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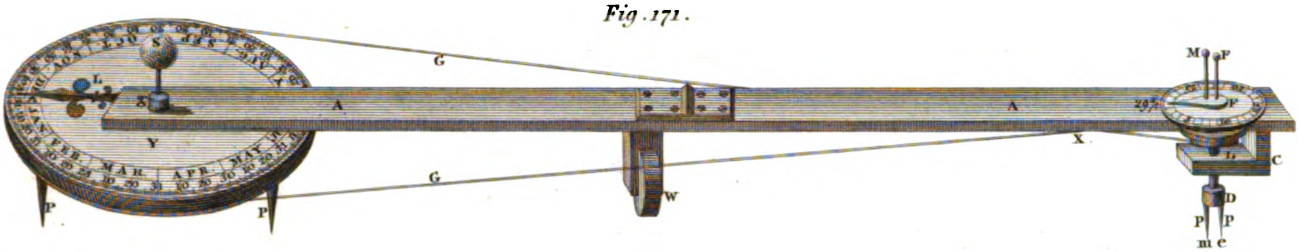
TRAJECTORIUM LUNARE.

Fig. 171.



PLANETARIUM by Jones.

Fig. 164.

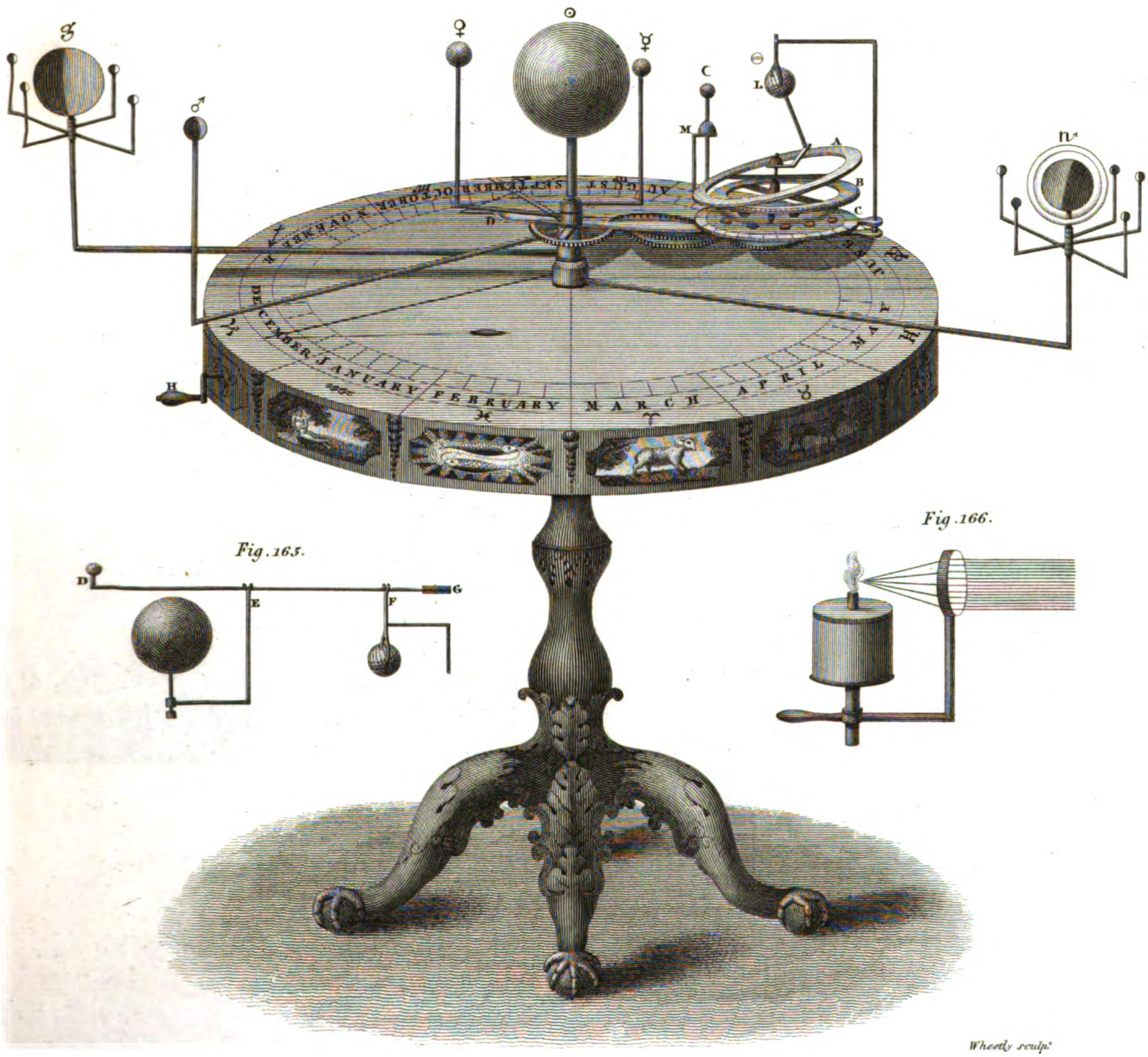


Fig. 165.

Fig. 166.

Wheatly sculp.

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Fig. 167.

Mechanical Paradox

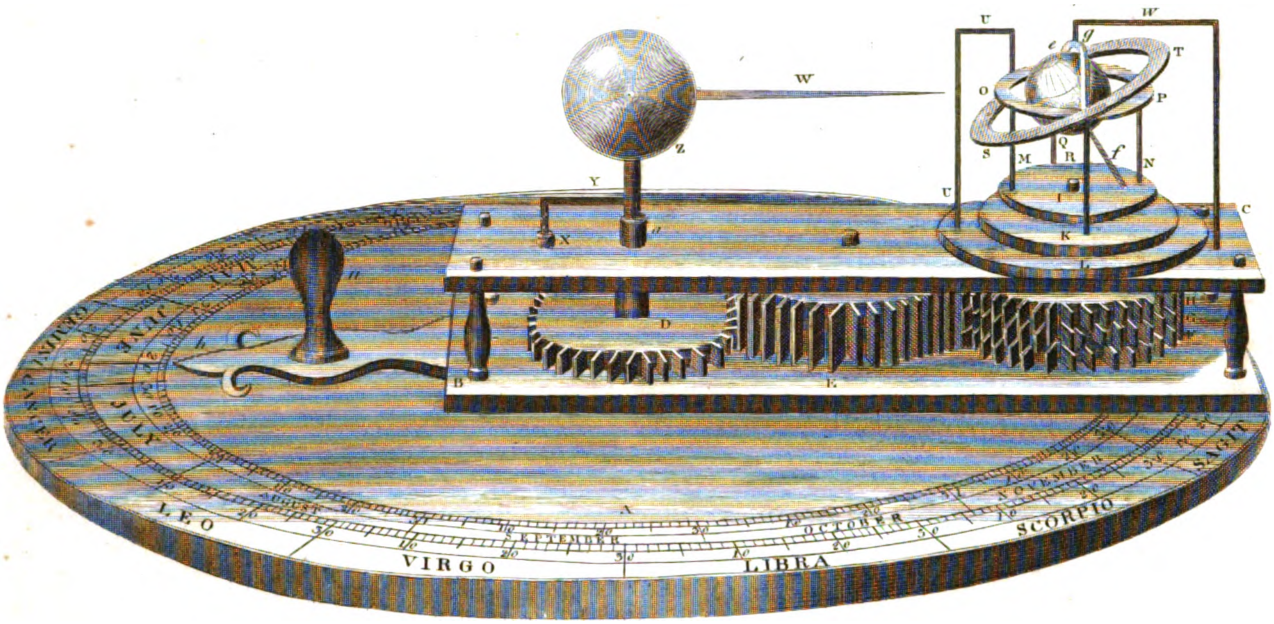


Fig. 172.

Mural Quadrant

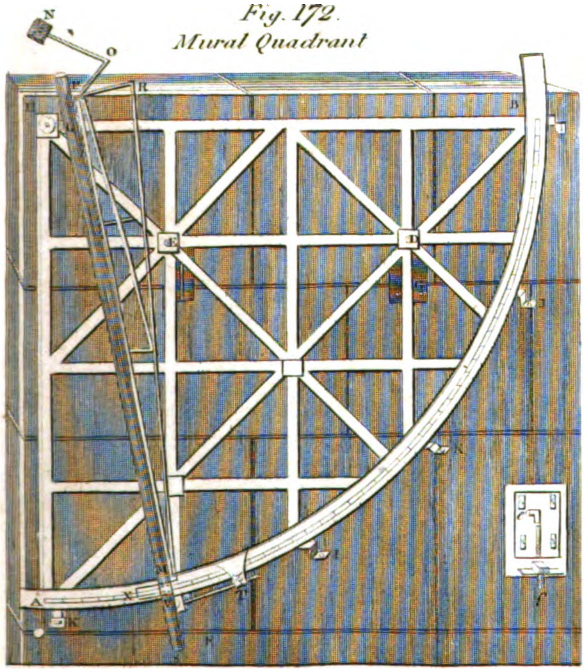


Fig. 168.

Cometarium

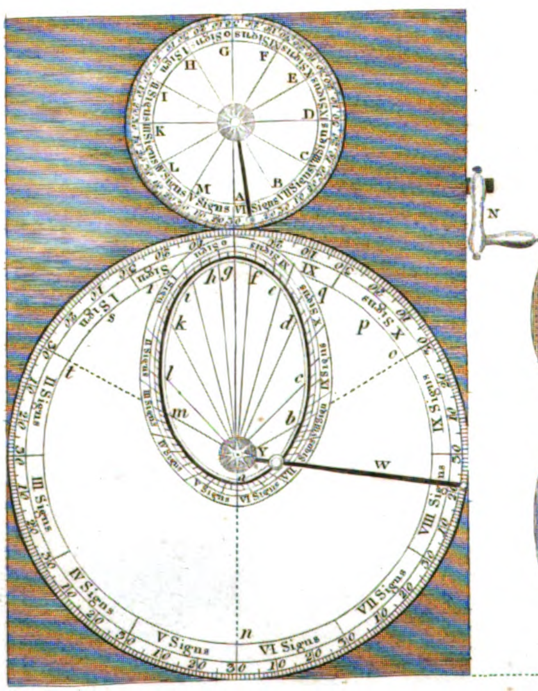
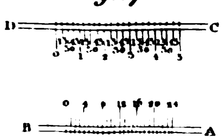


Fig. 169.

Fig. 173.



E. Mitchell sculp.

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Fig. 174.

Portable Astronomical Quadrant.

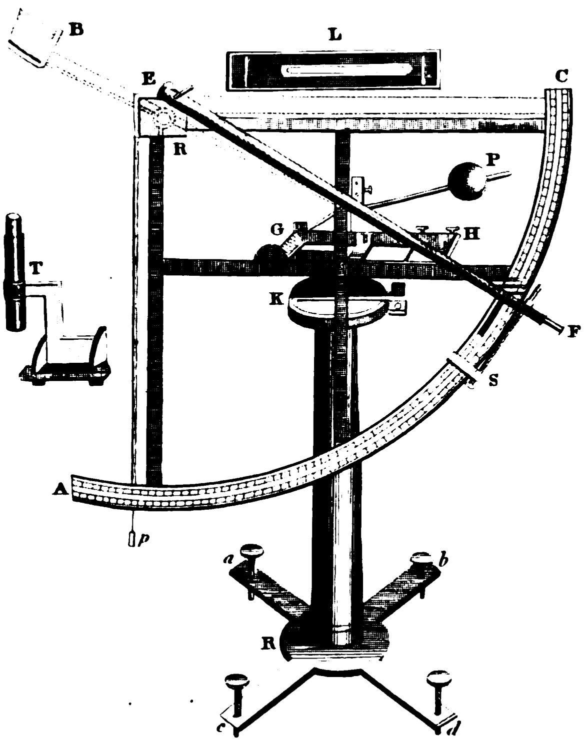


Fig. 176.

Transit Instrument.

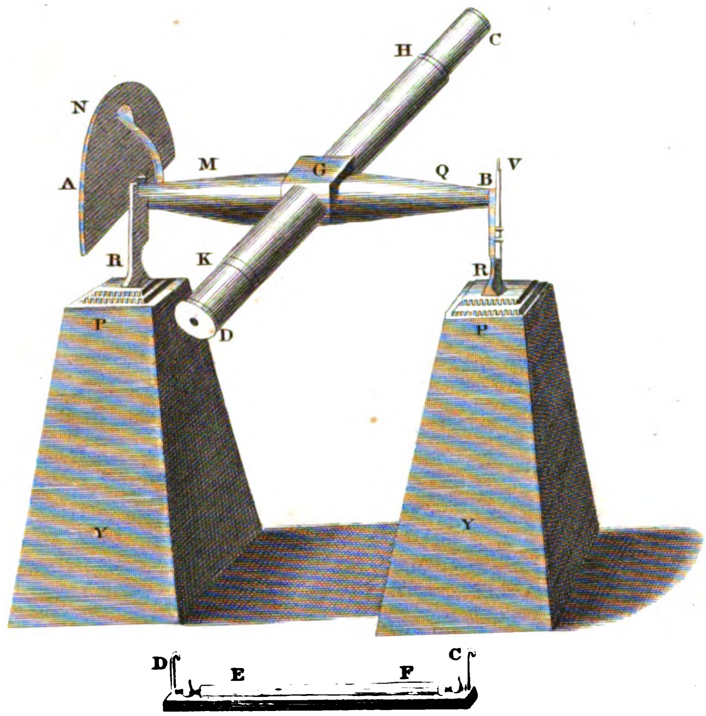


Fig. 179.

Universal Equatorial.

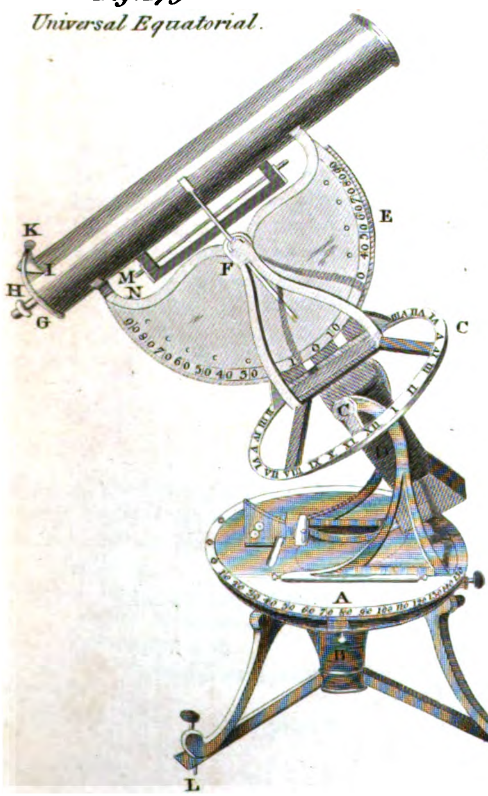


Fig. 177.

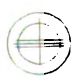
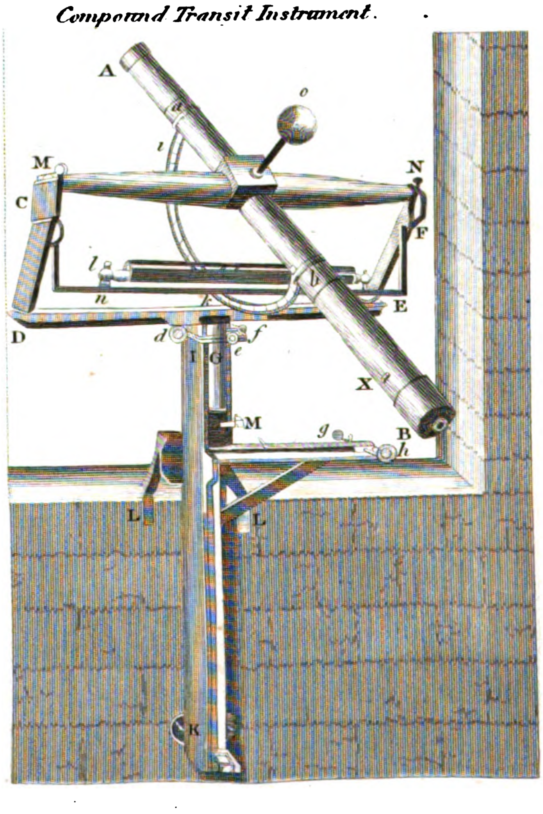


Fig. 178.

Compound Transit Instrument.



E. Mitchell sculp.

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tion of the telescope; and thus this axis will be at right angles to the polar axis. The next adjustment is to make the centre of cross hairs remain on the same object, while you turn the eye-tube quite round by the pinion of the refraction apparatus: for this adjustment, set the index on the slide to the first division on the dove-tail; and set the division marked 18″ on the refraction circle to its index; then look through the telescope, and with the pinion turn the eye-tube quite round; and if the centre of the hairs does not remain on the same spot during that revolution, it must be corrected by the four small screws, two and two at a time (which you will find upon unscrewing the nearest end of the eye-tube that contains the first eye-glass); repeat this correction till the centre of the hairs remains on the spot you are looking at during an entire revolution. In order to make the line of collimation parallel to the brass rod on which the level hangs, set the polar axis horizontal, and the declination circle to 90°, adjust the level by the polar axis; look through the telescope, on some distant horizontal object, covered by the centre of the cross hairs; then invert the telescope, which is done by turning the hour-circle half round; and if the centre of the cross hairs does not cover the same object as before, correct half the error by the uppermost and lowermost of the four small screws at the eye-end of the large tube of the telescope; this correction will give a second object now covered by the centre of the hairs, which must be adopted instead of the first object: then invert the telescope as before; and if the second object be not covered by the centre of the hairs, correct half the error by the same two screws which were used before: this correction will give a third object, now covered by the centre of the hairs, which must be adopted instead of the second object; repeat this operation till no error remains; then set the hour-circle exactly to 12 hours (the declination-circle remaining at 90° as before): and if the centre of the cross hairs does not cover the last object fixed on, set it to that object by the two remaining small screws at the eye-end of the large tube, and then the line of collimation will be parallel to the brass rod. For rectifying the nonius of the declination and equatorial circles, lower the telescope as many degrees, minutes, and seconds, below 0° or Æ on the declination semicircle as are equal to the complement of the latitude; then elevate the polar axis till the bubble be horizontal, and thus the equatorial circle will be elevated to the colatitude of the place; set this circle to 6 hours; adjust the level by the pinion of the declination-circle; then turn the equatorial circle exactly twelve hours from the last position; and if the level be not right, correct one-half of the error by the equatorial circle, and the other half by the declination-circle; then turn the equatorial circle back again exactly 12 hours from the last position; and if the level be still wrong, repeat the correction as before till it be right, when turned to either position; that being done, set the nonius of the equatorial circle exactly to 6 hours, and the nonius of the declination circle exactly to 0°.

Description of Astronomical Instruments.

The principal uses of this equatorial are,

1. To find your meridian by one observation only: for this purpose, elevate the equatorial circle to the colatitude of the place, and set the declination semicircle to the sun's declination for the day and hour of the day required; then move the azimuth and hour circles both at the same time, either in the same or contrary direction, till you bring the centre of the cross hairs in the telescope exactly to cover the centre of the sun; when that is done, the index of the hour-circle will give the apparent or solar time at the instant of observation; and thus the time is gained, though the sun be at a distance from the meridian; then turn the hour-circle till the index points precisely at 12 o'clock, and lower the telescope to the horizon, in order to observe some point there in the centre of your glass, and that point is your meridian mark found by one observation only; the best time for this operation is three hours before or three hours after 12 at noon.

2. To point the telescope on a star, though not on the meridian, in full daylight. Having elevated the equatorial circle to the colatitude of the place, and set the declination-semicircle to the star's declination, move the index of the hour-circle till it shall point to the precise time at which the star is then distant from the meridian, found in tables of the right ascension of the stars, and the star will then appear in the glass. Besides these uses peculiar to this instrument, it is also applicable to all the purposes to which the principal astronomical instruments, viz. a transit, a quadrant, and an equal altitude instrument are applied.

See the article ASTRONOMY, PHYSICAL, in the SUPPLEMENT.

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ASTROPE-WELLS, near Banbury in Oxfordshire, are recommended as excellent in many disorders. The water is a brisk, spirituous, pleasant-tasted chalybeate, and is also gently purgative. It should be drank from three to five quarts in the forenoon.

ASTROSCOPE, a kind of astronomical instrument, composed of two cones, on whose surface the constellations, with their stars, are delineated, by means whereof the stars may be easily known. The astroscope is the invention of William Schuckhard, formerly professor of mathematics at Tubingen, who published a treatise expressly on it in 1698.

ASTRUC, JOHN, a celebrated physician, was born in the year 1684, at the little town of Savoy, in the province of Languedoc. His father, who was a Protestant clergyman, bestowed particular pains upon the earliest part of his education. After which he went to the university of Montpelier, where he was created master of arts in the year 1700. He then began the study of medicine; and, in two years, obtained the degree of bachelor, having upon that occasion written a dissertation on the cause of fermentation, which he defended in a very spirited manner. On the 25th of January 1703 he was created doctor of physic; after which, before arriving at extensive practice, he applied to the study of medical authors, both ancient and modern, with uncommon assiduity. The good effects of this study soon appeared; for, in the year 1710, he published a treatise concerning muscular motion, from which he acquired very high reputation. In the year 1717, he was appointed to teach medicine at Montpelier; which he did with such perspicuity and elo-

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quence, that it was universally said he had been born to be a professor. His fame soon rose to such a height, that the king assigned him an annual salary; and he was, at the same time, appointed to superintend the mineral waters in the province of Languedoc. But as Montpelier did not afford sufficient scope for his aspiring genius, he went to Paris with a great stock of manuscripts, which he intended to publish, after subjecting them to the examination of the learned. Soon after, however, he left it, having in the year 1729 accepted the office of first physician to the king of Poland. In this capacity he remained only for a short time, and he again returned to Paris. Upon the death of the celebrated Geoffroy, in the year 1731, he was appointed regius professor of medicine at Paris. The duties of this office he discharged in such a manner as to answer even the most sanguine expectations. He taught the practice of physic with so great applause, as to draw from other universities to that of Paris a great concourse of medical students, foreigners as well as natives of France. At the same time he was not more celebrated as a professor than a practitioner. And even at an advanced age, he persevered with unwearied assiduity in that intense study which first raised his reputation. Hence it is that he has been enabled to transmit to posterity so many valuable monuments of his medical erudition. He died, universally regretted, on the 15th of May 1766, in the 82d year of his age.

ASTURIA, an ancient kingdom of Spain, subdued by Augustus, emperor of Rome.—The inhabitants of this country, along with those of Cantabria, asserted their liberty long after the rest of Spain had received the Roman yoke. So great was their desire of liberty, that after being closely shut up by the Roman army, they endured the most terrible calamities of famine, even to the devouring of one another, rather than submit to the enemy. At length, however, the Asturians were for surrendering; but the Cantabrians opposed this measure, maintaining that they ought all to die sword in hand like brave men. Upon this the two nations quarrelled, notwithstanding their desperate situation; and a battle ensuing, 10,000 of the Asturians were driven to the intrenchments of the Romans, whom they begged in the most moving manner to receive them on any terms they pleased. But Tiberius, the emperor's son-in-law, refusing to admit them into the camp, some of these unhappy people put an end to their lives by falling upon their own swords; others lighting great fires threw themselves into them, while some poisoned themselves by drinking the juice of a venomous herb.

The campaign being put an end to by winter, the next year the Asturians summoned all their strength and resolution against the Romans; but notwithstanding their utmost efforts of valour and despair, they were entirely defeated in a most bloody battle, which lasted two days, and for that time entirely subdued. A few years afterwards they rebelled, in conjunction with the Cantabrians; but were soon reduced by the Romans, who massacred most of the young men that were capable of bearing arms. This did not prevent them from revolting anew in a short time afterwards; but without success, being obliged to submit to the Roman power, till the subversion of that empire by the Goths.

Asturias, anciently the kingdom of Asturia, is now a principality of modern Spain, bounded by Biscay on the east, Galicia on the west, Old Castile and Leon on the south, and the sea on the north. Its greatest length is about 110 miles, and its breadth 54. On the south it is separated from Old Castile and Leon by high mountains covered with woods. The province is tolerably fertile, but thinly inhabited. The inhabitants value themselves much on being descended from the ancient Goths. Even the poor peasants, who are fain to go to seek work in other provinces, call themselves *illustrious Goths* and *Mountaineers*, thinking it ignominious to marry even with great and rich families of another race. This pride is flattered by the respect paid them by the rest of the nation, and the privileges bestowed upon them by the government. The hereditary prince of Spain is styled *prince of the Asturias*. The Asturias contain 688 parishes, and the population is estimated at 348,000, including 2868 ecclesiastics, monks and nuns.

ASTYAGES, son of Cyaxares, the last king of the Medes. He dreamed, that from the womb of his daughter Mandane, married to Cambyses king of Persia, there sprung a vine that spread itself over all Asia. She being with child, he resolved to kill the infant as soon as born. Its name was Cyrus; and Harpagus being sent to destroy it, preserved it; which Astyages after a long time hearing of, he caused Harpagus to eat his own son. Harpagus called in Cyrus, who dethroned his grandfather, and thereby ended the monarchy of the Medes. See Media and Persia.

ASTYANAX, the only son of Hector and Andromache. After the taking of Troy, he was thrown from the top of a tower by Ulysses's orders.

ASTYNOMI, in *Grecian Antiquity*, magistrates in Athens, corresponding to the ædiles of the Romans; they were ten in number. See Ædile.

ASYLUM, a sanctuary, or place of refuge, where criminals shelter themselves from the hands of justice. The word is compounded of the privative particle α, and συλαω, *I hurt*; because no person could be taken out of an asylum without sacrilege.

The asyla of altars and temples were very ancient; and likewise those of tombs, statues, and other monuments of considerable personages. Thus, the temple of Diana at Ephesus was a refuge for debtors, the tomb of Theseus for slaves. Among the Romans, a celebrated asylum was opened by Romulus between the mounts Palatine and Capitoline, in order to people Rome, for all sorts of persons indiscriminately, fugitive slaves, debtors, and criminals of every kind. The Jews had their asyla; the most remarkable of which were, the six cities of refuge, the temple, and the altar of burnt-offerings.

It was customary among the Heathens to allow refuge and impunity even to the vilest and most flagrant offenders; some out of superstition, and others for the sake of peopling their cities: and it was by this means, and with such inhabitants, that Thebes, Athens, and Rome, were first stocked. We even read of asylums at Lyons and Vienne among the ancient Gauls; and there are some cities in Germany which still preserve the

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the ancient right of asylum. Hence on the medals of several ancient cities, particularly in Syria, we meet with the inscription ΑΣΥΛΟΙ, to which is added ΙΕΡΑΙ. This quality of asylum was given them, according to M. Spanheim, in regard to their temples, and to the gods revered by them.

The emperors Honorius and Theodosius granting the like immunities to churches, the bishops and monks laid hold of a certain tract or territory, without which they fixed the bounds of the secular jurisdiction: and so well did they manage their privileges, that convents in a little time became next akin to fortresses; where the most notorious villains were in safety, and braved the power of the magistrate.

These privileges at length were extended not only to the churches and churchyards, but also to the bishops houses; whence the criminal could not be removed without a legal assurance of life, and an entire remission of the crime. The reason of the extension was, that they might not be obliged to live altogether in the churches, &c. where several of the occasions of life could not be decently performed.

But at length these asyla or sanctuaries were also stripped of most of their immunities, because they served to make guilt and libertinage more bold and daring. In England, particularly, they were entirely abolished. See SANCTUARY.

ASSYMETRY, the want of proportion between the parts of any thing; being the contrary of *symmetry*. Or, it is the relation of two quantities which have no common measure, as between 1 and $\surd 2$, or the side and diagonal of a square.

ASYMPTOTE, in *Geometry*, a line which continually approaches nearer to another; but, though continued infinitely, will never meet with it: Of these are many kinds. In strictness, however, the term *asymptotes* is appropriated to right lines, which approach nearer and nearer to some curves of which they are said to be *asymptotes*; but if they and their curves are indefinitely continued, they will never meet. See CONIC *Sections*.

ASYNDETON, in *Grammar*, a figure which omits the conjunctions in a sentence. As in *veni, vidi, vici*, where ET is left out: or in that of Cicero concerning Catiline, *abiit, excessit, evasit, erupit*: or in that verse of Virgil,

Ferte cito flammas, date vela, impellite remos.

Asyndeton stands opposed to polysyndeton, where the copulatives are multiplied.

ATABULUS, in *Physiology*, a provincial wind in Apulia, of a dry pinching quality, and very noxious in its effects. The ancient naturalists speak of the Atabulus in terms of horror, on account of the ravage it made among the fruits of the earth, which it scorched or withered up.

ATABYRIS, a very high mountain in the island of Rhodes, on which, according to Strabo and Diodorus Siculus, there stood a temple of Jupiter Atabyrius, whose worship a colony of Rhodians carried into Sicily, where a temple was built to the same deity at Agrigentum.

ATALANTA, an island in the Euripus of Euboea, near the Locri Opuntii, said to have been originally a city of the Locri, but torn from the continent in the time of an earthquake, and during an eruption of Mount Ætna. This happened in the fourth year of the 93d Olympiad, in the reign of Artaxerxes Mnemon.

ATALANTIS, ATLANTICA, or ATLANTIS. See ATLANTIS.

ATARAXY, a term used by the stoics and sceptics, to denote that calmness of mind which secures us from all emotions arising from vanity and self-conceit.

ATARGATIS FANUM, the temple of a goddess worshipped by the Syrians and Parthians, having the face of a woman and tail of a fish, and called *Derceto* by the Greeks. Her temple stood in the city Bambyce, called afterwards *Hieropolis*. It was extremely rich, insomuch that Crassus, in his march against the Parthians, spent several days in weighing the treasure. Vossius makes the name of this goddess Phœnician, from *Addir dag*, "the great fish."

ATARNEA, an ancient town of Mysia, situated between Adrymyttium and Pitane, remarkable for the marriage of Aristotle with the sister or concubine of the tyrant Hermias; also for the dotage of that philosopher.

ATAXY, in a general sense, the want of order: With physicians, it signifies irregularity of crises and paroxysms of fevers.

ATCHE, in commerce, a small silver coin used in Turkey, and worth only one-third of the English penny.

ATCHIEVEMENT, in *Heraldry*, denotes the arms of a person or family, together with all the exterior ornaments of the shield; as helmet, mantle, crest, scrolls, and motto, together with such quarterings as may have been acquired by alliances, all marshalled in order.

ATCHIEVE. This term is derived from the French *achever*, i. e. to finish or make an end of; but signifies, in its ordinary acceptation, to perform great actions or exploits.

ATE, the goddess of mischief, in the Pagan theology. She was daughter of Jupiter, and cast down from heaven at the birth of Hercules. For Juno having deceived Jupiter, in causing Eurystheus to be born before Hercules, Jupiter expressed his resentment on Ate, as the author of that mischief: and threw her headlong from heaven to the earth, swearing she should never return thither again (*Homer Il.* xix. 125.). The name of this goddess comes from *αταω*, *noceo*, "to hurt." Her being the daughter of Jupiter, means, according to mythologists, that no evil happens to us but by the permission of Providence; and her banishment to earth denotes the terrible effects of divine justice among men.

ATEGUA, or ATTEGUA, an ancient town of Spain, placed by some in the road from Antiquara, now Antequera, to Hispalis, or Seville; by others near Alcala Real; which last is the more probable situation, because the Flumen Salsum, now the Salado, was in its neighbourhood. Now *Tebala Vieja*, or *Teivela*.

ATELLA, an ancient town of Campania in Italy, between Capua and Neapolis. From this town the *Atellanæ fabulæ*, or *Atellani ludi*, took their name. Their were also called *Osci*, from their inventor, in whose territory Atella lay. They were generally a species of farce, interlarded with much ribbaldry and buffoonery; and sometimes were exordia or interludes presented between

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between the acts of other plays. The actors in these farces were not reckoned among the common players, nor deemed infamous; but retained the rights of their tribe, and might be listed for soldiers, the privilege only of free men. The ruins of this town are still to be seen, about 11 miles from the modern Aversa, which was built out of its materials.

ATEMPO GIUSTO, in *Music*, signifies to sing or play in an equal, true, and just time.

ATERGATIS, in *Mythology*, a goddess of the Syrians, supposed to be the mother of Semiramis. She was represented with the face and breasts of a woman, but the rest of her body resembled a fish. Vossius says the term signifies *without fish*, and conjectures that the votaries of this deity abstained from fish.

ATERNUM, a town of Lucania in Italy, now *Aterni*, (Cluverius): Also a town in the territory of the Piceni, now *Pescara*, a port town of Naples, situated on the Adriatic. E. Long. 15. 25. N. Lat. 42. 30.

ATESTE, a town in Austrian Lombardy in Italy, now called *Este*. E. Long. 12. 6. N. Lat. 45. 25.

ATHAMADULET, the prime minister of the Persian empire, as the grand vizier is of the Turkish empire. He is great chancellor of the kingdom, president of the council, superintendant of the finances, and is charged with all foreign affairs.

ATHAMANTA, SPIGNEL. See BOTANY *Index*.

ATHANASIA, GOLDILOCKS. See BOTANY *Index*.

ATHANASIAN CREED; a formulary, or confession of faith, long supposed to have been drawn up by Athanasius bishop of Alexandria, in the fourth century, to justify himself against the calumnies of his Arian enemies. But it is now generally allowed among the learned not to have been his. Dr Waterland ascribes it to Hilary bishop of Arles, for the following among other reasons: 1. Because Honoratus of Marseilles, the writer of his life, tells us, that he composed an *Exposition of the Creed;* a properer title for the *Athanasian* than that of *Creed* simply which it now bears. 2. Hilary was a great admirer and follower of St Austin; and the whole composition of this creed is in a manner upon St Austin's plan, both with respect to the Trinity and incarnation. 3. It is agreeable to the style of Hilary, as far as we can judge from the little that is left of his works. Upon the whole he concludes, that Hilary, bishop of Arles, about the year 430, composed *the Exposition of Faith*, which now bears the name of the *Athanasian Creed*, for the use of the Gallican clergy, and particularly those of the diocese of Arles: That, about the year 570, it became famous enough to be commented upon; but that all this while, and for several years lower, it had not yet acquired the name of *Athanasian*, but was simply styled *The Catholic Faith:* That, before 670, Athanasius's admired name came in to recommend and adorn it, being in itself an excellent system of the Athanasian principles of the Trinity and incarnation, in opposition chiefly to the Arians, Macedonians and Apollinarians. This is the hypothesis of the learned author of the *Critical History of the Athanasian Creed.*

As to the reception of this creed in the Christian churches, we find, that it obtained in France in the time of Hincmar, or about 850: that it was received in Spain about 100 years later than in France, and in Germany much about the same time. As to our own country, we have clear and positive proofs of this creed being sung alternately in our churches in the tenth century. It was in common use in some parts of Italy, particularly in the diocese of Verona, about the year 960, and was received at Rome about the year 1014. As to the Greek and oriental churches, it has been questioned whether any of them ever received this creed at all; though some very considerable writers are of a contrary persuasion. It appears then, that the reception of this creed has been both general and ancient; and may vie with any, in that respect, except the Nicene or Constantinopolitan, the only general creed common to all the churches.

As to the matter of this creed, it is given as a summary of the true orthodox faith, and a condemnation of all heresies ancient and modern. Unhappily, however, it has proved a fruitful source of unprofitable controversy and unchristian animosity even down to the present time.

ATHANASIUS, ST, bishop of Alexandria, and one of the greatest defenders of the faith against the Arians, was born in Egypt. He followed St Alexander to the council of Nice, in 325, where he disputed against Arius, and the following year was made bishop of Alexandria; but, in 335, was deposed by the council of Tyre: when, having recourse to the emperor Constantine, the Arian deputies accused him of having hindered the exportation of corn from Alexandria to Constantinople; on which the emperor, without suffering him to make his defence, banished him to Treves. The emperor, two years after, gave orders that he should be restored to his bishopric: but, on his return to Alexandria, his enemies brought fresh accusations against him, and chose Gregory of Cappadocia to his see; which obliged Athanasius to go to Rome to reclaim it of Pope Julius. He was there declared innocent, in a council held in 342, and in that of Sardica in 347; and two years after was restored to his see by order of the emperor Constans: but after the death of that prince, he was again banished by the emperor Constantius, which obliged him to retire into the deserts. The Arians then elected one George in his room; who being killed in a popular sedition under Julian in 360, St Athanasius returned to Alexandria, but was again banished under Julian, and restored to his see under Jovian. He addressed to that emperor a letter, in which he proposed that the Nicene creed should be the standard of the orthodox faith, and condemned those who denied the divinity of the Holy Ghost. He was also banished by Valens in 367, and afterwards recalled. St Athanasius died on the 2d of May 375.

His works principally contain a defence of the mysteries of the Trinity, and of the incarnation and divinity of the Word and Holy Spirit. There are three editions of his works which are esteemed; that of Commelin, printed in 1600; that of Peter Nannius, in 1627; and that of Father Montfaucon. As to the creed which bears his name, see the preceding article.

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ATHANATI, in Persian antiquity, a body of cavalry, consisting of 10,000 men, always complete. They were called *athanati* (a word originally Greek, and signifying *immortal*), because, when one of them happened to die, another was immediately appointed to succeed him.

ATHANOR. Chemists have distinguished by this name a furnace so constructed that it can always maintain an equal heat, and which shall last a long time without addition or fresh fuel.

The body of the athanor has nothing in it particular, and is constructed like ordinary furnaces. But at one of its sides, or its middle, there is an upright hollow tower, which communicates with the fireplace by one or more sloping openings, and which has a lid to close its upper opening. This furnace is now rarely used.

ATHAROTH, or ATROTH, in *Ancient Geography*, the name of several towns. Two appear to have been in Samaria, in the tribe of Ephraim; and one four miles to the north of Sebaste, or the city of Samaria; the other in the confines of Benjamin and Ephraim, yet so as to be in the district of Ephraim rather than Benjamin (Joshua). This is the *Atroth-Adder* mentioned by Joshua xvi. 5. from which to Upper Bethoron extends the greatest breadth of the tribe of Ephraim.

ATHEISM, the disbelief of a deity. See ATHEIST.

ATHEIST, a person who does not believe the existence of a Deity. Many people, both ancient and modern, have pretended to atheism, or have been reckoned atheists by the world; but it is justly questioned whether any man seriously adopted such a principle. These pretensions, therefore, must be founded on pride or affectation.

Atheism, as absurd and unreasonable as it is, has had its martyrs. Lucilio Vanini, an Italian, native of Naples, publicly taught atheism in France, about the beginning of the 17th century; and being convicted of it at Thoulouse, was condemned to death. Being pressed to make public acknowledgment of his crime, and to ask pardon of God, the king, and justice, he answered, he did not believe there was a God; that he never offended the king; and, as for justice, he wished it to the devil. He confessed that he was one of twelve, who parted in company from Naples to spread their doctrine in all parts of Europe. His tongue was first cut out, and then his body burnt, April 9. 1619.

Cicero represents it as a probable opinion, that they who apply themselves to the study of philosophy believe there are no gods. This must, doubtless, be meant of the academic philosophy, to which Cicero himself was attached, and which doubted of every thing. On the contrary, the Newtonian philosophers are continually recurring to a Deity, whom they always find at the end of their chain of natural causes. Some foreigners have even charged them with making too much use of the notion of a God in philosophy, contrary to the rule of Horace:

Nec Deus intersit, nisi dignus vindice nodus.

Among us, the philosophers have been the principal advocates for the existence of a Deity. Witness the writings of Sir Isaac Newton, Boyle, Ray, Cheyne, Nieuwentyt, &c. To which may be added many others, who, though of the clergy (as was also Ray), yet have distinguished themselves by their philosophical pieces in behalf of the existence of a God; *e. gr.* Derham, Bentley, Whiston, Samuel and John Clarke, Fenelon, &c. So true is that saying of Lord Bacon, that though a smattering of philosophy may lead a man into atheism, a deep draught will certainly bring him back again to the belief of a God and Providence.

ATHELING, ADELING, EDELING, ETHLING, or ETHELING, among the Anglo-Saxons, was a title of honour, properly belonging to the heir-apparent, or presumptive, to the crown. This honourable appellation was first conferred by King Edward the Confessor on Edgar, to whom he was great uncle, when, being without any issue of his own, he intended to make him his heir.

ATHELSTAN, a Saxon king of England, natural son of Edward the Elder, and grandson of the great Alfred. He succeeded to the crown in 925, and reigned 16 years. There was a remarkable law passed by this prince, which shows his just sentiments of the advantages of commerce, as well as the early attention to it in this country: it declared, that any merchant who made three voyages on his own account beyond the British channel or narrow seas, should be entitled to the privilege of a thane or gentleman.

ATHENÆA, in antiquity, a feast celebrated by the ancient Greeks in honour of Minerva, who was called *Athene*.

ATHENÆUM, in antiquity, a public place wherein the professors of the liberal arts held their assemblies, the rhetoricians declaimed, and the poets rehearsed their performances. These places, of which there were a great number at Athens, were built in the manner of amphitheatres, encompassed with seats, called *cunei*. The three most celebrated Athenæa were those at Athens, at Rome, and at Lyons; the second of which was built by the emperor Adrian.

ATHENÆUS, a physician, born in Cilicia, cotemporary with Pliny, and founder of the Pneumatic sect. He taught that the fire, air, water, and earth, are not the true elements, but that their qualities are, viz. heat, cold, moisture, and dryness; and to these he added a fifth element, which he called *spirit*, whence his sect had its name.

ATHENÆUS, a Greek grammarian, born at Naucratis in Egypt in the third century, one of the most learned men of his time. Of all his works we have none extant but his Deipnosophi, i. e. the sophists at table. There is an infinity of facts and quotations in this work which render it very agreeable to admirers of antiquity.

There was also a mathematician of this name, who wrote a treatise on mechanics, which is inserted in the works of the ancient mathematicians, printed at Paris in 1693, in folio, in Greek and Latin.

ATHENAGORAS, an Athenian philosopher, flourished about the middle of the 2d century, and was remarkable for his zeal for Christianity, and his great learning, as appears from the apology which he addressed to the emperors Marcus Aurelius Antoninus and Lucius Commodus.

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Athenodorus ‖ Athens.

ATHENODORUS, a famous Stoic philosopher, born at Tarsus, went to the court of Augustus, and was made by him tutor to Tiberius. Augustus had a great esteem for him, and found him by experience a man of virtue and probity. He used to speak very freely to the emperor. He, before he left the court to return home, warned the emperor not to give himself up to anger, but whenever he should be in a passion, to rehearse the 24 letters of the alphabet before he resolved to say or do any thing. He did not live to see his bad success in the education of Tiberius.

ATHENOPOLIS, a town of the Massilienses, an ancient nation of Gaul. It is conjectured by Harduin to be the same with *Telo Martias*, now *Toulon;* by others to be the same with *Antipolis* or *Antibes*.

ATHENREE, a town of Ireland in the county of Galway, and province of Connaught. W. Long. 8. 5. N. Lat. 53. 14. It is governed by a portrieve, and hath a barrack for three companies of foot. It hath been a place of considerable strength; but, like the numerous churches and castles which surround it, has felt the resistless force of time. Some of the walls and towers, however, are still remaining, as monuments of its former grandeur.

ATHENS, a celebrated city of Greec, and capital of the ancient kingdom of Attica, situated in E. Long. 24. N. Lat. 38. 5. See ATTICA.

1 By whom founded.

In early times, that which was afterwards called the *citadel* was the whole city; and went under the name of *Cecropia*, from its founder Cecrops, whom the Athenians in after times affirmed to have been the first builder of cities, and called this therefore by way of eminence *Polis*, i. e. the city. In the reign of Erichthonius it lost the name of *Cecropia*, and acquired that of *Athens*, on what account is not certain; the most probable is, that it was so named in respect to the goddess Minerva, whom the Greeks call *Athene*, who was also esteemed its protectress. This old city was seated on the top of a rock in the midst of a large and pleasant plain, which, as the number of inhabitants increased, became full of buildings, which induced the distinction of Acro and Catapolis, i. e. of the upper and lower city. The extent of the citadel was 60 stadia; it was surrounded by olive trees, and fortified, as some say, with a strong pallisade; in succeeding times it was encompassed with a strong wall, in which there were nine gates, one very large one, and the rest small. The inside of the citadel was adorned with innumerable edifices. The most remarkable of which were, 1. The magnificent temple of Minerva, styled *Parthenon*, because that goddess was a virgin. The Persians destroyed it; but it was rebuilt with still greater splendour by the famous Pericles, all of the finest marble, with such skill and strength, that, in spite of the rage of time and barbarous nations, it remains perhaps the first antiquity in the world, and stands a witness to the truth of what ancient writers have recorded of the prodigious magnificence of Athens in her flourishing state. 2. The temple of Neptune and of Minerva; for it was divided into two parts: one sacred to the god, in which was the salt fountain said to have sprung up on the stroke of his trident; the other to the goddess protectress of Athens, wherein was the sacred olive which she produced, and her image which fell down from heaven in the reign of Erichthonius.

2 Remarkable buildings.

At the back of Minerva's temple was the public treasury, which was burnt to the ground through the knavery of the treasurers, who having misapplied the revenues of the state, took this short method of making up accounts.

The lower city comprehended all the buildings surrounding the citadel, the fort Munychia, and the havens Phalerum and Piræus, the latter of which was joined to the city by walls five miles in length; that on the north was built by Pericles, but that on the south by Themistocles; but by degrees the turrets which were at first erected on those walls were turned into dwelling-houses for the accommodation of the Athenians, whose large city was now become too small for them. The city, or rather the lower city, had 13 great gates, with the names of which it is not necessary to trouble the reader. Among the principal edifices which adorned it, we may reckon, 1. The temple of Theseus, erected by Conon, near its centre. Adjacent thereto, the young people performed their exercises. It was also a sanctuary for distressed persons, slaves or free. 2. The Olympian temple erected in honour of Jupiter, the honour of Athens, and of all Greece. The foundation of it was laid by Pisistratus; it was carried on but slowly in succeeding times, 700 years elapsing before it was finished, which happened under the reign of Adrian, who was particularly kind to Athens: this was the first building in which the Athenians beheld pillars. 3. The Pantheon, dedicated to all the gods: a most noble structure, supported by 120 marble pillars, and having over its great gate two horses carved by Praxiteles: it is yet remaining, as we shall have occasion to show hereafter when we come to speak of the present state of this famous city. In several parts of it were *staoi* or porticoes, wherein people walked in rainy weather, and from whence a sect of philosophers were denominated *Stoics*, because their master Zeno taught in those porticoes.

3 Ceramicus.

There were at Athens two places called *Ceramicus*, from Ceramus the son of Bacchus and Ariadne; one within the city, containing a multitude of buildings of all sorts; the other in the suburbs, in which was the academy and other edifices. The gymnasia of Athens were many; but the most remarkable were the Lyceum, Academia, and Cynosarges. The Lyceum stood on the banks of the Ilissus; some say it was built by Pisistratus, others by Pericles, others by Lycurgus. Here Aristotle taught philosophy, instructing such as came to hear him as they walked, whence his disciples are generally thought to derive the name of *Peripatetics*. The Ceramicus without the city was the distance of six stadia from its walls. The academy made part thereof; as to the name of which there is some dispute. Some affirm that it was so called from Academus, an ancient hero, who, when Helen was stolen by Theseus, discovered the place where she lay hid to Castor and Pollux: for which reason the Lacedemonians, when they invaded Attica, always spared this place. Dicæarchus writes, that Castor and Pollux had two Arcadians in their army, the one named *Echedemus*, the other *Marothus;* from the former of these he says this place took its name, and that the borough of Marathon was so called from the other. It was a marshy unwholesome place, till Cimon was at great pains to have it drained; and then it became extremely pleasant

Athens.

sant and delightful, being adorned with shady walks, where Plato read his lectures, and from thence his scholars were termed *Academics*. The Cynosarges was a place in the suburbs not far from the Lyceum: it was famous on many accounts; but particularly for a noble gymnasium erected there, appointed for the special use of such as were Athenians only by one side. In after times Themistocles derived to himself ill will, by carrying many of the nobility to exercise with him here, because, being but of the half blood, he could exercise nowhere else but in this gymnasium. Antisthenes instituted a sect of philosophers, who from the name of this district, as many think, were styled *Cynics*.

4 Cynosarges

5 Havens.

The havens of Athens were three. First, the Piræus, which was distant about 35 or 40 stadia from the city, till joined thereto by the long walls before-mentioned, after which it became the principal harbour of the city. It had three docks: Cantharos, Aphrodisium, and Zea; the first was so called from an ancient hero, the second from the goddess Venus who had there two temples, and the third from bread-corn. There were in this port five porticoes, which joining together formed one great one, called from thence *Macra Stoa*, or the grand portico. There were likewise two great markets or fora: one near the long portico, the other near the city. The second port was Munichia, a promontory not far distant from Piræus; a place very strong by nature, and afterwards rendered far stronger by art. It was of this that Epimenides said, if the Athenians foresaw what mischief it would one day produce to them, they would eat it away with their teeth. The third was Phalerum, distant from the city, according to Thucydides, 35 stadia, but according to Pausanias only 20. This was the most ancient harbour of Athens, as Piræus was the most capacious.

6 Present state.

Of this city, as it stands at present, we have the following account by Dr Chandler and other travellers. "It is now called *Athené*: and is not inconsiderable, either in extent or the number of inhabitants. It enjoys a fine temperature, and a serene sky. The air is clear and wholesome, though not so delicately soft as in Ionia. The town stands beneath the acropolis or citadel; not encompassing the rock as formerly, but spreading into the plain, chiefly on the west and north-west. Corsairs infesting it, the avenues were secured, and in 1676 the gates were regularly shut after sunset. It is now open again: but several of the gateways remain, and a guard of Turks patrols at midnight. Some masses of brick-work, standing separate, without the town, belonged perhaps to the ancient wall, of which other traces also appear. The houses are mostly mean and straggling; many with large courts or areas before them. In the lanes, the high walls on each side, which are commonly white-washed, reflect strongly the heat of the sun. The streets are very irregular; and anciently were neither uniform nor handsome. They have water conveyed in channels from Mount Hymettus, and in the bazar or market-place is a large fountain. The Turks have several mosques and public baths. The Greeks have convents for men and women; with many churches, in which service is regularly performed; and besides these, they have numerous oratories or chapels, some in ruins or consisting of bare walls, frequented only on the anniversaries of the saints to whom they are dedicated. A portrait of the owner on a board is placed in them on that occasion, and removed when the solemnity of the day is over.

"The city of Cecrops is now a fortress with a thick irregular wall, standing on the brink of precipices, and enclosing a large area about twice as long as broad. Some portions of the ancient wall may be discovered on the outside, particularly at the two extreme angles; and in many places it is patched with pieces of columns, and with marbles taken from the ruins. A considerable sum had been recently expended on the side next Hymettus, which was finished before we arrived. The scaffolding had been removed to the end toward Pentele; but money was wanting, and the workmen were withdrawn. The garrison consists of a few Turks, who reside there with their families, and are called by the Greeks *Castriani*, or the soldiers of the castle. The rock is lofty, abrupt, and inaccessible, except the front, which is towards the Piræus; and on that quarter is a mountainous ridge, within cannon-shot. It is destitute of water fit for drinking; and supplies are daily carried up in earthen jars, on horses and asses, from one of the conduits of the town.

7 Citadel, or city of Cecrops.

"The acropolis furnished a very ample field to the ancient virtuosi. It was filled with monuments of Athenian glory, and exhibited an amazing display of beauty, of opulence, and of art; each contending as it were for the superiority. It appeared as one entire offering to the Deity, surpassing in excellence and astonishing in richness. Heliodorus, named Periegetes, *the guide*, had employed on it 15 books. The curiosities of various kinds, with the pictures, statues, and pieces of sculpture, were so many and so remarkable, as to supply Polemo Periegetes with matter for four volumes: and Strabo affirms, that as many would be required in treating of other portions of Athens and of Attica. In particular, the number of statues was prodigious. Tiberius Nero, who was fond of images, plundered the acropolis as well as Delphi and Olympia; yet Athens, and each of these places, had not fewer than 3000 remaining in the time of Pliny. Even Pausanias seems here to be distressed by the multiplicity of his subject. But this banquet, as it were, of the senses has long been withdrawn; and is now become like the tale of a vision. The spectator views with concern the marble ruins intermixed with mean flat-roofed cottages, and extant amid rubbish; the sad memorials of a nobler people; which, however, as visible from the sea, should have introduced modern Athens to more early notice. They who reported it was only a small village, must, it has been surmised, have beheld the acropolis through the wrong end of their telescopes.

"The acropolis has now, as formerly, only one entrance, which fronts the Piræus. The ascent is by traverses and rude fortifications furnished with cannon, but without carriages, and neglected. By the second gate is the station of the guard, who sits cross-legged under cover, much at his ease, smoking his pipe, or drinking coffee, with his companions about him in like attitudes. Over this gateway is an inscription in large characters on a stone turned upside down, and black from the fires made below. It records a present of a pair of gates.

"Going farther up, you come to the ruins of the Propyléa, an edifice which graced the entrance of the 8 Propylea.

 citadel.

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Athens. citadel. This was one of the structures of Pericles, who began it when Euthymenes was archon, 435 years before Christ. It was completed in five years, at the expence of 2012 talents. It was of marble, of the Doric order, and had five doors to afford an easy passage to the multitudes which resorted on business or devotion to the acropolis.

While this fabric was building, the architect Mnesicles, whose activity equalled his skill, was hurt by a fall, and the physicians despaired of his life: but Minerva, who was propitious to the undertaking, appeared, it was said, to Pericles, and prescribed a remedy, by which he was speedily and easily cured. It was a plant or herb growing round about the acropolis, and called afterwards *parthenium*.

9 Temple of Victory.

"The right wing of the Propylea was a temple of Victory. They related that Ægeus had stood there, viewing the sea, and anxious for the return of his son Theseus, who was gone to Crete with the tributary children to be delivered to the Minotaur. The vessel which carried them had black sails suiting the occasion of its voyage; and it was agreed, that, if Theseus overcame the enemy, their colour should be changed to white. The neglect of this signal was fatal to Ægeus, who, on seeing the sails unaltered, threw himself down headlong from the rock, and perished. The idol was named *Victory without wings;* it was said, because the news of the success of Theseus did not arrive but with the conqueror. It had a pomegranate in the right hand, and a helmet in the left. As the statue was without pinions, it was hoped the goddess would remain for ever on the spot.

"On the left wing of the Propylea, and fronting the temple of Victory, was a building decorated with paintings by Polygnotus, of which an account is given by Pausanias. This edifice, as well as the temple, was of the Doric order, the columns fluted, and without bases. Both contributed alike to the uniformity and grandeur of the design; and the whole fabric, when finished, was deemed equally magnificent and ornamental. The interval between Pericles and Pausanias consists of several centuries. The Propylea remained entire in the time of this topographer; and, as will be shown, continued nearly so to a much later period. It had then a roof of white marble, which was unsurpassed either in the size of the stones or in the beauty of their arrangement; and before each wing was an equestrian statue.

"The Propylea have ceased to be the entrance of the acropolis. The passage which was between the columns in the centre, is walled up almost to their capitals, and above is a battery of cannon. The way now winds before the front of the ancient structure; and turning to the left hand among rubbish and mean walls, you come to the back part, and to the five door-ways. The soil without is risen higher than the top of the two smaller. There, under the vault and cannon, lies a heap of large stones, the ruin of the roof.

"The temple of Victory, standing on an abrupt rock, has its back and one side encumbered with the modern ramparts. The columns in the front being walled up, you enter it by a breach in the side, within the Propylea. It was used by the Turks as a magazine for powder, until about the year 1656, when a sudden explosion, occasioned by lightning, carried away the roof, with a house erected on it, belonging to the officer who commanded in the acropolis, whose family, except a girl, perished. The women of the aga continued to inhabit this quarter, but it is now abandoned and in ruins.

10 Roof carried off by an explosion.

"The cell of the temple of Victory, which is of white marble, very thick, and strongly cemented, sufficiently witnesses the great violence it has undergone; the stones in many places being disjointed, as it were, and forced from their original position. Two of these making an acute angle, the exterior edges touching, without the crevice; and the light abroad being much stronger than in the room, which has a modern roof and is dark, the portion in contact becoming pellucid, had illumined the vacant space with a dim colour resembling that of amber. We were desired to examine this extraordinary appearance, which the Greeks regarded as a standing miracle, and which he Turks, who could not refute them, beheld with equal astonishment. We found in the gape some coals, which had been brought on a bit of earthen ware for the purpose of burning incense, as we supposed, and also a piece of wax-taper, which probably had been lighted in honour of the saint and author of the wonder; but our Swiss unfortunately carrying his own candle too far in, the smoke blackened the marble, and destroyed the phenomenon.

"The building opposite to the temple has served as a foundation for a square lofty tower of ordinary masonry. The columns of the front are walled up, and the entrance is by a low iron gate in the side. It is now used as a place of confinement for delinquents: but in 1676 was a powder magazine. In the wall of a rampart near it are some fragments of exquisite sculpture, representing the Athenians fighting with the Amazons. These belong to the frieze, which was then standing. In the second century, when Pausanias lived, much of the painting was impaired by age, but some remained, and the subjects were chiefly taken from the Trojan story. The traces are since vanished.

"The pediment of the temple of Victory, with that of the opposite wing, is described as remaining in 1676; but on each building a square tower had been erected. One of the steps in the front of the Propylea was entire, with the four columns, their entablature and the pediment. The portico, to which the five door-ways belonged, consisted of a large square room, roofed with slabs of marble, which were laid on two great marble beams, and sustained by four beautiful columns. These were Ionic, the proportions of this order best suiting that purpose, as taller than the Doric; the reason it was likewise preferred in the pronaos of the temple of Victory. The roof of the Propylea, after standing above 2000 years, was probably destroyed, with all the pediments, by the Venetians in 1687, when they battered the castle in front, firing red-hot bullets, and took it, but were compelled to resign it again to the Turks in the following year. The exterior walls, and in particular a side of the temple of Victory, retain many marks of their hostilities.

11 Temple of Minerva.

"The chief ornament of the acropolis was the Parthenon or great temple of Minerva, a most superb and magnificent fabric. The Persians had burned the edifice which before occupied the site, and was called *hecatompedon*,

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Athens. *hecatompedon*, from its being 100 feet square. The zeal of Pericles and of all the Athenians was exerted in providing a far more ample and glorious residence for their favourite goddess. The architects were Callicrates and Ictinus; and a treatise on the building was written by the latter and Carpion. It was of white marble, of the Doric order, the columns fluted and without bases, the number in front eight; and adorned with admirable sculpture. The story of the birth of Minerva was carved in the front pediment; and in the back, her contest with Neptune for the country. The beasts of burden, which had conveyed up the materials, were regarded as sacred, and recompensed with pastures; and one, which had voluntarily headed the train, was maintained during life, without labour, at the public expence.

12 Her statue. "The statue of Minerva, made for this temple by Phidias, was of ivory, 26 cubits or 39 feet high. It was decked with pure gold to the amount of 44 talents, so disposed by the advice of Pericles as to be taken off and weighed if required. The goddess was represented standing, with her vestment reaching to her feet. Her helmet had a sphinx for the crest, and on the sides were griffins. The head of Medusa was on her breastplate. In one hand she held her spear, and in the other supported an image of Victory about four cubits high. The battle of the Centaurs and Lapithæ was carved on her sandals; and on her shield, which lay at her feet, the war of the gods and giants, and the battle of the Athenians and Amazons. By her spear was a serpent, in allusion to the story of Erichthonius; and on the pedestal, the birth of Pandora. The Sphinx, the Victory, and Serpent, were accounted eminently wonderful. This image was placed in the temple in the first year of the 87th Olympiad, in which the Peloponnesian war began. The gold was stripped off by the tyrant Lychares, when Demetrius Poliorcetes compelled him to fly. The same plunderer plucked down the golden shields in the acropolis, and carried away the golden Victories, with the precious vessels and ornaments provided for the Panathenæan festival.

"The Parthenon remained entire for many ages after it was deprived of the goddess. The Christians converted it into a church, and the Mahometans into a mosque. It is mentioned in the letters of Crusius, and miscalled the *Pantheon*, and the *temple of the unknown God*. The Venetians under Koningsmark, when they besieged the acropolis in 1687, threw a bomb, which demolished the roof, and setting fire to some powder, did much damage to the fabric. The floor, which is indented, still witnesses the place of its fall. This was the sad forerunner of farther destruction; the Turks breaking the stones, and applying them to the building of a new mosque, which stands within the ruin, or to the repairing their houses and the walls of the fortress. The vast pile of ponderous materials, which lay ready, is greatly diminished; and the whole structure will gradually be consumed and disappear.

13 Temple converted into a mosque. "The temple of Minerva in 1676 was, as Wheeler and Spon assert, the finest mosque in the world, without comparison. The Greeks had adapted the fabric to their ceremonial, by constructing at one end a semicircular recess for the holy tables, with a window; for before it was enlightened only by the door, obscurity being preferred under the heathen ritual, except on festivals, when it yielded to splendid illuminations: the reason, it has been surmised, why temples are commonly found simple and unadorned on the insides. In the wall beneath the window were inserted two pieces of the stone called *phengites* a species of marble discovered in Cappadocia in the time of Nero; and so transparent that he erected with it a temple to Fortune, which was luminous within when the door was shut. These pieces were perforated, and the light which entered was tinged with a reddish or yellowish hue. The picture of the Panagia or Virgin Mary, in mosaic, on the ceiling of the recess, remained; with two jasper columns belonging to the screen, which had separated that part from the nave; and within, a canopy supported by four pillars of porphyry, with Corinthian capitals of white marble, under which the table had been placed; and behind it, beneath the window, a marble chair for the archbishop; and also a pulpit standing on four small pillars in the middle aile. The Turks had white-washed the walls, to obliterate the portraits of saints, and the other paintings, with which the Greeks decorate their places of worship; and had erected a pulpit on the right hand for their iman or reader. The roof was disposed in square compartments; the stones massive; and some had fallen in. It had been sustained in the pronaos by six columns; but the place of one was then supplied by a large pile of rude masonry, the Turks not having been able to fill up the gap more worthily. The roof of the naos was supported by colonnades ranging with the door, on each side; and consisting of 22 pillars below, and of 23 above. The odd one was over the entrance, which by that disposition was left wide and unembarrassed. In the portico were suspended a few lamps, to be used in the mosque at the seasons when the Mussulmans assemble before day-break, or to be lighted up round the minaret, as is the custom during their Ramazan or Lent.

"It is not easy to conceive a more striking object than the Parthenon, though now a mere ruin. The columns within the naos have all been removed: but on the floor may be seen the circles which directed the workmen in placing them; and at the farther end is a groove across it, as for one of the partitions of the cell. The recess erected by the Christians is demolished; and from the rubbish of the ceiling the Turkish boys collect bits of the mosaic, of different colours, which composed the picture. We were told at Smyrna, that this substance had taken a polish, and been set in buckles. This cell is about half demolished; and in the columns which surround it is a large gap near the middle. On the walls are some traces of the paintings. Before the portico is a reservoir sunk in the rock, to supply the Turks with water for the purifications customary on entering their mosques. In it, on the left hand, is the rubbish of the pile erected to supply the place of a column; and on the right, a staircase, which leads out on the architrave, and has a marble or two with inscriptions, but worn so as not to be legible. It belonged to the minaret, which has been destroyed. 14 Magnificent ruin.

"The travellers, to whom we are indebted for an account of the mosque, have likewise given a description 15 Sculpture.

2

Athens.

tion of the sculpture then remaining in the front. In the middle of the pediment was seen a bearded Jupiter, with a majestic countenance, standing, and naked; the right arm broken. The thunderbolt, it has been supposed, was placed in that hand, and the eagle between his feet. On his right was a figure, it is conjectured, of Victory, clothed to the mid-leg; the head and arms gone. This was leading on the horses of a car, in which Minerva sat, young and unarmed; her head-dress, instead of a helmet, resembling that of a Venus. The generous ardour and lively spirit visible in this pair of celestial steeds, was such as bespoke the hand of a master, bold and delicate, of a Phidias or Praxiteles. Behind Minerva was a female figure, without a head, sitting with an infant in her lap; and in this angle of the pediment was the emperor Hadrian with his arm round Sabina, both reclining, and seeming to regard Minerva with pleasure. On the left side of Jupiter were five or six other trunks, to complete the assembly of deities into which he received her. These figures were all wonderfully carved, and appeared as big as life. Hadrian and his consort, it is likely, were complimented by the Athenians with places among the marble gods in the pediment, as benefactors. Both of them may be considered as intruders on the original company; and possibly their heads were placed on trunks, which before had other owners. They still possess their corner, and are easy to be recognised though not unimpaired. The rest of the statues are defaced, removed, or fallen. Morosini was ambitious to enrich Venice with the spoils of Athens; and by an attempt to take down the principal group, hastened their ruin. Nearly twenty years ago, Lord Elgin, then British ambassador at the Porte, procured an order from the Turkish government for the removal of some of these remains. Accordingly a considerable number of the bas-reliefs of the Parthenon were sent to England, along with many other precious antiquities, and they are now deposited in the British Museum.

16 Erectheum.

"Neptune and Minerva, once rival deities, were joint and amicable tenants of the Erectheum, in which was an altar of Oblivion. The building was double, a partition wall dividing it into two temples, which fronted different ways. One was the temple of Neptune Erectheus, the other of Minerva Polias. The latter was entered by a square portico connected with a marble skreen, which fronts towards the Propylea. The door of the cell was on the left hand: and at the farther end of the passage was a door leading down into the Pandroséum, which was contiguous.

17 Temple of Neptune Erectheus.

"Before the temple of Neptune Erectheus was an altar of Jupiter *the supreme*, on which no living thing was sacrificed, but they offered cakes without wine. Within it was the altar of Neptune and Erectheus; and two, belonging to Vulcan and a hero named *Butes*, who had transmitted the priesthood to his posterity, which were called *Butadæ*. On the walls were paintings of this illustrious family, from which the priestess of Minerva Polias was also taken. It was asserted that Neptune had ordained the well of salt water, and the figure of a trident in the rock, to be memorials of his contending for the country. The former, Pausanias remarks, was no great wonder, for other wells of a similar nature were found inland; but this when the south wind blew, afforded the sound of waves.

18 Of Minerva Polias.

"The temple of Minerva Polias was dedicated by all Attica, and possessed the most ancient statue of the goddess. The demi or towns had other deities, but their zeal for her suffered no diminution. The image, which they placed in the acropolis, then the city, was in after ages not only reputed consummately holy, but believed to have fallen down from heaven in the reign of Erichthonius. It was guarded by a large serpent, which was regularly served with offerings of honeyed cakes for his food. This divine reptile was of great sagacity, and attained to an extraordinary age. He wisely withdrew from the temple when in danger from the Medes; and, it is said, was living in the second century. Before this statue was an owl; and a golden lamp. This continued burning day and night. It was contrived by a curious artist, named *Callimachus*, and did not require to be replenished with oil oftener than once a year. A brazen palm-tree, reaching to the roof, received its smoke. Ariston had let the holy flame expire while Sylla besieged him, and was abhorred for his impiety. The original olive-tree, said to have been produced by Minerva, was kept in this temple. When the Medes set fire to the acropolis, it was consumed; but, they asserted, on the following day, was found to have shot up again as much as a cubit. It grew low and crooked, but was esteemed very holy. The priestess of Minerva was not allowed to eat of the new cheese of Attica; and, among her perquisites, was a measure of wheat, and one of barley, for every birth and burial. This temple was again burned when Callias was archon, 24 years after the death of Pericles. Near it was the tomb of Cecrops, and within it Erectheus was buried.

"The ruin of the Erectheum is of white marble; the architectural ornaments of very exquisite workmanship, and uncommonly curious. The columns of the front of the temple of Neptune are standing with the architrave; and also the skreen and portico of Minerva Polias, and with a portion of the cell retaining traces of the partition-wall. The order is Ionic. An edifice revered by ancient Attica, as holy in the highest degree, was in 1676 the dwelling of a Turkish family, and is now deserted and neglected; but many ponderous stones and much rubbish must be removed before the well and trident would appear. The former, at least, might probably be discovered. The portico is used as a powder-magazine; but we obtained permission to dig and examine the outside. The door-way of the vestibule is walled up, and the soil risen nearly to the top of the door-way of the Pandroseum. By the portico is a battery commanding the town, from which ascends an amusing hum. The Turks fire from it, to give notice of the commencement of Ramazan or of their Lent, and of Bairam or the holy-days, and on other public occasions.

"The Pandroseum is a small, but very particular building, of which no satisfactory idea can be communicated by description. The entablature is supported by women called *Caryatides*. Their story is thus related. The Greeks, victorious in the Persian war, jointly destroyed Carya, a city of the Peloponnesus, which had favoured the common enemy. They cut off

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off the males, and carried into captivity the women, whom they compelled to retain their former dress and ornaments, though in a state of servitude. The architects of those times, to perpetuate the memory of their punishment, represented them, as in this instance, each with a burden on her head, one hand uplifted to it and the other hanging down by her side. The images were in number six, all looking toward the Parthenon. The four in front, with that next to the Propylea, remain, but mutilated, and their faces besmeared with paint. The soil is risen almost to the top of the basement on which they are placed. This temple was open or latticed between the statues; and in it also was a stunted olive-tree, with an altar of Jupiter Herceus standing under it. The Propylea are nearly in a line with the space dividing it from the Parthenon; which disposition, besides its other effects, occasioned the front and flank of the latter edifice to be seen at once by those who approached it from the entrance of the acropolis.

19 Of Jupiter Olympius.

"The ruin of the temple of Jupiter Olympius consists of prodigious columns, tall and beautiful, of the Corinthian order, fluted; some single, some supporting the architraves; with a few massive marbles beneath: the remnant of a vast heap, which only many ages could have consumed and reduced into so scanty a compass. The columns are of very extraordinary dimensions, being about six feet in diameter, and near 60 in height. The number without the cell was 116 or 120. Seventeen were standing in 1676; but a few years before we arrived, one was overturned with much difficulty, and applied to the building a new mosque in the bazar or market-place. This violence was avenged by the bashaw of Negropont, who made it a pretext for extorting from the vaiwode or governor 15 purses; the pillar being, he alleged, the property of their master the Grand Signior. It was an angular column, and of consequence in determining the dimensions of the fabric. We regretted that the fall of this mighty mass had not been postponed until we came, as it would have afforded an opportunity of inspecting and measuring some members which we found far too lofty to be attempted. On a piece of the architrave, supported by a couple of columns, are two parallel walls, of modern masonry, arched about the middle, and again near the top. You are told it has been the habitation of a hermit, doubtless of a stylite; but of whatever building it has been part, and for whatever purpose designed, it must have been erected thus high in air, while the immense ruin of this huge structure was yet scarcely diminished, and the heap inclined so as to render it accessible. It was remarked that two stones of a step in the front had coalesced at the extremity, so that no juncture could be perceived; and the like was discovered also in a step of the Parthenon. In both instances it may be attributed to a concretory fluid, which pervades the marble in the quarry. Some portion remaining in the pieces, when taken green as it were, and placed in mutual contact, it exuded and united them by a process similar to that in a bone of an animal when broken and properly set.

20 Detached pieces of antique sculpture, &c.

"Besides the more stable antiquities, many detached pieces are found in the town, by the fountains, in the streets, the walls, the houses, and churches. Among these are fragments of sculpture; a marble chair or two, which probably belonged to the gymnasia or theatres: a sun-dial at the catholicon or cathedral, inscribed with the name of the maker; and, at the archiepiscopal house close by, a very curious vessel of marble, used as a cistern to receive water, but once serving, it is likely, as a public standard or measure. Many columns occur; with some maimed statues; and pedestals, several with inscriptions, and almost buried in earth. A custom has prevailed, as at Chios, of fixing in the wall, over the gateways and doors of the houses, carved stones, most of which exhibit the funeral supper. In the courts of the houses lie many round stylæ, or pillars, once placed on the graves of the Athenians; and a great number are still to be seen applied to the same use in the Turkish burying grounds before the acropolis. These generally have concise inscriptions, containing the name of the person, and of the town and tribe to which the deceased belonged. Demetrius the Phalerian, who endeavoured to restrain sepulchral luxury, enacted, that no person should have more than one, and that the height should not exceed three cubits. Another species, which resembles our modern head-stones, is sometimes adorned with sculpture, and has an epitaph in verse. We saw a few mutilated Hermæ. These were busts, on long quadrangular bases, the heads frequently of brass, invented by the Athenians. Athens at present contains, according to Dr Clarke, 15,000 inhabitants. According to Mr Hobhouse it contains 1200 or 1300 houses, of which 300 are occupied by Albanians, 400 by Turks, and 500 or 600 by Greeks. The houses are ill built, and the streets narow. Of mosques, churches, and chapels of all sorts, it contains nearly 200. The town lies chiefly on the north and north-west side of the acropolis. The harbour of Piræus is now almost desolate, not a single house being near it, except a wretched hut called the customhouse. A few small vessels resort to it, to trade in oil, the staple production of Attica.

ATHERINA. See ICHTHYOLOGY *Index*.

ATHEROMA, in *Surgery*, a tumor without pain or discoloration of the skin, containing, in a membranous bag, matter resembling pap, intermixed with hard and stony particles. These tumors are usually cured by incision.

ATHERTON, or ATHERSTON, a town of Warwickshire in England, situated on the river Stour, in W. Long. 1. 30. N. Lat. 52. 40. It is a considerable town, and had formerly a monastery; but now is best known by its fair, which is the greatest in England for cheese. Population 2921 in 1811.

ATHESIS, in *Ancient Geography*, a river of the Cisalpine Gaul, which, rising in the Rhetian Alps, in Mount Brenna, in the county of Tirol, runs southwards and washes Tridentum and Verona, which last it divides; and after passing this, bends its course eastwards, in a parallel direction with the Po, and falls into the Adriatic between Fossa Claudia and Philistina: it separated the Euganei, an ancient people, from the Veneti. The people dwelling on it are called *Athesini* (Pliny). Its modern name is the *Adige*.

ATHLETÆ, in antiquity, persons of strength and agility, disciplined to perform in the public games. The word is originally Greek, ἀθλητης: formed from ἀθλος, *certamen*, "combat;" whence also ἀθλον, the prize or reward adjudged the victor.—Under athletæ were comprehended wrestlers, boxers, runners, leapers, throwers

throwers of the disk, and those practised in other exercises exhibited in the Olympic, Pythian, and other solemn sports: for the conquerors wherein there were established prizes.

ATHLETIC HABIT, denotes a strong hale constitution of body. Anciently it signified a full fleshy corpulent state, such as the athletæ endeavoured to arrive at. The athletic habit is esteemed the highest pitch of health; yet it is dangerous, and the next door to disease; since, when the body is no longer capable of being improved, the next alteration must be for the worse. The chief object of the athletic diet, was to obtain a firm, bulky, weighty body; by force of which, more than art and agility, they frequently overpowered their antagonist: hence they fed altogether on dry, solid, and viscous meats. In the earlier days, their chief food was dry figs and cheese, which was called *arida saginatio*, ξηρα τροφη, and Ασκησις διαξηρων ισχαδων. Oribasius, or, as others say, Pythagoras, first brought this into disuse, and substituted flesh in lieu thereof. They had a peculiar bread called κολλητια: They exercised, ate, and drank, without ceasing: they were not allowed to leave off eating when satiated; but were obliged to cram on till they could hold no more; by which means they at length acquired a degree of voracity which to us seems incredible, and a strength proportional. Witness what Pausanias relates of the four celebrated athletæ, Polydamus the Thessalian, Milo the Crotonian, Theagenes the Thasian, and Euthymus the Locrian: The second is said to have carried a bull on his back a considerable way, then to have knocked him down with a blow of his fist, and lastly, as some add, devoured him at a meal.

ATHLONE, a town of Westmeath in Ireland, lying in W. Long. 8. 0. N. Lat. 53. 20. It is situated on both sides of the Shannon, and both parts are united by a strong, high-raised, and well-built bridge, in the middle of which stands a monument, with some figures cut in marble, together with Queen Elizabeth's arms, and some inscriptions declaring the time and the founders of the building. The castle was founded by King John on some land belonging to St Peter's abbey, for which he granted a compensation. It is built on a high-raised round hill, resembling one of the Danish raths or forts. Here were formerly two convents or monasteries. Athlone was formerly strongly fortified, and considered as of very great importance. In the year 1691, a part of the English army under General Ginckle, in the very face of the Irish, who were strongly intrenched on the opposite shore, fording the river, formed, and took possession of the town, not losing more than 50 men in the attack; which is esteemed as bold and successful an enterprise as any recorded in history. There are generally two troops of horse and four companies of foot quartered at Athlone. This town gives the title of *earl* to the family of Ginckle, as a reward for the noble services performed by the general.

ATHOL, the most northern district of Perthshire in Scotland, extending in length 43 miles, and in breadth 30. It is bordered on the north by Badenoch, on the west by Lochaber, on the east and south-east by Mar and Gowrie, on the south by Stratherne and Perth Proper, and on the south-west by Braidalbane.

The country is very rough and mountainous, and contains part of the ancient Caledonian forest; but these mountains are intersected with fruitful valleys. Here are several villages, but no towns of any consideration. The most noted place is Blair Castle, seated on the river Tilt, near its influx into the Garie: a pleasant limpid stream that falls into the Tay. This castle belongs to the duke of Athol, who derives his title from this district, and lives here with great magnificence. In the same neighbourhood we see the pass of Gillicranky, rendered memorable by the battle fought here in the beginning of King William's reign, between that monarch's general M'Kay, and the Highlanders adhering to King James. See GILLICRANKY.

ATHOS, a celebrated mountain of Chalcidia in Macedonia, situated in E. Long. 26. 20. N. Lat. 40. 10. The ancients entertained extravagant notions concerning its height. Mela affirmed it to be so high as to reach above the clouds; and Martianus Capellinus, that it was six miles high. It was a received opinion that the summit of Mount Athos was above the middle region of the air, and that it never rained there; because the ashes left on the altars erected near the summit were always found as they were left, dry and unscattered. But if on many accounts it was famous among the ancients, it is no less so among the moderns. The Greeks, struck with its singular situation and the venerable appearance of its towering ascent, erected so many churches, monasteries, hermitages, &c. upon it, that it became in a manner inhabited by devotees, and from thence received the name of the *Holy Mountain;* which name it still retains, though many of those consecrated works are now decayed. According to the accounts of modern travellers, this mountain advances into the Archipelago, being joined to the continent by an isthmus about half a league in breadth. It is about 30 miles in circumference, and its height is only 3353 feet. It may be travelled over in about three days, and may be seen 90 miles off. There is a fine prospect from the top; but, like all other high mountains, the cold on its summit is excessive. It abounds with many different kinds of plants and trees, particularly the pine and fir. In the valleys grows a plant called *elegia*, whose branches serve to make pens for writing. In short, this mountain is said to be adorned with variety of herbage and evergreens, a multitude of springs and streams, and woods growing near the shore, so as to be one of the most agreeable places in the world.

It is now inhabited by Caloyers, a sort of Greek monks, of the order of St Basil, who never marry, though others of that church do. They abstain from flesh, and fare very hardly, their ordinary meal being olives pickled when they are ripe. They are about 6000 in all, and inhabit 24 large old monasteries, surrounded with high walls for a defence against banditti. They are respected by the Turks, and are not idle like others; but labour in the fields, and in various mechanic arts. The researches of Professor Carlyle for some years have at length completely dissipated the expectations long indulged of finding valuable manuscripts in these monasteries.

Through this mountain, or rather through the isthmus behind it, Xerxes king of Persia is said to have cut

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cut a passage for his fleet when about to invade Greece. In this work he spent three whole years, and employed in it all the forces on board the fleet. He is also said, before the work was begun, to have written the following insolent and ridiculous letter to the mountain: "Athos, thou proud and aspiring mountain, that liftest up thy head to the very skies, I advise thee not to be so audacious as to put rocks and stones that cannot be cut in the way of my workmen. If thou makest that opposition, I will cut thee entirely down, and throw thee headlong into the sea." The truth of such a canal being cut was long denied, but has at length been proved. Its remains were distinctly seen by Dr Sibthorp, partly filled with water. (See Walpole's Memoirs relating to Turkey, 1817.)

ATHWART, in *Navigation*, is synonymous with across the line of the course.

Athwart the Fore-foot, is a phrase that denotes the flight of a cannon ball from one ship across the course of another, to intercept the latter, and oblige her to shorten sail, that the former may come near enough to examine her.

Athwart-Hause, expresses the situation of a ship, when she is driven by wind or tide, or any other accident, across the fore part of another.

Athwart-Ships, reaching across ships from one side to the other.

ATHY, a town of Ireland, in the county of Kildare, not far from the borders of Queen's county. W. Long. 7. 0. N. Lat. 53. 0. It is situated on the river Barrow; is governed by a sovereign, two bailiffs, and a recorder; and is, alternately with Naas, the assizes town.

ATIBAR, the name by which the inhabitants of the kingdom of Gago in Africa call gold dust; from which word, Europeans, and especially the French, have composed the word *tibir*, which also signifies gold dust among those who trade in that commodity.

ATIGNY, an ancient town of France, in the department of Ardennes, where several of the kings of France had their residence. It is seated on the river *Aisne*, in E. Long. 4. 47. N. Lat. 49. 30.

ATKINS, Sir Robert, lord chief baron of the exchequer, was born in 1621, and educated at the university of Oxford, from whence he removed to the inns of court, and became eminent in the law. He was made knight of the Bath, with many other persons of the first distinction, at the coronation of King Charles II. In 1672, he was appointed one of the judges of common pleas; in which honourable station he continued till 1679, when, foreseeing the troubles that soon after ensued, he thought fit to resign, and retire into the country. In 1689, he was made by King William lord chief baron of the exchequer; and about the same time executed the office of speaker to the house of lords, which had been previously refused by the marquis of Halifax. He distinguished himself by an unshaken zeal for the laws and liberties of his country. He wrote several pieces, which have been collected into one volume 8vo, under the title of *Parliamentary and Political Tracts*. The authors of the Biographia Britannica remark, that whoever inclines to be thoroughly informed of the true constitution of his country, of the grounds and reasons of the revolution, and of the danger of suffering prerogative to jostle law, cannot read a better or plainer book than those tracts of Sir Robert Atkins. He died in 1709, aged 88.

Atkins, *Sir Robert*, son of the preceding, was born in 1646, and was eminent for all the virtues that could adorn an English gentleman. He wrote The Ancient and Present State of Gloucestershire, in one large volume in folio; and died October 29. 1711.

ATKYNS, Richard, was descended from a good family, and was born at Tuffleigh in Gloucestershire in the year 1615. He was educated at Oxford, from whence he removed to Lincoln's-inn, and afterwards distinguished himself by his loyalty to King Charles I. for whom he raised a troop of horse at his own expence. At the Restoration he was made one of the deputy lieutenants of Gloucestershire, and distinguished himself by his attachment to the government. But at length being committed prisoner to the Marshalsea in Southwark for debt, he died there on the 14th of September 1677. He wrote several pieces, particularly A Treatise on the Original and Growth of Printing.

ATLANTIC ocean, that bounded by Europe and Africa on the east, and by America on the west.

ATLANTICA. See Atlantis.

ATLANTIDES, in *Astronomy*, a denomination given to the Pleiades, or seven stars, sometimes also called *Vergilliæ*. They are thus called, as being supposed by the poets to have been the daughters either of Atlas or his brother Hesperus, who were translated into heaven.

ATLANTIS, Atalantis, or Atlantica, an island mentioned by Plato and some others of the ancients, concerning the real existence of which many disputes have been raised. Homer, Horace, and the other poets make two Atlanticas, calling them *Hesperides* and *Elysian Fields*, making them the habitations of the blessed. The most distinct account of this island we have in Plato's Timæus, of which Mr Chambers gives the following abridgment. "The Atlantis was a large island in the western ocean, situated before or opposite to the straits of Gades. Out of this island there was an easy passage into some others, which lay near a large continent exceeding in bigness all Europe and Asia. Neptune settled in this island (from whose son Atlas its name was derived), and divided it among his ten sons. To the youngest fell the extremity of the island, called *Gadir*, which in the language of the country signifies *fertile*, or *abundant in sheep*. The descendants of Neptune reigned here from father to son, for a great number of generations, in the order of primogeniture, during the space of 9000 years. They also possessed several other islands; and passing into Europe and Africa, subdued all Libya as far as Egypt, and all Europe to Asia Minor. At length the island sunk under water; and for a long time afterwards the sea thereabouts was full of rocks and shelves."

Many of the moderns also are of opinion, that the existence of the Atlantis is not to be looked upon as entirely fabulous. Some take it to have been America; and from thence, as well as from a passage in Seneca's Medea, and some other obscure hints, they imagine that the new world was not unknown to the ancients. But allowing this to be the case, the abovementioned continent, which was said to lie beyond Atlantis,

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lantis, would seem rather to have been the continent of America than Atlantis itself. The learned Rudbeck, professor in the university of Upsal, in a work entitled *Atlantica sive Manheim*, endeavours to prove that Sweden and Norway are the Atlantis of the ancients; but this its situation will by no means allow us to believe. By Kircher it is supposed to have been an island extending from the Canaries quite to the Azores; that it was really swallowed up by the ocean, as Plato asserts; and that these small islands are the shattered remains of it which were left standing.

ATLANTIS, *New*, is the name of a fictitious philosophical commonwealth, of which a description has been given by Lord Bacon. The New Atlantis is supposed to be an island in the South sea, to which the author was driven in a voyage from Peru to Japan. The composition is an ingenious fable, formed after the manner of the Utopia of Sir Thomas More, or Campanella's City of the Sun. Its chief design is to exhibit a model or description of a college, instituted for the interpretation of nature and the production of great and marvellous works, for the benefit of men, under the name of *Solomon's House*, or "the college of the six days work." This much, at least, is finished; and with great beauty and magnificence. The author proposed also a frame of laws, or of the best state or mould of a commonwealth. But this part is not executed.

ATLAS, king of Mauritania, a great astronomer, contemporary with Moses. From his taking observations of the stars from a mountain, the poets feigned him to have been turned into a mountain, and to sustain the heavens on his shoulders. Being an excellent astronomer, and the first who taught the doctrine of the sphere, they tell us that his daughters were turned into stars: seven of them forming the Pleiades, and other seven the Hyades.

ATLAS, a chain of mountains in Africa, lying between the 20th and 25th degree of north latitude, and supposed almost to divide the continent from east to west. They are said to have derived their name from Atlas king of Mauritania, who was a great astronomer. They are greatly celebrated by the ancients on account of their height, insomuch that the above-mentioned king, who is said to have been transformed into a mountain, was feigned to bear up the heavens on his shoulders. We are assured, however, by Dr Shaw, that the part of this chain of mountains which fell under his observation could not stand in competition either with the Alps or Apennines. He tells us, that if we conceive a number of hills, usually of the perpendicular height of 400, 500, or 600 yards, with an easy ascent, and several groves of fruit or forest trees, rising up in a succession of ranges above one another; and that if to this prospect we add now and then a rocky precipice, and on the summit of each imagine a miserable mud-walled village; we shall then have a just idea of the mountains of Atlas.

According to M. Chenier *, this mountain is formed by an endless chain of lofty eminences, divided into different countries, inhabited by a multitude of tribes, whose ferocity permits no stranger to approach. "I have not been able (continues he) to obtain a sufficient knowledge of these mountains to describe them accurately: What Leo Africanus has said of them is very vague; and his account is the less to be regarded at present, as it is now about three centuries since he wrote, and the face of the country has been in that time totally changed. Nothing perhaps would be more interesting to the curiosity of the philosopher, or conduce more to the improvement of our knowledge in natural history, than a journey over Mount Atlas. The climate, though extremely cold in winter, is very healthy and pleasant; the valleys are well cultivated, abound in fruits, and are diversified by forests and plentiful springs, the streams of which uniting at a little distance, form great rivers, and lose themselves in the ocean. According to the reports of the Moors, there are many quarries of marble, granite, and other valuable stone, in these mountains: It is probable there are also mines, but the inhabitants have no idea of these riches; they consider their liberty, which their situation enables them to defend, as the most inestimable of all treasures."

* Hist. of Morocco, i. 13.

ATLAS, in matters of literature, denotes a book of universal geography, containing maps of all the known parts of the world.

ATLAS, in *Commerce*, a silk-satin, manufactured in the East Indies. There are some plain, some striped, and some flowered, the flowers of which are either gold or only silk. There are atlasses of all colours, but most of them false, especially the red and the crimson. The manufacture of them is admirable; the gold and silk being worked together after such a manner as no workman in Europe can imitate; yet they are very far from having that fine gloss and lustre which the French know how to give to their silk stuffs. In the Chinese manufactures of this sort, they gild paper on one side with leaf-gold; then cut it in long slips, and weave it into their silks; which makes them with very little cost, look very rich and fine. The same long slips are twisted or turned about silk threads, so artificially, as to look finer than gold thread, though it be of no greater value.

ATMOSPHERE, a word generally used to signify the whole mass of fluid, consisting of air, aqueous and other vapours, electric fluid, &c. surrounding the earth to a considerable height.

1 Atmosphere composed of two different fluids.

The composition of that part of our atmosphere properly called air, was till lately very much unknown. In former times it was supposed to be a simple, homogeneous and elementary fluid. The experiments of Dr Priestley discovered, that the purest kind of air, which he called *dephlogisticated*, was in reality a compound, and might be artificially produced in various ways. His first conjectures concerning its component parts were, that it consisted of earth, nitrous acid, and phlogiston. Subsequent experiments rendered these conjectures dubious; and at last it was supposed that dephlogisticated air is a pure elementary substance, the vivifying principle to animals, and the acidifying principle throughout all nature. This dephlogisticated air, however, is but a small part of the composition of our atmosphere. According to the most accurate computations, the air we usually breathe is composed of only one-fourth of this dephlogisticated air, or perhaps less; the other three or four parts consisting of what Dr Priestley calls *phlogisticated*, and M. Lavoisier *mephitic air*. This by itself is absolutely noxious, and

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Atmosphere.

and exceedingly poisonous to animals: though it seems only to be negatively so; for when mixed in a certain proportion with dephlogisticated air, it may be breathed with safety, which could not be if it contained any ingredient absolutely unfriendly to the human constitution. The other part, viz. the pure dephlogisticated air, seems to stand much in the same relation to plants that phlogisticated air does to animals; that is, it would prove poisonous and destroy them if they were to depend upon it entirely for their subsistence; but as they derive their nourishment partly from the air and partly from the soil, it thence happens, that the plants which are set to grow in dephlogisticated air do not die instantly, as animals do in the phlogisticated kind, but remain for some time weak and sickly.

2 Phlogisticated air poisonous to animals, and dephlogisticated air to vegetables.

3 A great quantity of electric fluid contained in the atmosphere.

The other component parts of our atmosphere are so various, and of such heterogeneous natures, that they do not admit of any kind of definition or analysis, one only excepted, namely, the *electric fluid*. This we know pervades the whole, but appears to be much more copious in the upper than in the lower atmospherical regions. See ELECTRICITY. To measure the absolute quantity of this fluid, either in the atmosphere or any other substance, is impossible. All that we can know on this subject is, that the electric fluid pervades the atmosphere; that it appears to be more abundant in the superior than the inferior regions; that it seems to be the immediate bond of connection between the atmosphere and the water which is suspended in it; and that, by its various operations, the phenomena of hail, rain, snow, lightning, and various other kinds of meteors, are occasioned.

4 Calculations of the height of the atmosphere.

Various attempts have been made to ascertain the height to which the atmosphere is extended all round the earth. These commenced soon after it was discovered, by means of the Torricellian tube, that air is a gravitating substance. Thus it also became known, that a column of air, whose base is a square inch, and the height that of the whole atmosphere, weighs 15 pounds: and that the weight of air is to that of mercury, as 1 to 10,800: whence it follows, that if the weight of the atmosphere be sufficient to raise a column of mercury to the height of 30 inches, the height of the aerial column must be 10,800 times as much, and consequently a little more than five miles high.

It was not, however, at any time supposed, that this calculation could be just; for as the air is an elastic fluid, the upper parts must expand to an immense bulk, and thus render the calculation above related exceedingly erroneous. By experiments made in different countries, it has been found, that the spaces which any portion of air takes up, are reciprocally proportional to the weights with which it is compressed. Allowances were therefore to be made in calculating the height of the atmosphere. If we suppose the height of the whole divided into innumerable equal parts, the density of each of which is as its quantity; and the weight of the whole incumbent atmosphere being also as its quantity; it is evident, that the weight of the incumbent air is everywhere as the quantity contained in the subjacent part; which makes a difference between the weights of each two contiguous parts of air. By a theorem in geometry, where the differences of magnitudes are geometrically proportional to the magnitudes themselves, these magnitudes are in continual arithmetical proportion; therefore, if, according to the supposition, the altitude of the air, by the addition of new parts into which it is divided, do continually increase in arithmetical proportion, its density will be diminished, or (which is the same thing) its gravity decreased, in continual geometrical proportion.

It is now easy, from such a series, by making two or three barometrical observations, and determining the density of the atmosphere at two or three different stations, to determine its absolute height, or its rarity, at any assignable height. Calculations accordingly were made upon this plan; but it having been found that the barometrical observations by no means corresponded with the density which, by other experiments, the air ought to have had, it was suspected that the upper parts of the atmospherical regions were not subject to the same laws with the lower ones. Philosophers therefore had recourse to another method for determining the altitude of the atmosphere, viz. by a calculation of the height from which the light of the sun is refracted, so as to become visible to us before he himself is seen in the heavens. By this method it was determined, that at the height of 45 miles the atmosphere had no power of refraction; and consequently beyond that distance was either a mere vacuum or the next thing to it, and not to be regarded.

5 Height of it determined from the beginning and end of twilight.

This theory soon became very generally received, and the height of the atmosphere was spoken of as familiarly as the height of a mountain, and reckoned to be as well ascertained, if not more so, than the heights of most mountains are. Very great objections, however, which have never yet been removed, arise from the appearances of some *meteors*, like large globes of fire, not unfrequently to be seen at vast heights above the earth (see METEOR). A very remarkable one of this kind was observed by Dr Halley in the month of March 1719, whose altitude he computed to have been between 69 and $73\frac{1}{2}$ English miles; its diameter 2800 yards, or upwards of a mile and a half; and its velocity about 350 miles in a minute. Others, apparently of the same kind, but whose altitude and velocity were still greater, have been observed; particularly that very remarkable one, August 18th, 1783, whose distance from the earth could not be less than 90 miles, and its diameter not less than the former; at the same time that its velocity was certainly not less than 1000 miles in a minute. Fire-balls, in appearance similar to these, though vastly inferior in size, have been sometimes observed at the surface of the earth. Of this kind Dr Priestley mentions one seen on board the Montague, 4th November 1749, which appeared as big as a large millstone, and broke with a violent explosion.

6 Objection from the appearance of meteors.

From analogical reasoning, it seems very probable, that the meteors which appear at such great heights in the air are not essentially different from those which, like the fire-ball just mentioned, are met with on the surface of the earth. The perplexing circumstances with regard to the former are, that at the great heights above mentioned, the atmosphere ought not to have any density sufficient to support flame, or to propagate sound; yet these meteors are commonly succeeded by one or more explosions, nay are sometimes said to be accompanied with a hissing noise as they pass over our heads. The meteor of 1719 was not

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only very bright, insomuch that for a short space it turned night into day, but was attended with an explosion heard over all the island of Britain, occasioning a violent concussion in the atmosphere, and seeming to shake the earth itself. That of 1783 also, though much higher than the former, was succeeded by explosions; and, according to the testimony of several people, a hissing noise was heard as it passed. Dr Halley acknowledged that he was unable to reconcile these circumstances with the received theory of the height of the atmosphere; as, in the regions in which this meteor moved, the air ought to have been 300,000 times more rare than what we breathe, and the next thing to a perfect vacuum.

In the meteor of 1783, the difficulty is still greater, as it appears to have been 20 miles farther up in the air. Dr Halley offers a conjecture, indeed, that the vast magnitude of such bodies might compensate for the thinness of the medium in which they moved. Whether or not this was the case indeed cannot be ascertained, as we have so few data to go upon; but the greatest difficulty is to account for the brightness of the light. Appearances of this kind are indeed with great probability attributed to electricity, but the difficulty is not thus removed. Though the electrical fire pervades with great ease the vacuum of a common air-pump, yet it does not in that case appear in bright well defined sparks, as in the open air, but rather in long streams resembling the aurora borealis. From some late experiments, indeed, Mr Morgan concludes, that the electrical fluid cannot penetrate a perfect vacuum *. If this is the case, it shows that the regions we speak of are not such a perfect vacuum as can be artificially made; but whether it is or not, the extreme brightness of the light shows that a fluid was present in those regions, capable of confining and condensing the electric matter as much as the air does at the surface of the ground; for the brightness of these meteors, considering their distance, cannot be supposed inferior to that of the brightest flashes of lightning.

* See *Electricity* Index.

7
Density of the air does not always keep pace with its gravity.

This being the case, it appears reasonable to conclude, that what is called the *density* of the air does not altogether keep pace with its gravity. The latter indeed must in a great measure be affected by the vapours, but above all by the quantity of the basis of fixed or dephlogisticated air contained in it: for Mr Kirwan has discovered that the basis of fixed air, when deprived of its elastic principle, is not greatly inferior to gold in specific gravity; and we cannot suppose that of dephlogisticated air to be much less. It is possible, therefore, that pure air, could it be deprived of all the water it contains, might have very little gravity; and as there is great reason to believe that the basis of dephlogisticated air is only one of the constituent parts of water, we see an evident reason why the air ought to become lighter, and likewise less fit for respiration, the higher up we go, though there is a possibility that its density, or power of supporting flame, may continue unaltered.

There are not yet, however, a sufficient number of facts to enable us to determine this question; though such as have been discovered seem rather to favour the above conjecture. Dr Boerhaave was of opinion that the gravity of the air depended entirely on the water it contained; and, by the means of alkaline salts, he was enabled to extract as much water from a quantity of air as was very nearly equivalent to its weight. By the calcination of metals we may extract as much of the basis of dephlogisticated air from a quantity of atmospherical air as is equivalent to the weight of air lost. Were it possible, therefore, to extract the whole of this, as well as all other vapours, and to preserve only the elastic principle, it is highly probable that its gravity would entirely cease. It has been found, by those who have ascended with aerostatic machines, or to the tops of high mountains, that the dephlogisticated air is found to be contained in smaller quantities in the atmosphere of those elevated regions than on the lower grounds. It is also found, that in such situations the air is much drier, and parts with water with much more difficulty, than on the ordinary surface. Salt of tartar, for instance, which at the foot of a mountain will very soon run into a liquid, remains for a long time exposed to the air on the top of it, without showing the least tendency to deliquesce. Nevertheless, it hath never been observed that fires did not burn as intensely on the tops of the highest mountains as on the plains. The matter indeed was put to the trial in the great eruption of Vesuvius in 1779, where, though the lava spouted up to the height of three miles above the level of the sea, the uppermost parts all the while were to appearance as much inflamed as the lowest.

8
Gravity of the upper regions of the atmosphere perhaps diminished by electricity.

The high degree of electricity, always existing in the upper regions of the atmosphere, must of necessity have a very considerable influence on the gravity of any heterogeneous particles floating in it. When we consider the effects of the electric fluid upon light bodies at the surface of the earth, it will readily be admitted, that in those regions where this fluid is very abundant, the gravity of the atmosphere may be much diminished without affecting its density. We know that it is the nature of any electrified substance to attract light bodies; and that, by proper management, they may even be suspended in the air, without either moving up or down for a considerable time. If this is the case with light terrestrial bodies, it cannot be thought very improbable that the aerial particles themselves, i. e. those which we call the basis of dephlogisticated air, and of aqueous or other vapour diffused among them, should be thus affected in the regions where electricity is so abundant. From this cause, therefore, also the gravity of the atmosphere may be affected without any alteration at all being made in its density; and hence may arise anomalies in the barometer hitherto not taken notice of.

9
Absolute height of the atmosphere undetermined.

It appears, therefore, that the absolute height of the atmosphere is not yet determined. The beginning and ending of twilight indeed show, that the height at which the atmosphere begins to refract the sun's light is about 44 or 45 English miles. But this may not improbably be only the height to which the aqueous vapours are carried: for it cannot be thought any unreasonable supposition, that light is refracted only by means of the aqueous vapour contained in the atmosphere; and that where this ceases, it is still capable of supporting the *electric* fire at least as bright and strong as at the surface. That it does extend much higher, is evident from the meteors already mentioned; for all these are undoubtedly carried along with the atmosphere;

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atmosphere; otherwise that of 1783, which was seen for about a minute, must have been left 1000 miles to the westward, by the earth flying out below it in its annual course round the sun.

10 Of the pressure of the atmosphere.

It has already been mentioned, that the pressure of the atmosphere, when in its mean state, is equivalent to a weight of 15 pounds on every square inch. Hence Dr Cotes computed, that the pressure of the whole ambient fluid upon the earth's surface is equivalent to that of a globe of lead 60 miles in diameter. Hence also it appears, that the pressure upon a human body must be very considerable; for as every square inch of surface sustains a pressure of 15 pounds, every square foot, as containing 144 inches, must sustain a pressure of 2160; and if we suppose a man's body to contain 15 square feet of surface, which is pretty near the truth, he must sustain a weight of 32,400 pounds, or 16 tons, for his ordinary load. By this enormous pressure we should undoubtedly be crushed in a moment, were not all parts of our bodies filled either with air or some other elastic fluid, the spring of which is just sufficient to counterbalance the weight of the atmosphere. But whatever this fluid may be, we are sure that it is just able to counteract the atmospherical gravity and no more; for if any considerable pressure be superadded to that of the air, as by going into deep water, or the like, it is always severely felt, let it be ever so equable. If the pressure of the atmosphere is taken off from any part of the human body, the hand, for instance, when put in an open receiver from whence the air is afterwards extracted, the weight of the atmosphere then discovers itself, and we imagine the hand strongly sucked down into the glass. See PNEUMATICS.

11 Variation of the pressure, and its effects.

In countries at some distance from the equator, the pressure of the atmosphere varies considerably, and thus produces considerable changes on many terrestrial bodies. On the human body the quantity of pressure sometimes varies near a whole ton; and when it is thus so much diminished, most people find something of a listlessness and inactivity about them. It is surprising, however, that the spring of the internal fluid, already mentioned, which acts as a counterpoise to the atmospherical gravity, should in all cases seem to keep pace with it when the pressure is naturally diminished, and even when it is artificially augmented, though not when the pressure is artificially diminished. Thus in that kind of weather when the pressure of the air is least, we never perceive our veins to swell, or are sensible of any inward expansion in our bodies. On the contrary, the circulation is languid, and we seem rather to be oppressed by a weight.

12 Of difficulty of respiration on the tops of mountains.

Even in going up to the tops of mountains, where the pressure of the atmosphere is diminished more than three times what it usually is on the plain, no such appearances are observed. Some travellers indeed have affirmed, that on the tops of very high mountains, the air is so light as to occasion a great difficulty of respiration, and even violent retching and vomiting of blood. It does not appear, however, that these assertions are well founded. Mr Brydone found no inconvenience of this kind on the top of Mount Ætna; nor is any such thing mentioned by Mr Houel, who also ascended this mountain. Sir William Hamilton indeed says, that he did feel a difficulty of respiration, independent of any sulphureous steam. But, on the top of a volcano, the respiration may be affected by so many different causes, that it is perhaps impossible to assign the true one. The French mathematicians, when on the top of a very high peak of the Andes, did not make any complaint of this kind, though they lived there for some time. On the contrary, they found the wind so extremely violent, that they were scarcely able to withstand its force; which seems an argument for at least equal *density* of the atmosphere in the superior as in the inferior regions. Dr Heberden, who ascended to the top of Teneriffe, a mountain higher than Ætna, makes no mention of any difficulty of respiration.

13 M. Saussure's symptoms on the top of Mont Blanc accounted for.

M. Saussure, however, in his journey to the top of Mont Blanc, the highest of the Alps, felt very great uneasiness in this way. His respiration was not only extremely difficult, but his pulse became quick, and he was seized with all the symptoms of a fever. His strength was also exhausted to such a degree, that he seemed to require four times as long a space to perform some experiments on the top of the mountain as he would have done at the foot of it. It must be observed, however, that these symptoms did not begin to appear till he had ascended two miles and a half perpendicular above the level of the sea. The mountain is only about a quarter of a mile higher; and in this short space he was reduced to the situation just mentioned. But it is improbable that so small a difference, even at the end of his journey, should have produced such violent effects, had not some other cause concurred. A cause of this kind he himself mentions, viz. that the atmosphere at the top of the mountain was so much impregnated with fixed air, that lime-water, exposed to it, quickly became covered with a pellicle occasioned by the absorption of that fluid. Now it is known, that fixed air is extremely pernicious to animals, and would bring on symptoms similar to those above mentioned. There is no reason, therefore, to have recourse to the rarity of the atmosphere for solving a phenomenon which may more naturally be accounted for otherwise.

When the pressure of the atmosphere is augmented, by descending, in the diving-bell, to considerable depths in the sea, it does not appear that any inconvenience follows from its increase. Those who sit in the diving-bell are not sensible of any pressure as long as they remain in the air, though they feel it very sensible in going into the water: yet it is certain, that the pressure in both cases is the same: for the whole pressure of the atmosphere, as well as of the water, is sustained by the air in the diving-bell, and consequently communicated to those who sit in it.

But though artificial compression of the air, as well as natural rarefaction, can thus be borne, it is otherwise with artificial rarefaction. Animals in an air-pump show uneasiness from the very first, and cannot live for any time in an atmosphere rarefied artificially even as much as it appeared to be from the barometer on the top of Mont Blanc.

14 Variation of the atmospherical pressure accounted for.

It is not easy to assign the true reason of the variations of gravity in the atmosphere. Certain it is, however, that they take place only in a very small degree within the tropics; and seem there to depend on the heat of the sun, as the barometer constantly sinks near half an inch every day, and rises again to its former

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station in the night time. In the temperate zones the barometer ranges from 28 to near 31 inches, by its various altitudes showing the changes that are about to take place in the weather. If we could know, therefore, the latent causes by which the weather is influenced, we should likewise certainly know those by which the gravity of the atmosphere is affected. In general they may be reduced to two, viz. an emission of latent heat from the vapour contained in the atmosphere, or of electric fluid from the same, or from the earth. To one or both of these causes, therefore, may we ascribe the variations of the gravity of the atmosphere; and we see that they both tend to produce the same effect with the solar heat in the tropical climates, viz. to rarefy the air, by mixing with it or setting loose a non-gravitating fluid, which did not act in such large proportion in any particular place before. No doubt, the action of the latent heat and electric fluid is the same in the torrid as in the temperate zones: but in the torrid zone the solar heat and excessive evaporation counteract them; so that whatever quantities may be discharged by the excessive deluges of rain, &c. which fall in those countries, they are instantly absorbed by the abundant fluid, and are quickly ready to be discharged again; while, in the temperate zones, the air becomes sensibly lighter, as well as warmer, by them for some time before they can be absorbed again.

15
Variation of the heat and cold of the atmosphere.

The variations of heat and cold to which the atmosphere is subject, have been the subject of much speculation. In general they seem to depend entirely upon the light of the sun reflected into the atmosphere from the earth; and where this deflection is deficient, even though the light should be present ever so much, the most violent degrees of cold are found to take place. Hence, on the tops of mountains, the cold is generally excessive, though by reason of the clearness of the atmosphere the light of the sun falls upon them in greater quantity than it can do on an equal space on the plain. In long winding passages also, such as the caverns of Ætna and Vesuvius, where the air has room to circulate freely, without any access of the sun, the cold is scarcely tolerable; whence the use of these for cooling liquors, preserving meat, &c.

16
Lambert and De Luc's reasons for the cold on the tops of mountains.

The coldness of the atmosphere on the tops of mountains has been ascribed by M. Lambert and De Luc, to the igneous fluid, or elementary fire, being more rare in those elevated situations than on the plains. M. Lambert is of opinion that it is rarefied above by the action of the air, and that below it is condensed by its own proper weight. He considers fire as a fluid in motion, the parts of which are separable, and which is rarefied when its velocity is accelerated. He does not decide with regard to the identity of fire and light, though he seems inclined to believe it. M. de Luc compares elementary fire to a continuous fluid, whose parts are condensed by being mutually compressed. He denies that fire and light are the same; and maintains that the latter is incapable, by itself, of setting fire to bodies, thought it does so by putting in motion the igneous fluid they contain; and that it acts with more force near the earth than at a distance from its surface, by reason of this fluid, which he calls a *heavy* and *elastic* one, being more condensed there than at a greater height.

17
M. Saussure's account.

M. Saussure, in treating of this subject in his account of the Alps, does not consider fire as a fluid so free and detached as to be able either to ascend with rapidity by its specific levity, or to condense itself sensibly by its proper weight. He supposes it to be united to bodies by so strict an affinity, that all its motions are determined, or at least powerfully modified, by that affinity. As soon therefore as fire, disengaged by combustion or by any other cause, endeavours to diffuse itself, all the bodies that come within the sphere of its activity endeavour to attract it; and they absorb such quantities of it as are in the direct ratio of their affinities with it, or in the inverse ratio of what is necessary for their equilibrium with the surrounding bodies. Now it does not appear that in this distribution the situation of places, with regard to the horizon, has any other influence than what they receive from the different currents produced by the dilatation of the air, and by the levity which that dilatation produces. The ascent of flame, smoke, &c. or of air heated in any way, persuaded the ancients that fire is possessed of absolute levity, by which it had a tendency to mount upwards. "But these effects (says he) are owing either to the levity of the fluid which constitutes flame, or to that of air dilated by heat; and not to the levity of the igneous fluid. I am, however, sufficiently convinced, that this fluid is incomparably lighter than air, though I do not believe that it possesses the power of ascending in our atmosphere by virtue of its levity alone.

18
Mr Bouguer's reasons for the cold on the top of the Andes.

"The celebrated Bouguer has demonstrated, by principles the most simple, and most universally adopted, that it is not necessary, in order to account for the diminution of heat on mountains, to have recourse to hypotheses that are at best doubtful. The following is his explanation of what was felt on the mountains of Peru.

"It was proper, in order to explain this subject, to insist on the short duration of the sun's rays, which cannot strike the different sides of mountains but for a few hours, and even this not always. A horizontal plain, when the sun is clear, is exposed at mid-day to the perpendicular and undiminished action of these rays, while they fall but obliquely on a plain not much inclined, or on the sides of a high pile of steep rocks. But let us conceive for a moment an insulated point, half the height of the atmosphere, at a distance from all mountains, as well as from the clouds which float in the air. The more a medium is transparent, the less heat it ought to receive by the immediate action of the sun. The free passage which a very transparent body allows to the rays of light, shows that its small particles are hardly touched by them. Indeed what impression could they make on it, when they pass through almost without obstruction? Light, when it consists of parallel rays, does not by passing through a foot of free atmospheric air, near the earth, lose an hundred thousandth part of its force. From this we may judge how few rays are weakened, or can act on this fluid, in their passage through a stratum of the diameter not of an inch or a line, but of a particle. Yet the subtility and transparency are still greater at great heights, as was obvious on the Cordilleras, when we looked at distant objects. Lastly, the grosser air is heated below by the contact or neighbourhood of bodies of greater density than itself, which it surrounds, and

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and on which it rests; and the heat may be communicated by little and little to a certain distance. The inferior parts of the atmosphere by this means contract daily a very considerable degree of heat, and may receive it in proportion to its density or bulk. But it is evident that the same thing cannot happen at the distance of a league and a half or two leagues above the surface of the earth, although the light there may be something more active. The air and the wind therefore must at this height be extremely cold, and colder in proportion to the elevation.

"Besides, the heat necessary to life is not merely that which we receive every instant from the sun. The momentary degree of this heat corresponds to a very small part of that which all the bodies around us have imbibed, and by which ours is chiefly regulated. The action of the sun only serves to maintain nearly in the same state the sum of the total heat, by repairing through the day the loss it sustains through the night, and at all times. If the addition be greater than the loss, the total heat will increase, as it happens in summer, and it will continue to accumulate in a certain degree; but for the reasons already given, this accumulation cannot be very great on the top of a mountain, where the summit, which rises high, is never of great bulk. The lowest state of the thermometer in every place is always in proportion to the heat acquired by the soil; and that being very small on the top of a mountain, the quantity added to it by the sun during the day must be comparatively greater; and the accumulated heat will be more in a condition to receive increase in proportion to its distance from the degree which it cannot pass.

"Another particular observable on all the high places of the Cordilleras, and which depends on the same cause, is, that when we leave the shade, and expose ourselves to the sunshine, we feel a much greater difference than we do here in our fine days when the weather is temperate. Every thing contributes at Quito to make the sun exceedingly powerful: a single step from an exposed place to the shade gives the sensation of cold: this would not be the case if the quantity of heat acquired by the soil were more considerable. We now also see why the same thermometer, put first into the shade and then in the sun, does not undergo the same changes at all times and in all places. In the morning, upon Pichincha, this instrument is generally a few degrees below the freezing point, which may be reckoned the natural temperature of the place; but when during the day we expose it to the sun, it is easy to imagine that the effect must be great, and much more than double in whatever way it is measured."

This theory is adopted by M. Saussure, who adds the following fact to prove that the action of the sun's rays, considered abstractedly and independent of any extrinsic source of cold, is as great on mountains as on plains; viz. that the power of burning lenses and mirrors is the same at all heights. To ascertain this fact, our author procured a burning-glass so weak that at Geneva it would just set fire to tinder. This he carried, with some of the same tinder, to the top of the mountain Saleve (a height of 3000 feet); where it not only produced the same effect, but apparently with greater facility than on the plain. Being persuaded, then, that the principal source of cold on the tops of high mountains is their being continually surrounded with an atmosphere which cannot be much heated either by the rays of the sun on account of its transparency, or by the reflection of them from the earth by reason of its distance, he wished to know, whether the direct solar rays on the top of a high mountain had the same power as on the plain, while the body on which they acted was placed in such a manner as to be unaffected by the surrounding air. For this purpose he instituted a set of experiments, from which he drew the following conclusions, viz. that a difference of 777 toises in height diminishes the heat which the rays of the sun are able to communicate to a body exposed to the external air, 14° of the thermometer; that it diminishes the heat of a body partially exposed, only 6°; and that it augments by 1° the heat of a third body completely defended from the air.

19 Burning-glasses equally powerful on the tops of mountains as on plains.

20 Atmosphere every where counteracts the heat of the sun.

Hence it appears that the atmosphere, though so essentially necessary to the support of fire, is somehow or other the greatest antagonist of heat, and most effectually counteracts the operation of the solar rays in producing it. This power it seems to exert at all distances, at the surface as well as in the higher regions. From some experiments made by M. Pictet it appears, that even in places exposed to the rays of the sun, the heat, at five feet distance from the ground, is greater only by one or two degrees than at 50 feet above the surface, though the ground was at that time 15 or 20° warmer than the air immediately in contact with it. Inconsiderable as this difference is, however, it does not hold as we go higher up; for if it did, the cold on the top of the mountain of Saleve, which is 3000 feet above the level of the lake of Geneva, would be 60° greater than at the foot of it; whereas in reality it is only 10°. In the night-time the case is reversed; for the stratum of air at five feet from the ground, was found by M. Pictet to be colder than at 50. Besides this, different strata of the atmosphere are found to possess very different and variable degrees of cold, without any regard to their situation high up or low down. In the year 1780, Dr Wilson of Glasgow found a very remarkable cold existing close to the surface of the ground; so that the thermometer, when laid on the surface of the snow, sunk many degrees lower than one suspended 24 feet above it. It has been likewise observed, that in clear weather, though the surface of the earth be then most liable to be heated by the sun, yet after that is set, and during the night, the air is coldest near the ground, and particularly in the valleys. Experiments on this subject were made for a whole year by Mr James Sex, who has given an account of them in the 78th volume of the Philosophical Transactions. He suspended thermometers (constructed in such a manner as to show the true maximum and minimum of heat that might take place in the observer's absence) in a shady northerly aspect, and at different heights in the open air. One of these was placed at the height of 9 feet, and the other at that of 220 from the ground; and the observations were continued, with only a few days omission, from July 1784 to July 1785. The greatest variations of heat were in the months of October and June; in the former the thermometers generally differed most in the night, and in the latter mostly in the day. From the 25th to the

21 Is colder very near the surface of the ground than at some distance.

22 Mr Sex's experiments on this subject.

28th

28th of October, the heat below, in the night-time, exceeded in a small degree the heat above; at which time there was frequent rain mingled with hail. From the 11th to the 14th, and also on the 31st, there was no variation at all; during which time likewise the weather was rainy; all the rest of the month proving clear, the air below was found colder than that above, sometimes by nine or ten degrees. In the month of June, the greatest variations took place from the 11th to the 15th, and from the 25th to the 30th; and at both these times there appeared to be two currents of wind, the upper from the south-west and the lower from the north-east. Sometimes these were rendered visible by clouds, in different strata, moving in different directions; and sometimes by clouds moving in a contrary direction to a very sensible current of air below. On cloudy nights the lowest thermometer sometimes showed the heat to be a degree or two greater than the upper one; but in the day-time the heat below constantly exceeded that above more than in the month of October.

To determine whether the nocturnal refrigeration was augmented by a nearer approach to the earth, two thermometers were placed in the midst of an open meadow, on the bank of the river near Canterbury. One was placed on the ground, and the other only six feet above it. The thermometer, at six feet distance from the ground, agreed nearly with the former at nine feet; but the nocturnal variations were found to correspond entirely with the clearness or the cloudiness of the sky; and though they did not always happen in proportion to their respective altitudes, yet when the thermometers differed in any respect, that on the ground always indicated the greatest degree of cold.

The difference between these two thermometers, at the small distance of six feet from each other, being found no less than three degrees and a half, the number of thermometers in the meadow was augmented to four. One was sunk in the ground, another placed just upon it, and the third suspended at three feet above it. Three others were placed on a rising ground where the land was level with the cathedral tower, and about a mile distance from it. One of these was likewise sunk in the ground, another placed just upon it, and a third suspended six feet above it. With these seven thermometers, and the two first mentioned, which were placed in the city, he continued his observations for 20 days; but as the weather happened to be cloudy during the whole of that space, excepting for seven or eight days, no considerable variation happened excepting on these days. The result of the experiments was, that the cold was generally greater in the valley than on the hill; but the variations between the thermometers on the ground and those six feet above them, were often as great on the hill as in the valley.

Thus it was perceived that a difference of temperature took place at the distance of only three feet from the ground; but the length of the thermometers hitherto made use of rendered it impossible to make any experiment at a smaller distance. Two new ones, therefore, were formed by bending down the large tube, the body or bulb of the thermometer, to a horizontal position, while the stem remained in a vertical one; by which method the temperature might be observed to the distance of a single inch. Sometimes, in clear weather, these two horizontal thermometers were placed in the open air, one within an inch of the ground, and the other nine inches above it. When the variation among the other thermometers was considerable, a difference was likewise perceived between these; the lower one sometimes indicating more than two degrees less heat than the upper one, though placed so near each other.

23 His conclusions from these experiments.

From these experiments, Mr Sex concludes, that a greater diminution of heat frequently takes place near the earth in the night-time than at any altitude in the atmosphere within the limits of his inquiry, that is, 220 feet from the ground; and at such times the greatest degrees of cold are always met with nearest the surface of the earth.

This is a constant and regular operation of nature under certain circumstances and dispositions of the atmosphere, and takes place at all seasons of the year; and this difference never happens in any considerable degree but when the air is still, and the sky perfectly unclouded. The moistest vapour, as dews and fogs, did not at all impede, but rather promote, the refrigeration. In very severe frosts, when the air frequently deposites a quantity of frozen vapour, it is commonly found greatest; but the excess of heat which in the day-time was found at the lowest station in summer, diminished in winter almost to nothing.

24 Mr Darwin's experiments on cold produced by the rarefaction of air.

It has been observed, that a thermometer, included in a receiver, always sinks when the air begins to be rarefied. This has been thought to arise, not from any degree of cold thus produced, but from the sudden expansion of the bulb of the thermometer, in consequence of the removal of the atmospherical pressure: But from some late experiments related, Phil. Trans. vol. lxxviii. by Mr Darwin, it appears that the atmosphere always becomes warm by compression, and cold by dilatation from a compressed state. These experiments were,

1. The blast from an air-gun was repeatedly thrown upon the bulb of a thermometer, and it uniformly sunk it about two degrees. In making this experiment, the thermometer was firmly fixed against a wall, and the air-gun, after being charged, was left for an hour in its vicinity, that it might previously lose the heat it had acquired in the act of charging; the air was then discharged in a continued stream on the bulb of the thermometer, with the effect already mentioned.

2. A thermometer was fixed in a wooden tube, and so applied to the receiver of an air-gun, that, on discharging the air by means of a screw pressing on the valve of the receiver, a continued stream of air, at the very time of its expansion, passed over the bulb of the thermometer. This experiment was four times repeated, and the thermometer uniformly sunk from five to seven degrees. During the time of condensation there was a great difference in the heat, as perceived by the hand, at the two ends of the condensing syringe: that next the air-globe was almost painful to touch; and the globe itself became hotter than could have been expected from its contact with the syringe. "Add to this (says Mr Darwin), that in exploding an air-gun the stream of air always becomes visible, which is owing

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owing to the cold then produced, precipitating the vapour it contained; and if this stream of air had been previously more condensed, or in greater quantity, so as not instantly to acquire heat from the common atmosphere in its vicinity, it would probably have fallen in snow.

3. A thermometer was placed in the receiver of an air-pump, and the air being hastily exhausted, it sunk two or three degrees; but after some minutes regained its former station. The experiment was repeated with a thermometer open at the top, so that the bulb could not be affected by any diminution of the external pressure; but the result was the same. Both during exhaustion and re-admission of the air into the receiver, a steam was regularly observed to be condensed on the sides of the glass; which, in both cases, was in a few minutes re-absorbed, and which appeared to be precipitated by being deprived of its heat by the expanded air.

4. A hole, above the size of a crow-quill, was bored into a large air-vessel placed at the commencement of the principal pipe of the water-works of Derby. There are four pumps worked by a water-wheel, the water of which is first thrown into the lower part of this air-vessel, and rises from thence to a reservoir about 35 or 40 feet above the level; so that the water in this vessel is constantly in a state of compression. Two thermometers were previously suspended on the leaden air-vessel, that they might assume the temperature of it, and as soon as the hole above mentioned was opened, had their bulbs applied to the stream of air which issued out; the consequence of which was, that the mercury sunk some degrees in each. This sinking of the mercury could not be ascribed to any evaporation of moisture from their surfaces, as it was seen both in exhausting and admitting the air into the exhausted receiver mentioned in the last experiment, that the vapour which it previously contained was deposited during its expansion.

5. There is a curious phenomenon observed in the fountain of Hiero, constructed on a very large scale, in the Chemniscensian mines in Hungary. In this machine the air, in a large vessel, is compressed by a column of water 260 feet high: a stop-cock is then opened: and, as the air issues with great vehemence, and in consequence of its previous condensation becomes immediately much expanded, the moisture it contains is not only precipitated, as in the exhausted receiver above mentioned, but falls down in a shower of snow, with icicles adhering to the nose of the cock. See Phil. Trans. vol. lii.

25
His conclusions with regard to cold on the tops of mountains.

From this phenomenon, as well as the four experiments above related, Mr Darwin thinks "there is good reason to conclude, that in all circumstances where air is mechanically expanded, it becomes capable of attracting the fluid matter of heat from other bodies in contact with it.

"Now (continues he), as the vast region of air which surrounds our globe is perpetually moving along its surface, climbing up the sides of mountains, and descending into the valleys; as it passes along, it must be perpetually varying the degree of heat according to the elevations of the country it traverses: for in rising to the summits of mountains, it becomes expanded, having so much of the pressure of the superincumbent atmosphere taken away; and when thus expanded, it attracts or absorbs heat from the mountains in contiguity with it; and, when it descends into the valleys, and is compressed into less compass, it again gives out the heat it has acquired to the bodies it comes in contact with. The same thing must happen to the higher regions of the atmosphere, which are regions of perpetual frost, as has lately been discovered by the aerial navigators. When large districts of air, from the lower parts of the atmosphere, are raised two or three miles high, they become so much expanded by the great diminution of the pressure over them, and thence become so cold, that hail or snow is produced by the precipitation of the vapour: and as there is, in these high regions of the atmosphere, nothing else for the expanded air to acquire heat from after it has parted with its vapour, the same degree of cold continues, till the air, on descending to the earth, acquires its former state of condensation and of warmth.

"The Andes, almost under the line, rests its base on burning sands; about its middle height is a most pleasant and temperate climate covering an extensive plain, on which is built the city of Quito; while its forehead is encircled with eternal snow, perhaps coeval with the mountain. Yet, according to the accounts of Don Ulloa, these three discordant climates seldom encroach much upon each other's territories. The hot winds below, if they ascend, become cooled by their expansion; and hence they cannot affect the snow upon the summit; and the cold winds that sweep the summit, become condensed as they descend, and of temperate warmth before they reach the fertile plains of Quito."

26
Difficulties still remain on the subject.

Notwithstanding all these explanations, however, several very considerable difficulties remain with regard to the heat and cold of the atmosphere. That warm air should always ascend; and thus, when the source of heat is taken away by the absence of the sun, that the stratum of atmosphere lying immediately next to the earth should be somewhat colder than that which lies a little farther up; is not at all to be wondered at. We have an example somewhat similar to this in the potter's kiln; where, after the vessels have been intensely heated for some time, and the fire is then withdrawn, the cooling always begins at bottom, and those which stand lowermost will often be quite black, while all the upper part of the furnace and the vessels next to it are of a bright red. It doth not, however, appear why such degrees of cold should take place at the surface of the earth as we sometimes meet with. It is, besides, no uncommon thing to meet with large strata in the upper regions of the atmosphere, remarkable for their cold, while others are warmer than those at the surface; as we have been assured by the testimony of several aerial navigators. It is also difficult to see why the air which has once ascended, and become rarefied to an extreme degree, should afterwards descend among a denser fluid of superior gravity, though indeed the atmospherical currents by which this fluid is continually agitated may have considerable effect in this way. See the article WINDS.

For the quantity of water contained in the atmosphere, see the articles HYGROMETER, CLOUDS, VAPOUR,

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Atmosphere.

pour, &c. For the cause of the elasticity of the atmosphere, see Elasticity; and for an explanation of its various operations, see Meteorology. See also the articles Atmometer, Climate, Dew, and Meteorology, in the Supplement.

The uses of the atmosphere are so various, that it is impossible to enumerate them. One of the most essential is its power of giving life to vegetables, and supporting that of all animated beings. For the latter purpose, however, it is not in all places equally proper: we shall therefore conclude this article with some remarks on

27 Of the salubrity of the atmosphere.

The Salubrity of the Atmosphere.—The air on the tops of mountains is generally more salubrious than that in pits. Dense air indeed is always more proper for respiration than such as is more rare; yet the air on mountains, though much more rare, is more free from phlogistic vapours than that of pits. Hence it has been found, that people can live very well on the tops of mountains where the barometer sinks to 15 or 16 inches. M. de Saussure, in his journey upon the Alps, having observed the air at the foot, on the middle, and on the summits of various mountains, observes, that the air of the very low plains seems to be the least salubrious; that the air of very high mountains is neither very pure, nor, upon the whole, seems so fit for the lives of men, as that of a certain height above the level of the sea, which he estimates to be about 200 or 300 toises, that is, about 430 or 650 yards.

Dr White, in the 68th volume of the Phil. Trans. giving an account of his experiments on air made at York, says, that the atmospherical air was in a very bad state, and indeed in the worst he had ever observed it, the 13th of September 1777; when the barometer stood at 30.30, the thermometer at 69°; the weather being calm, clear, and the air dry and sultry, no rain having fallen for above a fortnight. A slight shock of an earthquake was perceived that day.

The air of a bed-room at various times, viz. at night, and in the morning after sleeping in it, has been examined by various persons; and it has been generally found, that after sleeping in it the air is less pure than at any other time. The air of privies, even in calm weather, has not been found to be so much phlogisticated as might have been expected, notwithstanding its disagreeable smell.

From this and other observations, it is thought that the exhalations of human excrements are very little if at all injurious, except when they become putrid, or proceed from a diseased body; in which case they infect the air very quickly.

28 Dr Ingenhousz's experiments.

Dr Ingenhousz, soon after he left London, sent an account of his experiments made in the year 1779 upon the purity of the air at sea and other parts; which account was read at the Royal Society the 24th of April 1780, and inserted in the 70th vol. of the Phil. Trans. His first observations were made on board a vessel in the mouth of the Thames, between Sheerness and Margate, where he found that the air was purer than any other sort of common air he had met with before. He found that the sea-air taken farther from the land, viz. between the English coast and Ostend, was not so pure as that tried before; yet this inferior purity seems not to take place always. The Doctor's general observations, deduced from his numerous experiments, are, "That the air at sea and close to it, is in general purer, and fitter for animal life, than the air on the land, though it seems to be subject to some inconsistency in its degree of purity with that of the land: That probably the air will be found in general much purer far from the land than near the shore, the former being never subject to be mixed with land air."

The Doctor in the same paper transcribes a journal of experiments, showing the degree of purity of the atmosphere in various places, and under different circumstances; which we shall insert here in an abridged manner.

The method used in those experiments was to introduce one measure of common air into the eudiometer tube, and then one measure of nitrous air. The moment that these two sorts of elastic fluids came into contact, he agitated the tube in the water-trough, and then measured the diminution, expressing it by hundredth parts of a measure; thus, when he says, that such air was found to be 130, it signifies, that after mixing one measure of it with one of nitrous air, the whole mixed and diminished quantity was 130 hundredths of a measure, viz. one measure and 30 hundredths of a measure more. 29 His journal of the purity of the air in different places.

"The different degrees of salubrity of the atmosphere, as I found it in general in my country house at Southal-Green, ten miles from London, from June to September, lay between 103 and 109. I was surprised when, upon my return to town to my former lodgings in Pall Mall Court, I found the common air purer in general in October than I used to find it in the middle of summer in the country; for on the 22d of October, at nine o'clock in the morning, the weather being fair and frosty, I found that one measure of common air, and one of nitrous air, occupied 100 subdivisions in the glass-tube, or exactly one measure. That very day, at two o'clock in the afternoon (it being then rainy weather), the air was somewhat altered for the worse. It gave 102. October the 23d, it being rainy weather, the air gave 102. October the 24th, the weather being serene, the air at nine o'clock in the morning gave 100. October the 25th, the sky being cloudy at 11 o'clock in the morning, the air gave 102. At 11 o'clock at night, from five different trials, it gave 105. October the 26th, the weather being very dark and rainy, the air gave 105, as before."

The air at Ostend was found by the Doctor to be generally very good, giving between 94 and 98. At Bruges, the air taken at seven o'clock at night gave 103. November the 8th, the air at Ghent at three in the afternoon gave 103.

November the 12th, the air of Brussels at seven o'clock P. M. gave $105\frac{1}{2}$. The next day, the air of the lower part of the same city gave 106; that of the highest appeared to be purer, as it gave 104: which agrees with the common popular observation. November the 14th, both the air of the highest and that of the lowest part of the city appeared to be of the same goodness, giving 103. The weather was frosty.

November the 22d, the air of Antwerp in the evening gave $109\frac{1}{2}$; the weather being rainy, damp, and cold. November the 23d, the air of Breda gave 106. The next day about 11 o'clock the air gave 102; the weather being fair, cold, and inclining to frost. At seven

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Atmosphere.

seven o'clock it gave 103. Next day, being the 25th, the air gave 104; the weather being cold and rainy. The 26th it gave 103; the weather being very rainy, cold, and stormy. November the 27th, the air at the Moordyke close to the water gave $101\frac{1}{2}$; the weather being fair and cold, but not frosty. This spot is reckoned very healthy. November the 28th, the air of Rotterdam gave 103; the weather being rainy and cold. November the 29th, the air of Delft gave 103; the weather being stormy and rainy.

November the 30th, the air of the Hague gave 104; the weather being cold, and the wind northerly. The first of December the weather underwent a sudden change; the wind becoming southerly and stormy, and the atmosphere becoming very hot. The day after, Fahrenheit's thermometer stood at 54°; and the common air being repeatedly and accurately tried gave 116; and that preserved in a glass phial from the preceding day gave 117; and that gathered close to the sea gave 115.

December the 4th, the air of Amsterdam gave 103; the weather being rainy, windy, and cold. The day after, the weather continuing nearly the same, the air gave 102. December the 10th, the air of Rotterdam gave 101; the weather being rainy. December the 12th, being in the middle of the water between Dort and the Moordyke, the air gave 109; the weather being remarkably dark, rainy, and windy. December the 13th, the air of Breda in the morning gave 109; the weather continuing as the day before. And in the afternoon, the air gave $106\frac{1}{2}$; the weather having cleared up. December the 16th, the air of the lower part of the city of Antwerp gave 105, that of the higher part 104; the weather being rainy and temperate. December the 17th, the air of Antwerp gave 107; the weather continuing nearly as in the preceding day. December the 10th, the air of Brussels gave 109; the weather being rainy, windy, and rather warm. December the 21st, the air of Brussels gave 106; the weather being dry and cold. The next day the air and the weather continued the same. December the 23d, the air of Mons gave 104; the weather being rainy and cold. December the 24th, the air near Bouchain gave $104\frac{1}{2}$; the weather being cloudy and cold. December the 25th, the air of Peronne gave $102\frac{1}{2}$; the weather being frosty. December the 26th, the air of Cuvilli gave 103; the weather frosty. December the 27th, the air of Senlis gave $102\frac{1}{2}$; the weather frosty. December the 29th, the air of Paris gave 103; the weather frosty. 1780, January the 8th, the air of Paris gave 100; the weather frosty. January the 13th, the air of Paris gave 98; hard frost.

30 Apparatus with which his experiments were made.

Thus far with Dr Ingenhousz's observations. His apparatus was a very portable one, made by Mr Martin, which in reality is the eudiometer-tube and measure as used by Mr Fontana before he made his last improvement. "The whole of this apparatus (says Dr Ingenhousz) was packed up in a box about ten inches long, five broad, and three and a half high. The glass-tube or great measure, which was 16 inches long, and divided into two separate pieces, lay in a small compass, and could be put together by brass screws adapted to the divided extremities. Instead of a water trough, such as is used commonly, I made use of a small round wooden tub," &c.

31 Fontana's opinions on the subject.

The abbé Fontana, who has made a great number of very accurate experiments upon this subject, gives his opinion in the following words: "I have not the least hesitation in asserting, that the experiments made to ascertain the salubrity of the atmospherical air in various places in different countries and situations, mentioned by several authors, are not to be depended upon; because the method they used was far from being exact (A), the elements or ingredients for the experiment were unknown and uncertain, and the results very different from one another.

"When all the errors are corrected, it will be found that the difference between the air of one country and that of another, at different times, is much less than what is commonly believed; and that the great differences found by various observers are owing to the fallacious effects of uncertain methods. This I advance from experience; for I was in the same error. I found very great differences between the results of the experiments of this nature which ought to have been similar; which diversities I attributed to myself, rather than to the method I then used. At Paris I examined the air of different places at the same time, and especially of those situations where it was most probable to meet with infected air, because those places abounded with putrid substances and impure exhalations; but the differences I observed were very small, and much less than what could have been suspected, for they hardly arrived at one-fiftieth of the air in the tube. Having taken the air of the hill called *Mount Valerian*, at the height of about 500 feet above the level of Paris, and compared it with the air of Paris taken at the same time, and treated alike, I found the former to be hardly one-thirtieth better than the latter.

"In London I have observed almost the same. The air of Islington and that of London suffered an equal diminution by the mixture of nitrous air; yet the air of Islington is esteemed to be much better. I have examined the air of London taken at different heights (for instance, in the street, at the second floor, and at the top of the adjoining houses), and have found it to be of the same quality. Having taken the air at the iron gallery of St Paul's cupola, at the height of 313 feet above the ground, and likewise the air of the stone gallery, which is 202 feet below the other; and having compared these two quantities of air with that of the street adjoining, I found that there was scarce any sensible difference between them, although taken at such different heights.

"In this experiment a circumstance is to be considered, which must have contributed to render the above-mentioned differences more sensible: that is, the agitation of the air of the cupola; for there was felt a pretty brisk wind upon it, which I observed to be stronger and stronger the higher I ascended; whereas in

(A) It is plain that Dr Ingenhousz's method is not implied in this remark; since the Doctor's experiments were made long after, and the method used by him was properly that of Mr Fontana.

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in the street, and indeed in all the streets I passed through, there was no sensible wind to be felt. This experiment was made at four in the afternoon, the weather being clear. The quicksilver in the barometer at that time was 28,6 inches high, and Fahrenheit's thermometer stood at 54°."

A few lines after, Mr Fontana proceeds thus:—— "From this we clearly see, how little the experiments hitherto published about the differences of common air are to be depended upon. In general, I find that the air changes from one time to another: so that the differences between them are far greater than those of the airs of different countries or different heights. For instance, I have found that the air of London in the months of September, October, and November, 1778, when treated with the nitrous air, gave II, I, 1,90, and II, II, 2,25, which is a mean result of many experiments which differed very little from each other. The 26th day of November last, I found the air, for the first time, much better; for it gave II, I, 1,80, and II, II, 2,20; but the 14th of February 1779, the air gave II, I, 1,69 and II, II, 2,21; from whence it appears, that the air of this 14th of February was better than it had been six months before. There can be no doubt of the accuracy of the experiments, because I compared the air taken at different times with that which I had first used in the month of September, and which I had preserved in dry glass bottles accurately stopped."

This difference in the purity of the air at different times, Mr Fontana farther remarks, is much greater than the difference between the air of the different places observed by him: notwithstanding this great change, as he observed, and as he was informed by various persons, no particular change of health in the generality of people, or facility of breathing, was perceived.

Mr Fontana lastly concludes with observing, that "Nature is not so partial as we commonly believe. She has not only given us an air almost equally good everywhere at every time, but has allowed us a certain latitude, or a power of living and being in health in qualities of air which differ to a certain degree. By this I do not mean to deny the existence of certain kinds of noxious air in some particular places; but only say, that in general the air is good everywhere, and that the small differences are not to be feared so much as some people would make us believe. Nor do I mean to speak here of some vapours and other bodies which are accidentally joined to the common air in particular places, but do not change its nature and intrinsical property. This state of the air cannot be known by the test of nitrous air; and those vapours are to be considered in the same manner as we should consider so many particles of arsenic swimming in the atmosphere. In this case it is the arsenic, and not the degenerated air, that would kill the animals who ventured to breathe it."

ATOCK, the capital of a province of the same name in the north-western part of Hindostan. It is supposed to be the Taxila of the Greeks, and the place where Alexander, Tamerlane, and Nadir Shah crossed the Indus. Formerly nobody was permitted to enter the fortress without a passport from the Mogul himself. E. Long. 71. 55. N. Lat. 33. 59.

ATOM, in *Philosophy*, a particle of matter, so minute, as to admit of no division. Atoms are the *minima naturæ*, and are conceived as the first principles or component parts of all physical magnitude.

ATOMICAL PHILOSOPHY, or the doctrine of atoms, a system which, from the hypothesis that atoms are endued with gravity and motion, accounted for the origin and formation of things. This philosophy was first broached by Moschus, some time before the Trojan war; but was much cultivated and improved by Epicurus; whence it is denominated the *Epicurean Philosophy*. See EPICUREAN.

ATOMIC THEORY, a new species of philosophy, lately introduced into chemistry, to explain the combinations of bodies. See ATOMIC THEORY, SUPPLEMENT.

ATONEMENT. See EXPIATION.

ATONY, in *Medicine*, a defect of tone or tension, or a laxity or debility of the solids of the body.

ATOOI, one of the Sandwich islands, situated in W. Long. 160. 20. N. Lat. 21. 57. Towards the north-east and north-west, the face of the country is rugged and broken; but to the southward it is more even. The hills rise from the sea-side with a gentle acclivity, and at a little distance back are covered with wood. Its produce is the same with that of the other islands of this cluster; but its inhabitants greatly excel the people of all the neighbouring islands in the management of their plantations. In the low grounds, contiguous to the bay wherein our navigators * anchored, these plantations were regularly divided by deep ditches; the fences were formed with a neatness approaching to elegance; and the roads through them were finished in such a manner as would have reflected credit even on an European engineer.

* *Cook's Voyage.*

The island is about 30 miles in length. The road, or anchoring place, which our vessels occupied, is on the south-west side of the island, about two leagues from the west end, before a village named *Wymoa*. This road is somewhat exposed to the trade wind; notwithstanding which defect, it is far from being a bad station, and greatly superior to those which necessity continually obliges ships to use, in countries where the winds are not only more variable but more boisterous; as at Madeira, Teneriffe, the Azores, &c. The landing too is not so difficult as at most of those places; and, unless in very bad weather, is always practicable. The water in the neighbourhood is excellent, and may be conveyed with ease to the boats. But no wood can be cut at any convenient distance, unless the islanders could be prevailed upon to part with the few etooa trees (*cordia sebestina*) that grow about their villages, or a species called *dooe dooe*, which grows farther up the country. The ground from the wooded part to the sea, is covered with an excellent kind of grass, about two feet in height, which sometimes grows in tufts, and appeared capable of being converted into abundant crops of fine hay. But on this extensive space not even a shrub grows naturally.

Besides taro, the sweet potato, and other similar vegetables used by our crews as refreshments, among which were at least five or six varieties of plantains, the island produces bread fruit; which, however, seems to be scarce. There are also a few cocoa palms; some yams; the kappe of the Friendly islands, or Virginian arum; the etooa tree, and odoriferous gardenia, or cape

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cape jasmine. Our people also met with several trees of the dooe dooe, that bear the oily nuts, which are stuck upon a kind of skewer and made use of as candles. There is a species of sida, or Indian mallow; also the morinda citrifolia, which is here called *none;* a species of convolvulus; the ava or intoxicating pepper, besides great quantities of gourds. These last grow to a very large size, and are of a remarkable variety of shapes, which are perhaps the effect of art.

The scarlet birds, which were brought for sale, were never met with alive; but one small one was seen, about the size of a canary bird, of a deep crimson colour; also a large owl, two brown hawks or kites, and a wild duck. Other birds were mentioned by the natives; among which were the otoo or bluish heron, and the torata, a sort of whimbrel. It is probable that the species of birds are numerous, if we may judge by the quantity of fine yellow, green, and small velvet-like blackish feathers, used upon the cloaks and other ornaments worn by these people. Fish, and other productions of the sea, were, to appearance, not various. The only tame or domestic animals found here were hogs, dogs, and fowls, which were all of the same kind that had been met with at the islands of the South Pacific. There were also small lizards, and some rats.

The inhabitants of Atooi are of the middle size, and in general stoutly made, They are neither remarkable for a beautiful shape nor for striking features. Their visage, particularly that of the women, is sometimes round, but others have it long; nor can it justly be said, that they are distinguished as a nation by any general cast of countenance. Their complexion is nearly of a nut-brown; but some individuals are of a darker hue. They are far from being ugly, and have to all appearance few natural deformities of any kind. Their skin is not very soft nor shining; but their eyes and teeth are, for the most part, pretty good. Their hair in general is straight; and though its natural colour is usually black, they stain it, as at the Friendly and other islands. They are active, vigorous, and most expert swimmers; leaving their canoes upon the most frivolous occasion, diving under them, and swimming to others, though at a considerable distance. Women, with infants at their breast, when the surf was so high as to prevent their landing in the canoes, frequently leaped overboard, and swam to the shore, frequently endangering their little ones. They appeared to be of a frank, cheerful disposition; and are equally free from the fickle levity which characterizes the inhabitants of Otaheite, and the sedate cast which is observable among many of those of Tongataboo. They seem to cultivate a sociable intercourse with each other; and except the propensity to thieving, which is as it were innate in most of the people in those seas, they appeared extremely friendly. It was pleasing to observe with what affection the women managed their infants, and with what alacrity the men contributed their assistance in such a tender office; thus distinguishing themselves from those savages who consider a wife and child as things rather necessary than desirable or worthy of their regard and esteem. From the numbers that were seen assembled at every village in coasting along, it was conjectured that the inhabitants of this island are pretty numerous. Including the straggling houses, it was computed that there might perhaps be, in the whole island, sixty such villages as that near which our ships anchored; and allowing five persons to each house, there would be in every village, five hundred, or thirty thousand upon the island. This number is by no means exaggerated; for there were sometimes three thousand people at least collected upon the beach, when it could not be supposed that above a tenth part of the natives were present.

ATRA Bilis, Black Bile, or Melancholy. According to the ancients it hath a twofold origin: 1st, From the grosser parts of the blood, and this they called the *melancholy humour*. 2d, From yellow bile being highly concocted. Dr Perceival, in his Essays Med. and Exp. suggests, that it is the gall rendered acrid by a stagnation in the gall-bladder, and rendered viscid by the absorption of its fluid parts. Bile in this state discharged into the duodenum, occasions universal disturbance and disorder until it is evacuated: it occasions violent vomiting, or purging, or both; and previous to this the pulse is quick, the head aches, a delirium comes on, a hiccough, intense thirst, inward heat, and a fetid breath. Some describe this kind of bile as being acid, harsh, corroding, and when poured on the ground, bubbling up and raising the earth after the manner of a ferment. Dr Percival says, that by the use of the *infus. senæ limon.* warmed with the *tinct. columb.* he had checked the vomitings occasioned by this matter.

Atra Dies, in antiquity, denotes *a fatal day* whereon the Romans received some memorable defeat. The word literally imports *a black day;* a denomination taken from the colour which is the emblem of death and mourning. Whence the Thracians had a custom of marking all their happy days with white stones or calculi, and their unhappy days with black ones; which they cast, at the close of each day, into an urn. At the person's death the stones were taken out; and from a comparison of the numbers of each complexion, a judgment was made of the felicity or infelicity of his course of life. The *dies atræ* or *atri* were afterwards denominated *nefasti* and *posteri*. Such in particular was the day when the tribunes were defeated by the Gauls at the river Allia, and lost the city; also that whereon the battle of Cannæ was fought; and several others marked in the Roman calendar, as *atræ* or unfortunate.

ATRACTYLIS, Distaff Thistle. See Botany *Index*.

ATRÆTI, in *Medicine*, infants having no perforation in the anus, or persons imperforated in the vagina or urethra.

ATRAGENE. See Botany *Index*.

ATRAPHAXIS. See Botany *Index*.

ATREBATII, a people of Britain, seated next to the Bibroci, in part of Berkshire and part of Oxfordshire. This was one of those Belgic colonies which had come out of Gaul into Britain, and there retained their ancient name. For the Atrebatii were a tribe of the Belgæ, who inhabited the country which is now called Artois. They are mentioned by Cæsar among the nations which composed the Belgic confederacy against him: and the quota of troops which they engaged to furnish on that occasion was 15,000. Comius of Arras was a king or chieftain among the Atrebatii in Gaul in Cæsar's time: and he seems to

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have possessed some authority, or at least some influence, over our Atrebatii in Britain; for he was sent by Cæsar to persuade them to submission. This circumstance makes it probable that this colony of the Atrebatii had not been settled in Britain very long before that time. The Atrebatii were among those British tribes which submitted to Cæsar: nor do we hear of any remarkable resistance they made against the Romans at their next invasion under Claudius. It is indeed probable, that before the time of this second invasion they had been subdued by some of the neighbouring states, perhaps by the powerful nation of the Cattivellauni, which may be the reason they are so little mentioned in history. Calliva Atrebatum, mentioned in the seventh, twelfth, thirteenth, and fourteenth Itinera of Antoninus, and called by Ptolemy *Calcula*, seems to have been the capital of the Atrebatii; though our antiquaries differ in their sentiments about the situation of this ancient city, some of them placing it at Wallingford, and others at Ilchester.

ATREUS, in fabulous history, the son of Pelops and Hippodamia, and the father of Agamemnon and Menelaus, is supposed to have been king of Mycenæ and Argos about 1228 years before the Christian era. He drove his brother Thyestes from court, for having a criminal commerce with Ærope his wife: but understanding that he had had two children by her, he sent for him again, and made him eat them; at which horrid action, the sun, it is said, withdrew his light.

ATRI, a town of Italy, in the farther Abruzzo, in the kingdom of Naples, with the title of a duchy; it is the see of a bishop, and is seated on a craggy mountain, four miles from the Adriatic sea. E. Long. 13. 8. N. Lat. 42. 45.

ATRIENSES, in antiquity, a kind of servants or officers in the great families at Rome, who had the care and inspection of the atriæ and the things lodged therein.

These are otherwise called atriarii, though some make a distinction between *atrienses* and *atriarii*; suggesting that the latter were an inferior order of servants, perhaps assistants of the atrienses, and employed in the more servile offices of the atrium, as to attend at the door, sweep the area, &c.

The atrienses are represented as servants of authority and command over the rest: they acted as procurators, or agents, of their master, in selling his goods, &c. To their care were committed the statues and images of the master's ancestors, &c. which were placed round the atrium; and which they carried in procession at funerals, &c.

In the villas, or country houses, the atrienses had the care of the other furniture and utensils, particularly those of metal, which they were to keep bright from rust. Other things they were to hang from time to time in the sun, to keep them dry, &c. They were clothed in a short white linen habit, to distinguish them, and prevent their loitering from home.

ATRIP, in nautical language, is applied either to the anchor or sails. The anchor is atrip, when it is drawn out of the ground in a perpendicular direction, either by the cable or buoy-rope. The topsails are atrip, when they are hoisted up to the mast-head, or to their utmost extent.

ATRIPLEX, ORACH, or ARACH. See BOTANY *Index*.

ATRIUM, in ecclesiastical antiquity, denotes an open place or court before a church, making part of what was called the *narthex* or *antetemple*.

The atrium in the ancient churches was a large area or square plat of ground, surrounded with a portico or cloyster, situated between the porch or vestibule of the church and the body of the church.

Some have mistakenly confounded the atrium with the porch or vestibule, from which it was distinct; others with the narthex, of which it was only a part.

The atrium was the mansion of those who were not suffered to enter farther into the church. More particularly, it was the place where the first class of penitents stood to beg the prayers of the faithful as they went into the church.

ATRIUM is also used in the canon law, for the cemetry or churchyard. In this sense we find a law prohibiting buildings to be raised *in atrio ecclesiæ*, except for the clergy: which the glossary explains thus, *id est in cemeterio*, which includes the space of forty paces around a large church, or thirty round a little church or chapel.

ATROPA, DEADLY NIGHTSHADE. See BOTANY *Index*.

Buchanan gives an account of the destruction of the army of Sweno the Dane, when he invaded Scotland, by mixing a quantity of the belladonna berries with the drink which the Scots were, according to a treaty of truce, to supply them with. This so intoxicated the Danes, that the Scots fell upon them in their sleep, and killed the greatest part of them, so that there were scarcely men enough left to carry off their king. There have also been many instances in Britain of children being killed by eating berries of a fine black colour, and about the size of a small cherry, which are no other than those of belladonna. When an accident of this kind is discovered in time, a glass of warm vinegar will prevent the bad effects.

Naturalists tell strange stories of this plant: but setting aside its soporiferous virtue, the modern botanists will scarce warrant any of them, nor even that human figure ordinarily ascribed to its roots, especially since the discovery of the artifice of charlatans in fashioning it, to surprise the credulity of the people.

Moses informs us (Gen. xxx. 14.) that Reuben the son of Leah, being in the field, happened to find mandrakes, which he brought home to his mother. Rachel had a mind to them, and obtained them from Leah, upon condition that she should consent that Jacob should be Leah's bedfellow the night following. The term דודאים, *dudaim*, here made use of by Moses, is one of those words of which the Jews at this day do not understand the true signification. Some translate it *violets*, others *lilies*, or *jessamine*. Junius calls it *agreeable flowers*; Codurquus makes it *truffle*, or *mushroom*; and Calmet will have it to be the *citron*. Those that would support the translation of *mandrakes* plead, that Rachel being barren, and having a great desire to conceive, coveted Leah's mandrakes, it may be presumed, with a view to its prolific virtues. The ancients have given to mandrakes the name of the apples

apples of love, and to Venus the name of *Mandragoritis;* and the emperor Julian, in his epistle to Calixenes, says, that he drinks the juice of mandrakes to excite amorous inclinations.

ATROPHY, in *Medicine*, a disease, wherein the body or some of its parts, does not receive the necessary nutriment, but wastes and decays incessantly. See MEDICINE *Index*.

ATROPOS, in fabulous history, the name of the third of the Parcæ, or Fates, whose business it was to cut the thread of life.

ATTACHMENT, in the *Law of England*, implies the taking or apprehending a person by virtue of a writ or precept. It is distinguished from an *arrest*, by proceeding out of a higher court by precept or writ; whereas the latter proceeds out of an inferior court by precept only. An arrest lies only on the body of a man; whereas an attachment lies often on the goods only, and sometimes on the body and goods. An attachment by writ differs from *distress*, in not extending to lands, as the latter does; nor does a distress touch the body, as an attachment does.

ATTACHMENT out of the Chancery, is obtained upon an affidavit made, that the defendant was served with a subpœna, and made no appearance; or it issues upon not performing some order or decree. Upon the return of this attachment by the sheriff, *quod non est inventus in balliva sua*, another attachment, with a proclamation, issues; and if he still refuses to appear, a commission of rebellion.

ATTACHMENT of the Forest, is one of the three courts held in the forest. The lowest court is called the *court of attachment*, or *wood-mote court;* the mean, *swanmote*, and the highest, the *justice in eyre's seat*. The court of attachments has its name from the verdurers of the forest having no other authority in it, but to receive the attachments of offenders against vert and venison taken by the foresters, and to enroll them, that they may be presented or punished at the next justice in eyre's seat. This attachment is by three means: by goods and chattels; by body, pledges, or mainprize; or by the body only. This court is held every 40 days throughout the year; and is thence called *forty days court*.

Foreign ATTACHMENT, is an attachment of money or goods found within a liberty or city, to satisfy some creditor within such liberty or city. By the custom of London, and several other places, a man can attach money or goods in the hands of a stranger, to satisfy himself.

ATTACK, a violent attempt upon any person or thing, an assault, or the act of beginning a combat or dispute.

ATTACK, in the military art, is an effort made to force a post, break a body of troops, &c.

ATTACK of a Siege, is a furious assault made by the besiegers with trenches, covers, mines, &c. in order to make themselves masters of a fortress, by storming one of its sides. If there are two or three attacks made at the same time, there should be a communication betwixt them. See WAR.

ATTACOTTI, an ancient people of Britain, mentioned by Ammianus Marcellinus and St Jerome, as well as in the *Notitia Imperii*. They are represented as allies and confederates of the Scots and Picts, and therefore probably their neighbours: though their precise situation has not been determined by antiquaries.

ATTAINDER, in *Law*. When sentence of death, the most terrible and highest judgment in our laws, is pronounced, the immediate inseparable consequence by the common law is attainder. For when it is now clear beyond all dispute, that the criminal is no longer fit to live upon the earth, but is to be exterminated as a monster and a bane to human society, the law sets a note of infamy upon him, puts him out of its protection, and takes no farther care of him than barely to see him executed. He is then called *attaint*, *attinctus*, *stained* or *blackened*. He is no longer of any credit or reputation; he cannot be a witness in any court; neither is he capable of performing the functions of another man: for by an anticipation of his punishment, he is already dead in law. This is after judgment: for there is a great difference between a man *convicted* and *attainted;* though they are frequently through inaccuracy confounded together. After conviction only, a man is liable to none of these disabilities: for there is still in contemplation of law a possibility of his innocence. Something may be offered in arrest of judgement: the indictment may be erroneous, which will render his guilt uncertain, and thereupon the present conviction may be quashed: he may obtain a pardon, or be allowed the benefit of clergy; both which suppose some latent sparks of merit, which plead in extenuation of his fault. But when judgment is once pronounced, both law and fact conspire to prove him completely guilty; and there is not the remotest possibility left of any thing to be said in his favour. Upon judgement, therefore, of death, and not before, the attainder of a criminal commences: or upon such circumstances as are equivalent to judgment of death; as judgment of outlawry on a capital crime, pronounced for absconding or fleeing from justice, which tacitly confesses the guilt; and therefore, upon judgment either of outlawry, or of death, for treason or felony, a man shall be said to be attainted.

A person attainted of high treason forfeits all his lands, tenements, and hereditaments; his blood is corrupted, and he and his posterity rendered base; and this corruption of blood cannot be taken off but by act of parliament. *

* See the articles *Forfeiture* and *Corruption* of Blood.

Attainders may be reversed or falsified (i. e. proved to be false) by writ of error, or by plea. If by writ of error, it must be by the king's leave, &c.; and when by plea, it must be by denying the treason, pleading a pardon by act of parliament, &c.

Persons may be attainted by act of parliament.—Acts of attainder of criminals have been passed in several reigns, on the discovery of plots and rebellions, from the reign of King Charles II. when an act was made for the attainder of several persons guilty of the murder of King Charles I. Among acts of this nature, that for attainting Sir John Fenwick, for conspiring against King William, is the most remarkable; it being made to attaint and convict him of high treason on the oath of one witness, just after a law had been enacted, "That no person should be tried or attainted of high treason where corruption of blood is incurred, but by the oath of two lawful witnesses, unless the party confess, stand mute, &c." Stat. 7 and 8 W. III.

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W. III. cap. 3. But in the case of Sir John Fenwick there was something extraordinary; for he was indicted of treason on the oaths of two witnesses, though but only one could be produced against him on his trial.

ATTAINT, is a writ that lies after judgment against a jury of twelve men that have given false verdict in any court of record, in an action real or personal, where the debt or damages amounted to above 40s. stat. 5 and 34 Edw. III. c. 7. It is called *attaint*, because the party that obtains it endeavours thereby to stain or taint the credit of the jury with perjury, by whose verdict he is grieved.

The jury who are to try this false verdict must be twenty-four, and are called *the grand jury*; for the law wills not that the oath of one jury of twelve men should be attainted or set aside by an equal number, nor by less indeed than double the former. And he that brings the attaint can give no other evidence to the grand jury, than what was originally given to the petit. For as their verdict is now trying, and the question is whether or no they did right upon the evidence that appeared to them, the law adjudged it the highest absurdity to produce any subsequent proof upon such trial, and to condemn the prior jurisdiction for not believing evidence which they never knew. But those against whom it is brought are allowed, in the affirmance of the first verdict, to produce new matter: because the petit jury may have formed their verdict upon evidence of their own knowledge, which never appeared in court; and because very terrible was the judgment which the common law inflicted upon them, if the grand jury found their verdict a false one. The judgment was, 1. That they should lose their *liberam legem*, and become for ever infamous. 2. That they should forfeit all their goods and chattels. 3. That their lands and tenements should be seized into the king's hands. 4. That their wives and children should be thrown out of doors. 5. That their houses should be razed and thrown down. 6. That their trees should be rooted up. 7. That their meadows should be ploughed. 8. That their bodies should be cast into jail. 9. That the party should be restored to all that he lost by reason of the unjust verdict. But as the severity of this punishment had its usual effect, in preventing the law from being executed, therefore by the statute 11 Hen. VII. c. 24. revived by 23 Hen. VIII. c. 3. and made perpetual by 13 Eliz. c. 25. it is allowed to be brought after the death of the party, and a more moderate punishment was inflicted upon attainted jurors: viz. perpetual infamy, and if the cause of action were above 40l. value, a forfeiture of 20l. a-piece by the jurors; or, if under 40l. then 5l. a-piece; to be divided between the king and the party injured. So that a man may now bring an attaint either upon the statute or at common law, at his election; and in both of them may reverse the former judgment. But the practice of setting aside verdicts upon motion, and granting new trials, has so superseded the use of both sorts of attaints, that there is hardly any instance of an attaint later than the 16th century.

ATTAINT, among farriers, a knock or hurt in a horse's leg, proceeding either from a blow with another horse's foot, or from an over-reach in frosty weather, when a horse, being rough shod, or having shoes with long caulkers, strikes his hinder feet against his fore leg.

ATTAINTED, in *Law*, is applied to a person's being under attainder. See ATTAINDER.

ATTALICÆ VESTES, in antiquity, garments made of a kind of cloth of gold. They took the denomination from Attalus, surnamed Philomater, a wealthy king of Pergamus, who was the first, according to Pliny, who procured gold to be wove into cloth.

ATTALUS, the name of several kings of Pergamus. See PERGAMUS.

ATTELABUS. See ENTOMOLOGY *Index*.

ATTENTION, a due application of the ear, or the mind, to any thing said or done, in order to acquire a knowledge thereof. The word is compounded of *ad*, "to," and *tendo*, "I stretch."

Attention of mind is not properly an act of the understanding, but rather of the will, by which it calls the understanding from the consideration of other objects, and directs it to the thing in hand. Nevertheless, our attention is not always voluntary: an interesting object seizes and fixes it beyond the power of controul.

Attention, in respect of hearing, is the stretching or straining of the *membrana tympani*, so as to make it more susceptible of sounds, and better prepared to catch even a feeble agitation of the air. Or it is the adjusting the tension of that membrane to the degree of loudness or lowness of the sound to which we are attentive.

According to the degree of attention, objects make a stronger or weaker impression (A). Attention is requisite even to the simple act of seeing: the eye can take in a considerable field at one look; but no object in the field is seen distinctly but that singly which fixes the attention: in a profound reverie that totally occupies the attention, we scarce see what is directly before us. In a train of perceptions, no particular object makes such a figure as it would do singly and apart; for when the attention is divided among many objects, no particular object is entitled to a large share. Hence the stillness of night contributes to terror, there being nothing to divert the attention.

Horror ubique animos, simul ipsa silentia terrent. Æn.

Zara. Silence and solitude are ev'rywhere!
Through all the gloomy ways and iron doors
That hither lead, nor human face nor voice

Is

(A) Bacon, in his natural history, makes the following observations. "Sounds are meliorated by the intension of the sense, where the common sense is collected most to the particular sense of hearing, and the sight suspended. Therefore sounds are sweeter, as well as greater, in the night than in the day; and I suppose they are sweeter to blind men than to others; and it is manifest, that between sleeping and waking, when all the senses are bound and suspended, music is far sweeter than when one is fully waking."

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Is seen or heard. A dreadful din was wont
To grate the sense, when enter'd here, from groans
And howls of slaves condemn'd, from clink of chains,
And crash of rusty bars and creaking hinges;
And ever and and anon the sight was dash'd
With frightful faces, and the meagre looks
Of grim and ghastly executioners.
Yet more this stillness terrifies my soul,
Than did that scene of complicated horrors.

Mourning Bride, act v. sc. 3.

In matters of slight importance, attention is mostly directed by will; and for that reason, it is our own fault if trifling objects make any deep impression. Had we power equally to withhold our attention from matters of importance, we might be proof against any deep impression. But our power fails us here: an interesting object seizes and fixes the attention beyond the possibility of controul; and while our attention is thus forcibly attached to one object, others may solicit for admittance; but in vain, for they will not be regarded. Thus a small misfortune is scarcely felt in presence of a greater:

Lear. Thou think'st 'tis much, that this contentious storm
Invades us to the skin: so 'tis to thee:
But where the greater malady is fix'd,
The lesser is scarce felt. Thou'dst shun a bear;
But if thy flight lay tow'rd the roaring sea,
Thou'dst meet the bear i' th' mouth. When the mind's free,
The body's delicate: the tempest in my mind
Doth from my senses take all feeling else,
Save what beats there.

King Lear, act iii. sc. 5.

ATTENUANTS, or ATTENUATING *Medicines*, are such as were supposed to subtilize and break the humours into finer parts; and thus dispose them for motion, circulation, excretion, &c.

ATTENUATION, the act of attenuating; that is, of making any fluid thinner, and less consistent, than it was before. The word is compounded of *ad*, 'to,' and *tenuis*, 'thin.' Attenuation is defined more generally by Chavin, the dividing or separating of the minute parts of any body, which before, by their mutual *nexus* or implication, formed a more continuous mass. Accordingly, among alchemists, we sometimes find the word used for pulverization, or the act of reducing a body into an impalpable powder, by grinding, pounding, the like.

ATTERBURY, DR FRANCIS, son of Dr Lewis Atterbury, was born at Milton in Buckinghamshire, 1662; educated at Westminster; and from thence elected to Christ-church in Oxford, where he soon distinguished himself by his fine genius and turn for polite literature. The year he was made M. A. 1687, he exerted himself in the controversy with the Papists, vindicated Luther in the strongest manner, and showed an uncommon fund of learning, enlivened with great vivacity. In 1690 he married Miss Osborn, a distant relation of the duke of Leeds; a lady of great beauty, but with little or no fortune, who lived at or in the neighbourhood of Oxford.

In Feb. 1690–1, we find him resolved to "bestir himself in his office in the house;" that of censor probably, an officer (peculiar to Christ-church) who presides over the classical exercises; he then also held the catechetical lecture founded by Dr Busby.

About this period it must have been that he took orders, and entered into another scene, and another sort of conversation: for in 1691 he was elected lecturer of St Bride's church in London, and preacher at Bridewell chapel. An academic life, indeed must have been irksome and insipid to a person of his active and aspiring temper. It was hardly possible that a clergyman of his fine genius, improved by study, with a spirit to exert his talents, should remain long unnoticed; and we find that he was soon appointed chaplain to King William and Queen Mary.

The share he took in the controversy against Bentley (about the genuineness of Phalaris's Epistles) is now very clearly ascertained. In one of the letters to his noble pupil, dated "Chelsea 1698 (he says), the matter had cost him some time and trouble. In laying the design of the book, in writing above half of it, in reviewing a good part of the rest, in transcribing the whole, and attending the press (he adds), half a year of my life went away."

"In 1700, a still larger field of activity opened, in which Atterbury was engaged four years with Dr Wake (afterwards archbishop of Canterbury) and others, concerning "the Rights, Powers, and Privileges of Convocations:" in which, however the truth of the question may be supposed to lie, he displayed so much learning and ingenuity, as well as zeal for the interests of his order, that the lower house of convocation returned him their thanks, and the university of Oxford complimented him with the degree of D. D. January 29. 1700, he was installed archdeacon of Totness, being promoted to that dignity by Sir Jonathan Trelawney, then bishop of Exeter. The same year he was engaged, with some other learned divines, in revising an intended edition of the "Greek Testament," with Greek "Scholia," collected chiefly from the fathers, by Mr Archdeacon Gregory. At this period he was popular as preacher at the Rolls chapel; an office which had been conferred on him by Sir John Trevor, a great discerner of abilities, in 1698, when he resigned Bridewell, which he had obtained in 1693. Upon the accession of Queen Anne in 1702, Dr Atterbury was appointed one of her majesty's chaplains in ordinary; and, in October 1704, was advanced to the deanery of Carlisle. About two years after this, he was engaged in a dispute with Mr Hoadly, concerning the advantages of virtue with regard to the present life; occasioned by his sermon, preached August 30. 1706, at the funeral of Mr Thomas Bennet a bookseller. In 1707, Sir Jonathan Trelawney, then bishop of Exeter, appointed him one of the canons residentiaries of that church. In 1709, he was engaged in a fresh dispute with Mr Hoadly, concerning "Passive Obedience;" occasioned by his Latin Sermon, entitled "Concio ad Clerum Londinensem, habita in Ecclesia S. Elphegi." In 1710, came on the famous trial of Dr Sacheverell, whose remarkable speech on that occasion was generally supposed to have been drawn up by our author, in conjunction with Dr Smalridge and Dr Freind. The same year Dr Atterbury was unanimously chosen prolocutor of the lower house of convocation, and had the chief management of

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Atterbury. of affairs in that house. May 11. 1711, he was appointed by the convocation, one of the committee for comparing Mr Whiston's doctrines with those of the church of England; and in June following, he had the chief hand in drawing up "A Representation of the Present State of Religion." In 1712, Dr Atterbury was made dean of Christ-church, notwithstanding the strong interest and warm applications of several great men in behalf of his competitor Dr Smalridge. The next year saw him at the top of his preferment, as well as of his reputation: for, in the beginning of June 1713, the queen, at the recommendation of Lord Chancellor Harcourt, advanced him to the bishopric of Rochester, with the deanery of Westminster, in commendam; he was confirmed July 4. and consecrated at Lambeth next day.

At the beginning of the succeeding reign, his tide of prosperity began to turn; and he received a sensible mortification presently after the coronation of King George I. when, upon his offering to present his majesty (with a view, no doubt, of standing better in his favour) with the chair of state or royal canopy, his own perquisites as dean of Westminster, the offer was rejected, not without some evident marks of dislike to his person.

During the rebellion in Scotland, when the Pretender's declaration was dispersed, the archbishop of Canterbury, and the bishops in or near London, had published a *Declaration of their abhorrence of the present Rebellion, and an Exhortation to the Clergy and People to be zealous in the discharge of their duties to his majesty King George*: but the bishop of Rochester refused to sign it; and engaged Bishop Smalridge in the same refusal, on account of some reflections it contained against the high church party. He appeared generally among the protestors against the measures of the ministry under the king, and drew up the reasons of the protests with his own hand.

In 1716, we find him advising Dean Swift in the management of a refractory chapter. April 26. 1722, he sustained a severe trial in the loss of his lady; by whom he had four children; Francis, who died an infant; Osborn, student of Christ-church; Elizabeth, who died September 29. 1716, aged 17; and Mary, who had been then seven years married to Mr Morice.

In this memorable year, on a suspicion of his being concerned in a plot in favour of the Pretender, he was apprehended August 24. and committed prisoner to the Tower.

Two officers, the under secretary, and a messenger, went about two o'clock in the afternoon to the bishop's house at Westminster, where he then was, with orders to bring him and his papers before the council. He happened to be in his nightgown when they came in; and being made acquainted with their business, he desired time to dress himself. In the mean time his secretary came in; and the officers went to search for his papers; in the sealing of which the messenger brought a paper, which he pretended to have found in his close stool, and desired it might be sealed up with the rest. His Lordship observing it, and believing it to be a forged one of his own, desired the officers not to do it, and to bear witness that the paper was not found with him. Nevertheless they did it; and though they behaved themselves with some respect to him, they suffered the messengers to treat him in a very rough manner, threatening him, if he did not make haste to dress himself, they would carry him away undrest as he was. Upon which he ordered his secretary to see his papers all sealed up, and went himself directly to the Cock-pit, where the council waited for him. The behaviour of the messengers, upon this occasion, seems to have been very unwarrantable, if what the author of "A Letter to the Clergy of the Church of England," &c. tells us be true, that the persons, directed by order of the king and council to seize his lordship and his papers, received a strict command to treat him with great respect and reverence. However this was, when he came before the council, he behaved with a great deal of calmness, and they with much civility towards him. He had liberty to speak for himself as much as he pleased, and they listened to his defence with a great deal of attention; and, what is more unusual, after he was withdrawn, he had twice liberty to re-enter the council chamber, to make for himself such representations and requests as he thought proper. It is said, that, while he was under examination, he made use of our Saviour's answer to the Jewish council, while he stood before them; "If I tell you, ye will not believe me; and if I also ask you, ye will not answer me, nor let me go." After three quarters of an hour's stay at the Cock-pit, he was sent to the Tower privately, in his own coach, without any manner of noise or observation.

This commitment of a bishop upon a suspicion of high treason, as it was a thing rarely practised since the Reformation, so it occasioned various speculations among the people. Those who were the bishop's friends, and pretended to the greatest intimacy with him, laid the whole odium of the matter upon the ministry. They knew the bishop so well, they said, his love to the constitution, and attachment to the Protestant succession, his professed abhorrence of Popery, and settled contempt of the Pretender, and his caution, prudence, and circumspection, to be such, as would never allow him to engage in an attempt of subverting the government, so hazardous in itself, and so repugnant to his principles; and therefore they imputed all to the malice and management of a great minister of state or two, who were resolved to remove him, on account of some personal prejudices, as well as the constant molestation he gave them in parliament, and the particular influence and activity he had shown in the late election. The friends to the ministry, on the other hand, were strongly of opinion, that the bishop was secretly a favourer of the Pretender's cause, and had formerly been tampering with things of that nature, even in the queen's time, and while his party was excluded from power; but upon their re-admission, had relinquished that pursuit, and his confederates therein, and became a good subject again. They urged, that the influence which the late duke of Ormond had over him, assisted by his own private ambition and revenge, might prompt him to many things contrary to his declared sentiments, and inconsistent with that cunning and caution which in other cases he was master of. And to obviate the difficulty, arising from the bishop's aversion to Popery, and the Pretender's bigotry to that religion, they talked of a new

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new invented scheme of his, not to receive the Pretender, whose principles were not to be changed, but his son only, who was to be educated a Protestant in the church of England, and the bishop to be his guardian, and lord protector of the kingdom, during his minority. These, and many more speculations, amused the nation at that time; and men, as usual, judged of things by the measure of their own affections and prejudices.

March 23. 1722 3, a bill was brought into the house of commons, for "inflicting certain pains and penalties on Francis Lord Bishop of Rochester;" a copy of which was sent to him, with notice that he had liberty of counsel and solicitors for making his defence. Under these circumstances, the bishop applied by petition, to the house of lords, for their direction and advice as to his conduct in this conjuncture; and April 4. he acquainted the speaker of the house of commons, by a letter, that he was determined to give that house no trouble in relation to the bill depending therein; but should be ready to make his defence against it when it should be argued in another house, of which he had the honour to be a member. On the 9th the bill passed the house of commons, and was the same day sent up to the house of lords for their concurrence.

May 6th being the day appointed by the lords for the first reading of the bill, Bishop Atterbury was brought to Westminster to make his defence. The counsel for the bishop were, Sir Constantine Phipps and William Wyne, Esq.; for the king, Mr Reeve and Mr Wearg. The proceedings continued above a week; and on Saturday May 11th, the bishop was permitted to plead for himself. This he did in a very eloquent speech: which he feelingly opens by complaining of the uncommon severity he had experienced in the Tower; which was carried to so great a length, that not even his son-in-law Mr Morice was permitted to speak to him in any nearer mode than standing in an open area, whilst the bishop looked out of a two-pair-of-stairs window. In the course of his defence he observes, "Here is a plot of a year or two standing, to subvert the government with an armed force; an invasion from abroad, an insurrection at home: just when ripe for execution, it is discovered; and twelve months after the contrivance of this scheme, no consultation appears, no men corresponding together, no provision made, no arms, no officers provided, not a man in arms; and yet the poor bishop has done all this. What could tempt me to step thus out of my way? Was it ambition, and a desire of climbing into a higher station in the church? There is not a man in my office farther removed from this than I am. Was money my aim? I always despised it too much, considering what occasion I am now like to have for it; for out of a poor bishopric of 500l. per annum, I have laid out no less than 1000l. towards the repairs of the church and episcopal palace; nor did I take one shilling for dilapidations. The rest of my little income has been spent, as is necessary, as I am a bishop. Was I influenced by any dislike of the established religion, and secretly inclined towards a church of greater pomp and power? I have, my lords, ever since I knew what Popery was, opposed it; and the better I knew it, the more I opposed it. I began my study in divinity, when the Popish controversy grew hot, with that immortal book of Tillotson's, when he undertook the Protestant cause in general; and as such, I esteemed him above all. You will pardon me, my lords, if I mention one thing: Thirty years ago, I writ in defence of Martin Luther; and have preached, expressed, and wrote to that purpose from my infancy; and whatever happens to me, I will suffer any thing, and by God's grace, burn at the stake, rather than depart from any material point of the Protestant religion as professed in the church of England. Once more: Can I be supposed to favour arbitrary power? The whole tenor of my life has been otherwise: I was always a friend to the liberty of the subject; and, to the best of my power, constantly maintained it. I may have been thought mistaken in the measures I took to support it; but it matters not by what party I was called, so my actions are uniform." Afterwards, speaking of the method of proceeding against him as unconstitutional, he says: "My ruin is not of that moment to any number of men, to make it worth their while to violate, or even to seem to violate, the constitution in any degree, which they ought to preserve against any attempts whatsoever. Though I am worthy of no regard, though whatsoever is done to me may for that reason be looked upon to be just; yet your lordships will have some regard to your own lasting interests and that of posterity. This is a proceeding with which the constitution is unacquainted; which, under the pretence of supporting it, will at last effectually destroy it. For God's sake, lay aside these extraordinary proceedings; set not up these new and dangerous precedents. I, for my part, will voluntarily and cheerfully go into perpetual banishment, and please myself that I am in some measure the occasion of putting a stop to such precedents, and doing some good to my country: I will live, wherever I am, praying for its prosperity; and do, in the words of Father Paul to the state of Venice, say, *esto perpetua*. It is not my departing from it I am concerned for. Let me depart, and let my country be fixed upon the immoveable foundation of law and justice, and stand for ever." After a solemn protestation of his innocence, and an appeal to the Searcher of Hearts for the truth of what he had said, he concludes thus: If, on any account, there shall still be thought by your lordships to be any seeming strength in the proofs against me; if, by your lordships judgments, springing from unknown motives, I shall be thought to be guilty; if, for any reasons or necessity of state, of the wisdom and justice of which I am no competent judge, your lordships shall proceed to pass this bill against me; I shall dispose myself quietly and tacitly to submit to what you do; God's will be done: Naked came I out of my mother's womb, and naked shall I return; and, whether he gives or takes away, blessed be the name of the Lord!"

On Monday the 13th he was carried for the last time from the Tower to hear the reply of the king's counsel to his defence. These were both men of great knowledge and sagacity in law, but of different talents in point of eloquence. Their speeches on this occasion were made public; and they seemed to have formed their "Replies," designedly, in a different way. The former sticks close to the matter in evidence, and enforces the charge against the bishop with great strength

 and

and perspicuity: The latter answers all his objections, and refutes the arguments brought in his defence, in an easy soft manner, and with great simplicity of reasoning. Mr Reeve is wholly employed in facts, in comparing and uniting together circumstances, in order to corroborate the proofs of the bishop's guilt: Mr Wearg is chiefly taken up in silencing the complaints of the bishop and his counsel, and replying to every thing they advance, in order to invalidate the allegations of his innocence. The one, in short, possesses the minds of the lords with strong convictions against the bishop: The other dispossesses them of any favourable impression that might possibly be made upon them by the artifice of his defence. And accordingly Mr Reeve is strong, nervous, and enforcing; but Mr Wearg, smooth, easy, and insinuating, both in the manner of his expression and the turn of his periods. Mr Wearg pays the highest compliments to the bishop's eloquence: but, at the same time, represents it as employed to impose upon the reason, and misguide the judgment of his hearers in proportion as it affected their passions; and he endeavours to strip the bishop's defence of all its ornaments and colour of rhetoric.

On the 15th the bill was read the third time; and after a long and warm debate, passed on the 16th, by a majority of 83 to 43. On the 27th, the king came to the house, and confirmed it by his royal assent. June 18. 1723, this eminent prelate, having the day before taken leave of his friends, who, from the time of passing the bill against him to the day of his departure, had free access to him in the Tower (B), embarked on board the Aldborough man of war, and landed

(B) The following anecdote was first communicated to the public by the late Dr Maty, on the credit of Lord Chesterfield: "I went (said Lord Chesterfield) to Mr Pope, one morning, at Twickenham, and found a large folio bible, with gilt clasps, lying before him upon his table; and, as I knew his way of thinking upon that book, I asked him, jocosely, if he was going to write an answer to it? It is a present, said he, or rather a legacy, from my old friend the Bishop of Rochester. I went to take my leave of him yesterday in the Tower, where I saw this bible upon his table. After the first compliments, the Bishop said to me, 'My friend Pope, considering your infirmities, and my age and exile, it is not likely that we should ever meet again; and therefore I give you this legacy to remember me by it. Take it home with you: and let me advise you to abide by it.'—'Does your Lordship abide by it yourself?'—'I do.' 'If you do, my Lord, it is but lately. May I beg to know what new light or arguments have prevailed upon you now, to entertain an opinion so contrary to that which you entertained of that book all the former part of your life?'—The Bishop replied, 'We have not time to talk of these things; but take home the book; I will abide by it, and I recommend you to do so too; and so God bless you."

These anecdotes Mr Nichols has inserted in the "Epistolary Correspondence," vol. ii. p. 79. with the professed view of vindicating Atterbury, in the following words of an ingenious correspondent:

"Dr Warton has revived this story, which he justly calls an 'uncommon' one, in his last 'Essay on the Genius and Writings of Pope.' It was indeed very uncommon; and I have my reasons for thinking it equally groundless and invidious. Dr Warton, though he retails the story from 'Maty's Memoirs,' yet candidly acknowledges, that it ought not to be implicitly relied on. That this caution was not unnecessary, will, I apprehend, be sufficiently obvious, from the following comparison between the date of the story itself and Mr Pope's letters to the bishop.

"According to Lord Chesterfield's account, this remarkable piece of conversation took place but a few days before the Bishop went into exile: and it is insinuated, that Mr Pope, till that period, had not even entertained the slightest suspicion of his friend's reverence for the bible: Nay, it is asserted, that the very recommendation of it from a quarter so unexpected, staggered Mr Pope to such a degree, that in a mingled vein of raillery and seriousness, he was very eager to know the grounds and reasons of the Bishop's change of sentiment.

"Unfortunately for the credit of Lord Chesterfield and his story, there is a letter on record, that was written nine months before this pretended dialogue took place, in which Mr Pope seriously acknowledged the Bishop's piety and generosity, in interesting himself so zealously and affectionately in matters which immediately related to his improvement in the knowledge of the holy scriptures. The passage I refer to is a very remarkable one; and you will find it in a letter, dated July 27. 1722. It appears undeniably from this letter, that the Bishop had earnestly recommended to Mr Pope the study of the bible; and had softened his zeal with an unusual urbanity and courtesy, in order to avoid the imputation of ill-breeding, and remove all occasion of disgust from a mind so 'tremblingly alive as Mr Pope's.' I will transcribe the passage at large. 'I ought first to prepare my mind for a better knowledge even of good profane writers, especially the moralists, &c. before I can be worthy of tasting the Supreme of books, and Sublime of all writings, in which, as in all the intermediate ones, you may (if your friendship and charity towards me continue so far) be the best guide to Yours, A. POPE.'

"The last letter of Mr Pope to the Bishop, previous to his going into exile, was written very early in June 1723. It must have been about this time that Pope paid his farewel visit to the Bishop in the Tower. But whether such a conversation as that which hath been pretended actually took place, may be left to the determination of every man of common sense, after comparing Lord Chesterfield's anecdote with Mr Pope's letter.

"There must have been a mistake, or a wilful misrepresentation, somewhere. To determine its origin, or to mark minutely the various degrees of its progress, till it issued forth into calumny and falsehood, is impossible.

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landed the Friday following at Calais. When he went on shore, having been informed that Lord Bolingbroke, who had, after the rising of the parliament, received the king's pardon, was arrived at the same place on his return to England, he said, with an air of pleasantry, "Then I am exchanged?" And it was, in the opinion of Mr Pope on the same occasion, "a sign of the nation's being cursedly afraid of being overrun with too much politeness, when it could not regain one great man but at the expence of another." But the severity of his treatment did not cease even with his banishment. The same vindictive spirit pursued him in foreign climes. No British subject was even permitted to visit him without the king's sign manual, which Mr Morice was always obliged to solicit, not only for himself, but for every one of his family whom he carried abroad with him, for which the fees of office were very high.

When Bishop Atterbury first entered upon his banishment, Brussels was the place destined for his residence; but, by the arts and instigations of the British ministers, he was compelled to leave that place, and retire to Paris. There being solicited by the friends of the Pretender to enter into their negociations, he changed his abode for Montpelier in 1728; and, after residing there about two years, returned to Paris, where he died Feb. 15. 1731-2. The affliction which he sustained by the death of his daughter in 1729, was thought to have hastened his own dissolution. The former event he hath himself related in a very affecting manner, in a letter to Mr Pope: "The earnest desire of meeting one I dearly loved, called me abruptly to Montpelier; where, after continuing two months under the cruel torture of a sad and fruitless expectation, I was forced at last to take a long journey to Toulouse; and even there I had missed the person I sought, had she not, with great spirit and courage, ventured all night up the Garonne to see me, which she above all things desired to do before she died. By that means she was brought where I was, between seven and eight in the morning, and lived 20 hours afterwards; which time was not lost on either side, but passed in such a manner as gave great satisfaction to both, and such as, on her part, every way became her circumstances and character: For she had her senses to the very last gasp, and exerted them to give me, in those few hours, greater marks of duty and love than she had done in all her lifetime, though she had never been wanting in either. The last words she said to me were the kindest of all; a reflection on the goodness of God, which had allowed us in this manner to meet once more, before we parted for ever. Not many minutes after that, she laid herself on her pillow, in a sleeping posture,

Placidaque ibi demum morte quievit.

Judge you, Sir, what I felt, and still feel, on this occasion, and spare me the trouble of describing it. At my age, under my infirmities, among utter strangers, how shall I find out proper reliefs and supports? I can have none, but those with which reason and religion furnish me; and those I laid hold on, and grasp as fast as I can. I hope that He who laid the burden upon me (for wise and good purposes no doubt) will enable me to bear it in like manner, as I have borne others, with some degree of fortitude and firmness."

How far the bishop might have been attached in his inclinations to the Stuart family, to which he might be led by early prejudices of education, and the divided opinions of the times, it is not necessary here to inquire: But that he should have been weak enough to engage in a plot so inconsistent with his station, and so clumsily devised (to say the least of it, and without entering into his solemn asseveration of innocence), is utterly inconsistent with that cunning which his enemies allowed him. The duke of Wharton, it is well known, was violent against him, till convinced by his unanswerable reasoning.

It has been said that Atterbury's wishes reached to the bishopric of London, or even to York or Canterbury. But those who were better acquainted with his views, knew that Winchester would have been much more desirable to him than either of the others. And there are those now living, who have been told from respectable authority, that that bishopric was offered to him whenever it should become vacant (and till that event should happen, a pension of 5000l. a-year, besides an ample provision for Mr Morice), if he would cease to give the opposition he did to Sir Robert Walpole's administration, by his speeches and protests in the house of lords. When that offer was rejected by the bishop, then the contrivance for his ruin was determined on.

In his speech in the house of lords, the bishop mentions his being "engaged in a correspondence with two learned men (Bishop Potter and Dr Wall) on settling the times of writing the four gospels." Part of this correspondence is still in being, and will soon be published. The same subject the bishop pursued during his exile, having consulted the learned of all nations, and had nearly brought the whole to a conclusion when he died. These laudable labours are an ample confutation of Bishop Newton's assertion, that Atterbury "wrote little whilst in exile but a few criticisms on French authors."

His body was brought over to England, and interred on the 12th of May following in Westminster abbey, in a vault which in the year 1722 had been prepared by his directions. There is no memorial over his grave; nor could there well be any, unless his friends would have consented (which it is most probable they refused to do) that the words implying him to have died bishop of Rochester should have been omitted on his tomb.

Some

I have simply stated matters of fact as they are recorded; and leave it to your readers to settle other points not quite so obvious and indisputable, as they may think fit. My motives in this very plain narration arose from an honest wish to remove unmerited obloquy from the dead. I should sincerely rejoice if the cloud which in other respects still shades the character of this ingenious prelate could be removed with equal facility and success. I am, dear Sir, your faithful humble servant, SAMUEL BADCOCK."

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Atterbury.

Some time before his death, he published a vindication of himself, Bishop Smalridge, and Dr Aldrich, from a charge brought against them by Mr Oldmixon, of having altered and interpolated the copy of Lord Clarendon's "History of the Rebellion." Bishop Atterbury's "Sermons" are extant in four volumes in octavo: those contained in the two first were published by himself, and dedicated to his great patron Sir Jonathan Trelawney bishop of Winchester; those in the two last were published after his death by Dr Thomas Moore, his lordship's chaplain. Four admirable "Visitation Charges" accompany his "Epistolary Correspondence."

As to Bishop Atterbury's character, however the moral and political part of it may have been differently represented by the opposite parties, it is universally agreed, that he was a man of great learning and uncommon abilities, a fine writer, and a most excellent preacher. His learned friend Smalridge, in the speech he made when he presented him to the upper house of convocation, as prolocutor, styles him *Vir in nullo literarum genere hospes, in plerisque artibus et studiis diu et feliciter exercitatus, in maxime perfectis literarum disciplinis perfectissimus.* In his controversial writings, he was sometimes too severe upon his adversary, and dealt rather too much in satire and invective; but this his panegyrist imputes more to the natural fervour of his wit than to any bitterness of temper or prepense malice. In his sermons, however, he is not only every way unexceptionable, but highly to be commended. The truth is, his talent as a preacher was so excellent and remarkable, that it may not properly be said, that he owed his preferment to the pulpit. "He has," says an author in the Tatler, "so particular a regard to his congregation, that he commits to his memory what he has to say to them; and has so soft and graceful a behaviour, that it must attract your attention. His person, it is to be confessed, is no small recommendation; but he is to be highly commended for not losing that advantage, and adding to propriety of speech (which might pass the criticism of Longinus) an action which would have been approved by Demosthenes. He never attempts your passions, till he has convinced your reason. All the objections which you can form are laid open and dispersed before he uses the least vehemence in his sermon; but when he thinks he has your head, he very soon wins your heart, and never pretends to show the beauty of holiness, till he has convinced you of the truth of it."—In his letters to Pope, &c. Bishop Atterbury appears in a pleasing light, both as a writer and as a man.

Atterbury ‖ Attica.

ATTESTATION, the act of affirming or witnessing the truth of something, more especially in writing.

ATTIC, any thing relating to Attica, or to the city of Athens: thus Attic salt, in philology, is a delicate poignant sort of wit and humour peculiar to the Athenian writers; Attic witness, a witness incapable of corruption, &c.

Attic Order. See Architecture.

Attic Base, a peculiar kind of base used by the ancient architects in the Ionic order; and by Palladio, and some others in the Doric.

Attic Story, in *Architecture;* a story in the upper part of a house, where the windows are usually square.

ATTICA.

Attica.

1 Boundaries, extent, &c.

ATTICA, an ancient kingdom of Greece, situated along the north coast of the gulf of Saron; bounded on the west by Megara, Mount Cithæron, and part of Bœotia; on the north by the strait of Euripus, now *Stretto di negro ponte*, and Bœotia; and on the east by the Euripus. It extends in length from north-west to south-west about 60 miles; its breadth from north to south was 56, decreasing as it approached the sea.

2 Inhabitants thought to be produced from the soil.

The soil of this country was naturally barren and craggy, though by the industry of its inhabitants it produced all the necessaries of life. On this account Attica was less exposed to invasions than other more fertile countries; and hence it preserved its ancient inhabitants beyond all the other kingdoms in its neighbourhood: so that they were reputed to be the spontaneous productions of the soil; and as a badge of this, Thucydides tells us, they wore golden grasshoppers in their hair.

3 Cities.

The chief cities in the kingdom of Attica were Athens the capital; next to it Eleusis, situated on the same gulf, near the coast of Megara; and next to that Rhamnus, famed for the temple of Amphiaraus and the statue of the goddess Nemesis.

4 Cecrops the first king.

The first king of this country, of whom we have any distinct account, was Cecrops. Others indeed are said to have reigned before him, particularly one Actæus, whose daughter Cecrops married, and in her right laid the foundation of his new monarchy. Cecrops is said to have been the first who deified Jupiter, set up altars and idols, and instituted marriage among the Greeks. He is likewise affirmed to have taught his subjects navigation; and for the better administration of justice, and promoting intercourse among them, to have divided them into the first four tribes, called *Cecropis*, *Autochthon*, *Actea* and *Paralia;* and he is also by some said to be the founder of the Areopagus. From this monarch the Athenians affected to call themselves *Cecropidæ* till the reign of Erectheus their sixth king, after whom they took the name of *Erecthydæ*.

Attica.

5 Cranaus.

Cecrops dying after a reign of 50 years, left three daughters; by marrying one of whom, probably, Cranaus a wealthy citizen ascended the throne. He enjoyed his crown peaceably for ten years; till, having married one of his daughters named *Attis*, to Amphictyon the son of Deucalion, he was by him dethroned, and forced to lead a private life to the last. From this daughter, the country, which before had been called *Actea*, took the name of *Attica*.

6 Whence the country was called Attica.

After

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After a reign of 10 or 12 years, Amphictyon was himself deposed by Ericthonius, said to be the son of Vulcan and Tethys. Being lame of both his feet, he is said to have invented coaches, or, as others will have it, instituted horse and chariot races, in honour of Minerva. He is also reported to have been the first who stamped silver coin. He reigned 50 years, and was succeeded by his son Pandion, the father of Progne and Philomela; whose hard fate, so famous among the poets, is supposed to have broke his heart, after a reign of about 40 years. In his time Triptolemus taught the Athenians agriculture, which he had learned from Ceres.

7 Ericthonius. 8 Pandion.

9 Erectheus.

Pandion was succeeded by his son Erectheus, who being reckoned the most powerful prince of his time, Boreas king of Thrace demanded his daughter Orithia in marriage, and on being refused carried her off by force. After a reign of 50 years, Erectheus being killed in a battle with the Eleusinians, was succeeded by his son Cecrops II. who is generally allowed to have been the first who gathered the people into towns; they having till then lived in houses and cottages scattered here and there, without order or regular distance. After a reign of 40 years he was driven out by his brethren Metion and Pandorus, who forced him to fly into Ægialea, where he died.

10 Cecrops II.

11 Pandion II.

Cecrops II. was succeeded by his son Pandion II. and he was likewise driven out by Metion, who assumed the government. Pandion in the mean time fled into Megara, where he married Pelia the daughter of Pylas king of that place, and was appointed successor to the kingdom. Here he had four sons, who returning to Athens, whether with or without their father is uncertain, expelled the sons of Metion, and after the decease of Pandion their father, divided the government among themselves; notwithstanding which, the royal dignity did in effect remain with Ægeus the eldest.

12 Ægeus.

Ægeus, when he ascended the throne, finding himself despised by his subjects because he had no sons, and sometimes insulted by his brother Pallas, who had no less than fifty, consulted the oracle of Apollo at Delphi. Receiving here, as was commonly the case, an answer which could not be understood without a commentator, he applied to Pittheus king of Troezen, famous for his skill in expounding oracles. This prince easily prevailed with him to lie with his daughter Æthra, who proved with child; and as none but these three were privy to the secret, Ægeus, before his return to Athens, hid a sword and a pair of shoes under a stone, leaving orders with the princess, that if the child proved a boy, she should send him to Athens with these tokens as soon as he was able to lift up that stone. He charged her moreover to use all imaginable secrecy, lest the sons of his brother Pallas should waylay and murder him.

13 Theseus born.

Æthra being delivered of a son, Pittheus gave out that Neptune was the father of it. This child was named *Theseus*, and proved one of the most famous heroes of antiquity. Being arrived at the age of 16, his mother brought him to the stone above mentioned; and he having lifted it with ease, was desired to take up the sword and shoes and prepare himself to go to his father. He was advised to go by sea rather than by land, as, ever since the departure of Hercules, the roads had been exceedingly infested by banditti. Theseus, however, who had already begun to discover marks of uncommon strength and courage, no sooner heard the name of Hercules mentioned, than he became desirous of imitating so great a pattern; and after performing a number of glorious exploits, for which see the article THESEUS, he arrived safe at his father's capital.

The great atchievements of our young hero procured him a welcome reception at the court of Ægeus, though his birth was unknown to all except Medea, to whom the king had lately been married. This queen being a sorceress, it is not to be supposed any thing could be concealed from her: she therefore, by her diabolical penetration, quickly found out that Theseus was the king's son; after which she became so jealous of him on account of his valour, that she persuaded her old husband to invite the young stranger to a banquet, and poison him in a glass of wine. The poison was accordingly prepared, and Theseus invited; but the prince suddenly drawing his sword, it was immediately recognised by Ægeus to be the same he had formerly buried below the stone. Upon this he stepped forward to Theseus, throwing down the poisoned draught in his way; and, embracing him with much tenderness, owned him for his son before all the court.

14 Is made known to his father.

At this time the king of Athens had great occasion for such a champion as Theseus. The sons of Pallas, who had all along behaved with great insolence, upon Theseus being discovered to be the king's son, and heir apparent to the crown, broke out in open rebellion. They were soon discomfited; but Ægeus and the whole country of Attica were still in great distress on the following account. Some years before, Androgeus, the son of Minos king of Crete, came to Athens to be present at one of their feasts. During this visit he contracted such an intimacy with the fifty sons of Pallas, that Ægeus, fearing some fatal consequences, caused him to be privately murdered. According to others, Androgeus having undertaken to encounter the Marathonian bull, was killed by it. Be this as it will, Minos having received news of his son's death, imputed it to the people of Attica; and therefore, after several unsuccessful attempts to revenge his own quarrel, prayed to the gods to do it for him. The Athenians, in consequence of this prayer, were visited with earthquakes, famine, and pestilence; on account of which they applied to the oracle. Here they were informed, that no relief was to be had till they were reconciled to the Cretan king. Minos resolving to make them pay dear for their deliverance, imposed upon them a tribute of seven young men and as many virgins, whom he condemned to be devoured by the Minotaur, a monster feigned by the poets to have been half man and half bull. This bloody tribute had been twice paid, and Minos had already sent his messengers the third time, when Theseus willingly offered himself to be one of the unhappy victims; and embarking with them in one ship, he gave the pilot two sails, the one black to sail with, and the other white to be hoisted up at his return in case he came off victorious. Our hero had all the success he could wish: he killed the Minotaur, prevailed with Minos to remit the tribute, and his daughter Ariadne to run away with him; but her he left with child in the isle of Naxos. Unfortunately, however, for Ægeus, the joy of Theseus and his

15 He kills the Minotaur.

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his company was so great, that at their return they forgot to hoist the white flag in token of their victory:
16 Death of Ægeus. upon which the old king, taking for granted that his son was killed, threw himself into the sea, which ever
17 Theseus king of Attica. since has from him been called the *Ægean Sea*.

Theseus being thus left in possession of the kingdom of Attica, began immediately to think of indulging his
18 New models the government. warlike genius, and rendering the civil affairs of his kingdom as little troublesome as possible. To accomplish this purpose, he began with gathering most of the people of Attica into the old and new town, which he incorporated into one city. After this he divested himself of all his regal power, except the title of king, the command of the army, and the guardianship of the laws. The rest he committed to proper magistrates chosen out of three different orders of the people, whom he divided into nobles, husbandmen, and artificers. The first he invested with the power of interpreting and executing the laws, and regulating whatever related to religion. The other two chose their inferior magistrates from among themselves, to take care of whatever related to their separate orders: so that the kingdom was in some measure reduced to a commonwealth, in which the king had the greatest post, the nobles were next to him in honour and authority, the husbandmen had the greatest profit, and the artists exceeded them in number. He likewise abolished all their distinct courts of judicature, and built one common council hall called *Prytaneum*, which stood for many ages afterwards.

Having thus new-modelled the government, his next care was to join to his dominions the kingdom of Megara, in right of his grandfather Pandion II. who had married the daughter of Pylas, as above mentioned. On this occasion he erected the famous pillar in the isthmus, which showed the limits of the two countries that met there. On the one side of this pillar was inscribed, "This is not Peloponnesus, but Ionia;" and on the other, "This is Peloponnesus, not Ionia." After this
19 Defeats the Amazons, kills the Centaurs, and carries off Helena. he undertook an expedition against the Amazons, whom he overcame, took their queen Hippolita, and afterwards married her. Soon after this, Theseus contracted an intimacy with Perithous the son of Ixion: and being invited to his nuptials, assisted him in killing a number of Centaurs, or rather Thessalian horsemen (who in their cups had offered violence to their female guests), and drove the rest out of the country. Our two associates then proceeded to Sparta, where Theseus fell in love with the famed Helena, at that time not above nine years old, while he himself was upwards of fifty. Her they carried off: and of the rape there are various accounts; but the following one, which is given by Plutarch, is generally allowed to be the most authentic.

According to that historian, they stole this beauty, the greatest in the world at that time, out of the temple of Diana Ortia, where Helena happened to be dancing. They were pursued as far as Tegea, but made their escape out of Peloponnesus; and thinking themselves now secure of their prey, they agreed to cast lots for her, upon condition that he to whose lot she fell should assist the other in procuring some celebrated beauty. Fortune having declared for Theseus, he assisted his companion in the like attempt upon Proserpina daughter of Aidonius king of the Mollossi in Epirus; who, being the next beauty to Helena, was guarded by the dog Cerberus, which had three heads, and was consequently a very formidable enemy. Her father, however, understanding that they designed to steal away his daughter, threw Perithous to be torn in
pieces by Cerberus, and put Theseus in prison, from 20 Imprisoned by the king of Epirus.
whence he was afterwards relieved at the intercession of Hercules.

After this misfortune, Theseus at length returned to Athens, but found himself very coolly received by his subjects. Mnestheus, the son of Pteus, and great-grandson of Erectheus, had made use of the king's absence to ingratiate himself with the people; and, upon the commencement of a war with Castor and Pollux, the two brothers of Helena, he persuaded the people of
Athens to open their gates to the two brothers. Up- 21 Driven out of Athens.
pon this, Theseus was under the necessity of conveying away himself and family with all possible privacy. This he luckily accomplished; and designed to have sailed to Crete, to have obtained assistance from Deucalion son of Minos, and now brother-in-law to Theseus himself, he having lately married Phædra sister to Deucalion. Unfortunately, however, our hero was shipwrecked on the island of Scyros. Here he was at first kindly re-
ceived by Lycomedes the king of that island; but was 22 His death.
soon after killed by a fall from a high rock, over which some say he was pushed by Lycomedes himself, who had been prevailed on to destroy Theseus in that manner by Mnestheus, that he might with the more security enjoy the kingdom of Athens.

Mnestheus reigned 24 years, but lost his life at the 23 Mnestheus, Demophon, &c.
siege of Troy; and was succeeded by Demophon one of the sons of Theseus by Phædra, who was likewise at the siege of Troy, but had the good fortune to return in safety. In his reign was erected the famous court of the Ephetæ; consisting originally of 50 Athenians and as many Argives, for trying of wilful murders. By this court the king himself afterwards submitted to be tried for having accidentally killed one of his subjects. He reigned 33 years, and was succeeded by his son, according to some, or according to others his brother, Oxyntes, who reigned 12 years. Oxyntes was succeeded by his son Aphydes, who was murdered by Thymætes the bastard son of Oxyntes.

This king discovered many base qualities unworthy 24 Thymætes deposed.
of his dignity; and at last was deposed by his subjects on the following occasion. Xanthus king of Bœotia had a contest with the Athenians about one of their frontier towns. He offered to decide the matter by single combat with the king; but this was declined by Thymætes. It happened, that at that time one Melanthus a Messenian, who had been driven out of his country by the Heraclidæ, was come to Athens; who accepted the king of Bœotia's challenge. At the first onset, Melanthus asked his adversary, why he had, contrary to the articles, brought a second into the field with him? and as Xanthus immediately looked about to see who was behind him, Melanthus run him through with his lance. This victory, though it did little honour to him who gained it, was so agreeable to the Athenians, that they deposed their cowardly king Thymætes, af-
ter he had reigned 8 years; and appointed Melanthus 25 Melanthus.
in his stead, who after a reign of 37 years left the kingdom to his son Codrus.

This prince reigned about 21 years; during which time the Dores and Heraclidæ had regained all Peloponnesus, Attica. ponnesus, and were upon the point of entering into Attica. Codrus, being informed that the oracle had

26 Codrus the last king sacrifices himself for his country.

promised them victory provided they did not kill the king of the Athenians, came immediately to a resolution of dying for his country. Disguising himself, therefore, like a peasant, he went into the enemy's camp, and quarrelling with some of the soldiers, was killed by them. On the morrow, the Athenians knowing what was done, sent to demand the body of their king; at which the invaders were so terrified, that they decamped without striking a blow.

27 Republican government introduced.

Upon the death of Codrus, a dispute which happened among his sons concerning the succession, furnished the Athenians with a pretence for ridding themselves of their kings altogether, and changing the monarchical form of government into a republican one. It was improbable, they said, that they should ever have so good a king as Codrus; and to prevent their having a worse, they resolved to have no king but Jupiter. That they might not, however, seem ungrateful to the family of Codrus, they made his son Medon their supreme magistrate, with the title of *archon*. They afterwards rendered that office decennial, but continued it still in the family of Codrus. The extinction of the Medontidæ at last left them without restraint; upon which they not only made this office annual, but created nine archons. By the latter invention they provided against the too great power of a single person, as by the former they took away all apprehension of the archons having time to establish themselves, so as to change the constitution. In a word, they now attained what they had long sought, viz. the making the supreme magistrates dependant on the people.

We have a list of these archons for upwards of 600 years, beginning with Creon, who lived about 684 years before Christ, to Herodes, who lived only 60 years before that time. The first archon of whom we

28 Draco legislator of Athens.

hear any thing worth notice, is named *Draco*. He reigned in the second, or, as others say, in the last year of the 39th Olympiad, when it is supposed he published his laws: but though his name is very frequently mentioned in history, yet no connected account can be found either of him or his institutions; only, in general, his laws were exceedingly severe, inflicting death for the smallest faults; which gave occasion to one Demades an orator to observe, that the laws of Draco were written with blood, and not with ink. For this extraordinary severity he gave no other reason, than that small faults seemed to him to be worthy of death, and he could find no higher punishment for the greatest. He was far advanced in years when he gave laws to Athens; and to give his institutions the greater weight, he would not suffer them to be called *nomoi*, or laws, but *thesmoi*, or sanctions proceeding from more than human wisdom. The extreme severity of these

29 Expelled the city.

laws, however, soon made the Athenians weary both of them and the author of them; upon which Draco was obliged to retire to Ægina. Here he was received with the highest honours: but the favour of the inhabitants of this place proved more fatal to him than the hatred of the Athenians; for coming one day into the theatre, the audience, to show their regard, threw, as the

30 His death.

custom then was, their cloaks upon him; and the multitude of these being very great, they stifled the old man, who was too weak to disengage himself from their load.

After the expulsion of Draco, nothing remarkable happened at Athens till the year before Christ 606 when we find the republic engaged in a war with the Mitylenians about the city Sigæum, situated near the mouth of the river Scamander. The Athenian army

31 Mitylenian war.

was commanded by Phrynon, a person equally remarkable for the comeliness of his person and the generosity of his mind. The Mitylenians were commanded by Pittacus, one of the celebrated sages of Greece. As these commanders looked upon the honour of their respective countries to be concerned, they exerted themselves to the utmost. At last they met in single combat; wherein Phrynon depended on his valour only: but Pittacus concealed behind his shield a net, wherewith he suddenly entangled his antagonist, and easily slew him. This, however, not putting an end to the war, Periander tyrant of Corinth interposed; and both parties having submitted to his arbitration, he decreed that Sigæum should belong to the Athenians.

32 Cylon's conspiracy.

About seven years after this war, a conspiracy was formed by Cylon son-in-law to Theagenes tyrant of Megara, who, having by his affable behaviour procured many friends, formed a design of seizing the sovereignty of Athens. Having consulted the oracle as to the most proper time, he was directed to make the attempt when the citizens of Athens were employed in celebrating their highest feasts to Jupiter. When many of the citizens therefore were gone to the Olympic games, Cylon and his associates made themselves masters of the citadel. Here they were instantly besieged by Megacles at that time archon, and soon reduced to great distress for want of water. The chief, together with his brother, found means to make their escape, but the meaner sort were left to shift for themselves. In this extremity they fled to the temple of Minerva; from whence Megacles with much ado prevailed upon them to come down and submit themselves to the mercy of their country. Having at last assented to this, they tied a cord to the image of the goddess, and carried the clue with them, to demonstrate, that though they were out of the temple they were still under Minerva's protection. Unfortunately for them, however, as they passed the temple of the Furies, the line snapt of itself; which Megacles construing into a renunciation by the goddess, caused his men to fall upon them and despatch

33 Conspirators massacred by Megacles;

as many as they could find. Such as were without the temple were immediately massacred, and those who fled thither again were murdered in their sanctuary. In short, none escaped but such as bribed the wives of the officers of justice. This carnage, however, did not put an end to the sedition. The remains of Cylon's faction created great disturbances, by insinuating that the violation of Minerva's sanctuary had drawn down

34 who is execrated by the people.

the anger of the gods; and these discourses had such an effect, that Megacles and his officers were styled *execrable*, and held to be persons under the displeasure of heaven.

35 Unsuccessful war with Megara.

During the time of this confusion, the Megarensians attacked Nisea, which they took, as well as Salamis; and so completely routed the Athenians in every attempt to recover the latter, that a law was at last passed, by which it should be capital for any one to propose the recovery of Salamis. About the same time the city was disturbed by reports of frightful appearances, and filled with superstitious fears; the oracle at

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Attica.

Delphi was therefore consulted, and an answer returned that the city behoved to be expiated. Upon this, Epimenides the Phestian was sent for from Crete, to perform the necessary ceremonies, he being reputed a holy man, and one that was deeply skilled in all the mysteries of religion. His expiation consisted in taking some black, and some white sheep, turning them all loose, and directing some persons to follow them to those places where they couched, and there to sacrifice them to the local deity. He caused also many temples and chapels to be erected, two of which have been particularly noted, viz. the chapel of *Contumely* and that of *Impudence*. This man is said to have looked wistfully on the port of Munychia for a long time, and then to have spoke as follows to those that were near him: "How blind is man to future things! for did the Athenians know what mischief will one day be derived to them from this place, they would eat it with their teeth." This prediction was thought to be accomplished 270 years after, when Antipater constrained the Athenians to admit a Macedonian garrison into that place.

36 Epimenides's expiation and prophecy.

37 Solon the wise legislator.

About 597 years before Christ, Solon the famed Athenian legislator began to show himself to his countrymen. He is said to have been lineally descended from Codrus; but left by his father in circumstances rather necessitous, which obliged him to apply to merchandise; it is plain, however, both from his words and writings, that he was a disinterested patriot. The shameful decree, that none under pain of death should propose the recovery of Salamis, grieved him so much, that having composed an elegy of 100 verses, such as he thought would be most proper to inflame the minds of the people, he ran into the market-place as if he had been mad, with his night-cap on his head, repeating his elegy. A crowd being gathered round the pretended madman, his kinsman Pisistratus mingled among the rest, and observing the people moved with Solon's words, he also seconded him with all the eloquence he was master of; and between them they prevailed so far as to have the law repealed, and a war was immediately commenced against the people of Megara. Who was commander in this expedition is not certain; but the city was recovered, according to the most general account, by the following stratagem. Solon coming with Pisistratus to Colias, and finding there the women busy in celebrating, according to custom, the feast of Ceres, sent a confidant of his to Salamis, who pretended to be no friend to the people of Attica, telling the inhabitants of Salamis, that if they had a mind to seize the fairest of the Athenian ladies, they might now do it by passing over to Colias. The Megarensians giving easy credit to what the man said, immediately fitted out a ship; which Solon perceiving from the opposite shore, dismissed the women, and having dressed a number of beardless youths in female habits, under which they concealed every one a dagger, he sent them to the sea-side to dance and divert themselves as the women were wont to do. When those who came from Salamis saw these young persons skipping up and down, they strove who should be first on shore; but were every one of them killed, and their vessel seized; aboard which the Athenians embarking, sailed immediately to Salamis and took it.

38 Salamis recovered by his means.

On the return of Solon to Athens, he was greatly honoured by the people, to whom another occasion of admiring his wisdom was quickly afforded. The inhabitants of Cirrha, a town situated in the bay of Corinth, after having by repeated incursions wasted the territory of Delphi, at last besieged the capital itself, with a view of making themselves masters of the treasures contained in the temple of Apollo. Advice of this intended sacrilege being sent to the Amphictyons, who were the states-general of Greece, Solon advised that the matter should be universally resented, and that all the states should join in punishing the Cirrhæans, and saving the Delphic oracle. This advice was complied with, and a general war against Cirrha declared. Clysthenes, tyrant of Sicyon, commanded in chief, and Alcmæon was general of the Athenian quota. Solon went as assistant or counsellor to Clysthenes, and by following his advice the war was conducted to a prosperous issue. For when the Greek army had besieged Cirrha for some time without any appearance of success, the oracle at Delphi was consulted, from whence the following answer was returned:

39 Cirrha likewise reduced by Solon's wisdom.

"In vain you hope to take the place before
"The sea's blue waves roll o'er the hallowed shore."

This answer struck the whole army with surprise, till Solon advised Clysthenes to consecrate solemnly the whole territory of Cirrha to the Delphic Apollo; so as that was a maritime country, the sea must then wash the sacred coast. According to Pausanias, the city was reduced by the following stratagem, likewise invented by Solon. He caused the river Plistus, which run through Cirrha, to be turned into another channel, hoping thereby to have distressed the inhabitants for want of water: but finding they had many wells within the city, and were not to be reduced by that means, he caused a vast quantity of roots of hellebore to be thrown into the river, which was then suffered to return into its former bed. The inhabitants, overjoyed at the sight of running water, came in troops to drink of it: whereupon an epidemic flux ensued, and the citizens being no longer able to defend the walls, the town was easily taken.

On the return of Solon to Athens he found things again in the utmost confusion. The remnant of Cylon's faction gave out, that all sorts of misfortunes had befallen the republic on account of the impiety of Megacles and his followers; which clamour was heightened by the retaking of Salamis about this time by the Megarensians. Solon interposed, and persuaded those who were styled *execrable* to abide a trial, and 300 persons were chosen to judge them. The event was, that 300 of Megacles's party who were alive were sent into perpetual banishment, and the bones of such as were dead were dug up and sent without the limits of their country.

40 Athens in great confusion.

41 Megacles's party banished.

Though this decision restored the public quiet for the present, it was not long before the people were divided into three factions, contending about the proper form of government. These were called the *Diacrii*, *Pediæi*, and *Parali*; the first of these were the inhabitants of the hilly country, who declared positively for democracy; the second, dwelling in the lower parts, and who were far more opulent than the former, declared for an oligarchy, as supposing the government would fall mostly into their hands; the third party, who lived on

42 Three factions start up.

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 on the sea-coast, were people of moderate principles, and therefore were for a mixed government. Besides the disturbances raised on this account, others were occasioned by the rich oppressing the poor. According to Plutarch, the poor being indebted to the rich, either tilled their grounds and paid them the sixth part of the produce, or engaged their bodies for their debts, so that many were made slaves at home, and many sold into other countries; nay, some were obliged to sell their children to pay their debts, and others in despair quitted Attica altogether. The greatest part, however, were for throwing off the yoke, and began to look about for a leader, openly declaring that they intended to change the form of government, and make a repartition of lands. In this extremity, the eyes of all the citizens were cast upon Solon. The most prudent were for offering him the sovereignty; but he perceiving their intentions, behaved in such a manner as to cheat both parties, and showed a spirit of patriotism perhaps never equalled. He refused the sovereignty as far as it might have benefited himself; and yet took upon himself all the care and trouble of a prince, for the sake of his people.

43 Solon chosen archon. He was chosen archon without having recourse to lots, and after his election disappointed the hopes of both parties. It was Solon's fundamental maxim, That those laws will be best observed which power and justice equally support. Wherever, therefore, he found the old constitution consonant to justice in any tolerable degree, he refused to make any alteration at all, and was at extraordinary pains to show the reason of the changes he did make. In short, being a perfect judge of human nature, he sought to rule only by showing his subjects that it was their interest to obey, and not by forcing upon them what he himself esteemed best. Therefore, to a person who asked whether he had given the Athenians the best laws in his power, he replied, "I have established the best they could receive."

44 Settles all disorders. As to the main cause of sedition, viz. the oppressed state of the meaner sort, Solon removed it by a contrivance which he called *sisachthia*, i. e. *discharge*; but what this was, authors are not agreed upon. Some say that he released all debts then in being, and prohibited the taking any man's person for payment of a debt for the future. According to others, the poor were eased, not by cancelling the debts, but by lowering the interest, and increasing the value of money; a mina, which before was made equal to 73 drachms only, being by him made equal to 100; which was of great advantage to the debtor, and did the creditor no hurt. It is, however, most probable that the sisachthia was a general remittance of all debts whatever, otherwise Solon could not have boasted in his verses that he had removed so many marks of mortgages (B) as were everywhere frequent; that he had freed from apprehension such as were driven to despair, &c.

45 Infamous behaviour of his three friends. But in the midst of all Solon's glory, an accident befel him, which, for a time, hurt his reputation, and had almost entirely ruined his schemes. He had consulted Conon, Clinias, and Hipponicus, his three friends, on an oration prepared with a view to engage the people's consent to the discharge; and these three men, thus knowing there was to be a general discharge of debts, basely took the opportunity of borrowing vast sums before the law was promulgated, in consequence of which they were never obliged to return them.

This was thought at first to have been done with Solon's consent, and that he had shared in the money; but this aspersion was quickly wiped off when it appeared that the lawgiver himself was a very considerable loser by his own law. His friends, however, could never recover their credit, but were ever afterwards stigmatized with the opprobrious appellation of *chreocopidæ*, or *debt-sinkers*.

46 Solon blamed at first, but afterwards applauded and chosen legislator. The Athenians were as little pleased with Solon's management as with their former condition; the rich thinking he had done too much in cancelling the money-debts due to them, and the poor that he had done too little, because he had not divided the lands of Attica equally. In a short time, however, they acquiesced in the new institutions, and gave a more public token of their repentance than they had before shown of their displeasure, instituting a solemn sacrifice under the name of *Sisachthia*, at the same time that Solon was unanimously elected legislator of Athens, with full power to make laws, and alter or new-model the constitution as he thought fit.

47 Compiles a new body of laws. Solon being now invested with unlimited authority, set about the arduous task of compiling new laws for the turbulent people of Attica; which having at last completed in the best manner he was able, or in the best manner the nature of the people would admit, he procured them to be ratified for 100 years. Such as related to private actions were preserved on parallelograms of wood, with cases which reached from the ground, and turned about upon a pin like a wheel. These were thence called *axones*; and were placed first in the citadel, and afterwards in the prytaneum, that all the subjects might have access to them when they pleased. Such as concerned public institutions and sacrifices were contained in triangular tables of stone called *cyrbes*. The Athenian magistrates were sworn to observe both; and in process of time these monuments of Solon's wisdom became so famous, that all public acts were from them named *Axones* and *Cyrbes*.

48 He goes abroad for ten years. After the promulgation of the laws, Solon found himself obliged to leave Athens, to prevent his being continually teazed for explanations and alterations of them. He therefore pretended an inclination to merchandise, and obtained leave to absent himself for 10 years, during which time he hoped the laws would be grown familiar. From Athens Solon travelled into Egypt, where he conversed with Psenophis the Heliopolitan, and Sonchis the Saite, the most learned priests of that age. From these he learned the situation of the island Atlantis, of which he wrote an account in verse, which Plato afterwards continued *.

* See *Atlantis*.

 From

(B) The Athenians had a custom of hanging up billets to show that houses were engaged for such and such sums of money.

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From Egypt he went to Cyprus, where he was extremely well received by one of the petty kings. This prince lived in a city called *Apeia*, built by Demophon the son of Theseus, on an eminence near the river Clarius, but in a soil craggy and barren. Solon observing a very pleasant plain below, engaged the king to remove thither; assisted in executing the scheme he had formed; and succeeded so well, that a new city was formed, which soon became populous, and out of gratitude to the Athenian legislator was called *Solos*.

49 Things fall into disorder in his absence.

But while Solon was thus travelling in quest of wisdom, and with a view to benefit those among whom he came, his countrymen, who seem to have resolved on being dissatisfied at all events, had again divided themselves into three factions. Lycurgus put himself at the head of the country people; Megacles the son of Alcmæon was at the head of those who lived on the sea coast; and Pisistratus put himself at the head of the poorer sort, to protect them, as he pretended, from tyranny, but in reality to seize on the sovereignty for himself. All the factions pretended to have a vast regard for Solon and his laws, at the same time that they were very desirous of a change; but how they were to be bettered, none of them knew, or pretended to know.

50 He returns to Athens, but refuses to resume his office.

In the midst of this confusion the legislator returned. Each of the factions paid their court to him, and affected to receive him with the deepest reverence and respect; beseeching him to reassume his authority, and compose the disorders which they themselves kept up. This Solon declined on account of his age, which, he said, rendered him unable to speak and act for the good of his country as formerly; however, he sent for the chiefs of each party, beseeching them in the most pathetic manner not to ruin their common parent, but to prefer the public good to their own private interest.

Pisistratus, who of all the three had perhaps the least intention to follow Solon's advice, seemed to be the most affected with his discourses; but as Solon perceived he affected popularity by all possible methods, he easily penetrated into his designs of assuming the sovereign power. This he spoke of to Pisistratus himself, at first privately; but as he saw that his admonitions in this way had no effect, he then said the same things to others, that the public might be on their guard against him.

51 Pisistratus assumes the sovereignty.

All the wise discourses of Solon, however, were lost upon the Athenians. Pisistratus had got the meaner sort entirely at his devotion, and therefore resolved to cheat them out of the liberty which they certainly deserved to lose. With this view he wounded himself, and, as Herodotus says, the mules that drew his chariot; then he drove into the market-place, and there showed his bleeding body, imploring the protection of the people from those whom his kindness to them had rendered his implacable enemies. A concourse of people being instantly formed, Solon came among the rest, and suspecting the deceit, openly taxed Pisistratus with his perfidious conduct; but to no purpose. A general assembly of the people was called, wherein it was moved by one Ariston, that Pisistratus should have a guard. Solon was the only person present who had resolution enough to oppose this measure; the richer Athenians, perceiving that the multitude implicitly followed Pisistratus, and applauded every thing he said, remaining silent through fear. Solon himself, when he saw he could prevail nothing, left the assembly, saying he was *wiser* than some, and *stouter* than others. A guard of 400 men was now unanimously decreed to Pisistratus, as we are told by Solon himself. This inconsiderable body he made use of to enslave the people, but in what manner he accomplished his purpose is not agreed. Certain it is, that with his guard he seized the citadel; but Polyænus hath given an account of a very singular method which he took to put it out of the power of the Athenians to defend themselves even against such a small number. He summoned an assembly to be held at the Anacium, and directed that the people should come thither armed. They accordingly came; and Pisistratus harangued them, but in a voice so low that they could not tell what he said. The people complaining of this, Pisistratus told them that they were hindered from hearing him by the clangour of their arms; but if they would lay them down in the portico, he would then be heard distinctly. This they did; and while they listened very attentively to a long and eloquent oration, Pisistratus's guard conveyed away their arms, so that they found themselves deprived of all power of resistance. During the confusion which followed this event, another assembly was held, wherein Solon inveighed bitterly against the meanness of his countrymen, inviting them to take up arms in defence of their liberty. When he saw that nothing would do, he laid down his own arms, saying, that he had done his utmost for his country and his laws. According to Plutarch, he refused to quit the city; but the most probable opinion is, that he immediately retired from the dominion of Athens, and refused to return, even at the solicitation of Pisistratus himself.

52 Solon leaves Athens.

53 Pisistratus governs with great moderation.

Pisistratus having thus obtained the sovereignty, did not overturn the laws of Solon, but used his power with the greatest moderation. It is not to be expected, however, that so turbulent a people as the Athenians could be satisfied by any method of government he could lay down. At the beginning of his administration, Megacles and his family retired out of Athens to save their own lives, yet without despairing of being able some time or other to return. With this view Megacles and his associates entered into a treaty with Lycurgus; and having brought him and his party into a scheme for deposing Pisistratus, they concerted matters so well, that Pisistratus was soon obliged to seek for shelter somewhere else, and, on his departure, the Athenians ordered his goods to be sold. Nobody, however, except one person (*Callias*) would venture to buy any of them, from an apprehension, no doubt, that they would soon be restored to their proper owner, which accordingly happened in a very short time.

54 Driven out by Megacles.

55 Who soon after reinstates him.

As Megacles and his party had negociated with Lycurgus to turn out Pisistratus, so they now entered into a treaty with Pisistratus to reinstate him in his principality, as soon as they found Lycurgus would not be implicitly governed by them. To accomplish this, they fell upon a very ridiculous project; which, however, was attended with the desired success. They found out a woman whose name was *Phya*, of a mean family and fortune, but of a great stature, and very handsome. Her

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Attica.

Her they dressed in armour, placed her in a chariot, and having disposed things so as to make her appear with all possible advantage, they conducted her towards the city, sending heralds before, with orders to speak to the people in the following terms: "Give a kind reception, O Athenians, to Pisistratus, who is so much honoured by Minerva above all other men, that she herself condescends to bring him back to the citadel." The report being universally spread that Minerva was bringing home Pisistratus, and the ignorant multitude believing this woman to be the goddess, addressed their prayers to her, and received Pisistratus with the utmost joy. When he had recovered the sovereignty, Pisistratus married the daughter of Megacles as he had promised, and gave the pretended goddess to his son Hipparchus.

56 Driven out a second time;

Pisistratus did not long enjoy the kingdom to which he had been restored in so strange a manner. He had married the daughter of Megacles, as already observed; but having children by a former wife, and remembering that the whole family of Megacles was reprobated by the Athenians, he thought proper to let his new spouse remain in a state of perpetual widowhood. This she patiently bore for some time, but at last acquainted her mother. An affront so grievous could not fail to be highly resented. Megacles instantly entered into a treaty with the maleconteuts, of whom there were always great plenty at Athens whatever was the form of government. This Pisistratus being apprized of, and perceiving a new storm gathering, he voluntarily quitted Athens, and retired to Eretria. Here having consulted with his sons, it was resolved to reduce Athens by force. With this view he applied to several of the Greek states, who furnished him with the troops he desired, but the Thebans exceeded all the rest in their liberality; and with this army he returned to Attica, according to Herodotus, in the 11th year of his banishment. They first reduced Marathon, the inhabitants of which had taken no measures for their defence, though they knew that Pisistratus was preparing to attack them. The republican forces in the mean time marched out of Athens to attack him; but behaving in a secure and careless manner, they were surprised by Pisistratus, and totally routed. While they were endeavouring to make their escape, he caused his two sons to ride before him with all speed, and tell those they came up with that nobody had any thing to fear, but that they might every one return to his own home. This stratagem so effectually dispersed the republican army, that it was impossible to rally them, and Pisistratus became a third time absolute master of Attica.

57 but returns with an army.

58 He takes possession of the city.

59 His subjects still discontented notwithstanding his moderation.

Pisistratus being once more in possession of the sovereignty, took a method of establishing himself on the throne directly opposite to what Theseus had done. Instead of collecting the inhabitants from the country into cities, Pisistratus made them retire from the cities into the country, in order to apply themselves to agriculture. This prevented their meeting together, and caballing against him in such bodies as they had been accustomed to do. By this means also the territory of Athens was greatly meliorated, and great plantations of olives were made over all Attica, which had before not only been destitute of corn, but also bare of trees. He also commanded, that, in the city, men should wear a kind of sheep-skin vest, reaching to the knees; but so intolerable were the laws of Pisistratus to his subjects, that this kind of garment in succeeding times became proverbially the habit of slavery.

As prince of Athens, Pisistratus received the tenth part of every man's revenues, and even of the fruits of the earth; and this also, though for the service of the state, seemed to the Athenians a most grievous burden. In short, though Pisistratus behaved in all respects as a most excellent prince, his subjects fancied themselves oppressed by tyranny, and were perpetually grumbling from the time he first ascended the throne to the day of his death, which happened about 33 years after he had first assumed the sovereignty, of which time, according to Aristotle, he reigned 17 years.

60 Hipparchus and Hippias.

Pisistratus left behind him two sons named *Hipparchus* and *Hippias*, both men of great abilities, who shared the government between them, and behaved with lenity and moderation. But though by the mildness of their government the family of the Pisistratidæ seemed to be fully established on the throne of Athens, a conspiracy was unexpectedly formed against both the brothers, by which Hipparchus was taken off, and Hippias narrowly escaped. The most material facts relating to this conspiracy are what follow.

61 Conspiracy of Harmodius and Aristogiton.

There were at that time in Athens two young men, called *Harmodius* and *Aristogiton;* the former of these was exquisitely beautiful in his person, and on that account, according to the infamous custom of the Greeks, violently beloved of the other. This Harmodius was also beloved of Hipparchus; who, if we may believe Thucydides, forced him. This was grievously resented, and revenge determined on; to hasten which, another accident concurred. Hipparchus, finding that Harmodius endeavoured to avoid him, publicly affronted him, by not suffering his sister to carry the offering of Minerva, as if she was a person unworthy of that office. The two young men, not daring to show any public signs of resentment, consulted privately with their friends; among whom it was resolved, that at the approaching festival of Panathenæa, when the citizens were allowed to appear in arms, they should attempt to restore Athens to its former liberty. In this they imagined that they should find themselves seconded by the whole body of the people. But when the day appointed was come, they perceived one of their number talking very familiarly with Hippias; and fearing that they were discovered, they immediately fell upon Hipparchus, and despatched him with a multitude of wounds. In this exploit the people were so far from seconding them, as they expected, that they suffered Harmodius to be killed by Hipparchus's guards, and seizing Aristogiton themselves, delivered him up to Hippias. Some time afterwards, however, the respect they paid to these two young men exceeded all bounds. They caused their praises to be sung at the Panathenæa, forbade any citizen to call a slave by either of their names, and erected brazen statues to them in the forum; which statues were afterwards carried into Persia by Xerxes, and sent back from thence by Alexander the Great, Antiochus, or Seleucus, for authors are not agreed by which. Several immunities and privileges were also granted to the descendants of these

62 Hipparchus killed.

63 The conspirators extravagantly honoured.

these two patriots, and all possible means were taken to render their memory venerable and respected by posterity.

64 Cruelty of Hippias.

Hippias being now sole master of Athens, and probably exasperated by the murder of his brother, began to alter his conduct greatly, and treat his subjects in an oppressive and cruel manner. He began with torturing Aristogiton, in order to make him confess his accomplices: but this proved fatal to his own friends: for Aristogiton impeaching such as he knew to be best affected to Hippias, they were immediately put to death; and when he had destroyed all those he knew, at last told Hippias, that now he knew of none that deserved to suffer death except the tyrant himself. Hippias next vented his rage on a woman named *Leæna*, who was kept by Aristogiton. She endured the torture as long as she could; but finding herself unable to bear it any longer, she at last bit off her tongue, that she might not have it in her power to make any discovery. To her the Athenians erected the statue of a lioness, alluding to her name, without a tongue, on which was engraved a suitable inscription.

After the conspiracy was, as Hippias thought, thoroughly quashed, he set himself about strengthening his government by all the means he could think of. He contracted leagues with foreign princes, increased his revenues by various methods, &c. But these precautions were of little avail; the lenity of Pisistratus's government had alone supported it; and Hippias pursuing contrary methods, was deprived of his sovereignty in less than four years after the death of his brother.

65 He is driven out of Athens;

This revolution was likewise owing to the family of Megacles, who were styled *Alcmæonidæ*, and had settled at Lipsydrum. In times of discontent, which at Athens were very frequent, this family was the common refuge of all who fled from that city; and at last they thought of a method of expelling the Pisistratidæ altogether. The method they took to accomplish their purpose was as follows. The agreed with the Amphictyons to rebuild the temple at Delphi; and being possessed of immense riches, they performed their engagement in a much more magnificent manner than they were bound to do; for having agreed only to build the front of common stone, they built it of Parian marble. At the same time they corrupted the prophetess Pythia, engaging her to exhort all the Lacedæmonians that came to consult the oracle either in behalf of the state, or their own private affairs, to attempt the delivery of Athens. This had the desired effect: the Lacedæmonians, surprised at hearing this admonition incessantly repeated, at last resolved to obey the divine command, as they imagined it to be; and sent Anchimolius, a man of great quality, at the head of an army, into Attica, though they were at that time in league with Hippias, and accounted by him his good friends and alies. Hippias demanding assistance from the Thessalians, they readily sent him 1000 horse, under the command of one of their princes named *Sineas*. The Lacedæmonians being landed, Hippias fell upon them so suddenly, that he defeated them with great slaughter, killed their general, and forced the shattered remains of their army to fly to their ships. The Spartans, incensed at this unfortunate expedition, determined to send another army into Attica; which they accordingly did soon after under their king Cleomenes: and he having, at his entrance into the Athenian territories, defeated the Thessalian horse, obliged Hippias to shut himself up in the city of Athens, which he was soon after forced to abandon altogether. He was, however, in no want of a place of refuge; the Thessalian princes inviting him into their country, and the king of Macedon offering his family a city and territory, if they choose to retire into his dominions. 66
But Hippias chose rather to go to the city of Sigeum, and retires
which Pisistratus had conquered, and left to his own to Sigeum.
family.

After the expulsion of the Pisistratidæ, the Athenians did not long enjoy the quiet they had proposed to themselves. 67 They were quickly divided into two factions; at the head of one was Clysthenes, one of the chief of the Alcmæonidæ; and of the other, Isagoras, a man of great quality, and highly in favour with the Athenian nobility. Clysthenes applied himself to the people, and endeavoured to gain their affection by increasing their power as much as possible. Isagoras perceiving that by this means his rival would get the better, applied to the Lacedæmonians for assistance, reviving at the same time the old story of Megacles's sacrilege, and insisting that Clysthenes ought to be banished as being of the family of Megacles. 68 Cleomenes king of Sparta readily came into his measures, and suddenly despatched a herald to Athens with a declaration of war in case all the Alcmæonidæ were not immediately banished. The Athenians did not hesitate to banish their benefactor Clysthenes, and all his relations; but this piece of ingratitude did not answer their purpose. Cleomenes entered Attica at the head of a Spartan army; and, arriving at Athens, condemned to banishment 700 families more than what had been sent into exile before. Not content with this, he would have dissolved the senate, and vested the government in 300 of the chief of Isagoras's faction. This the Athenians would by no means submit to; and therefore took up arms, and drove Cleomenes and his troops into the citadel, where they were besieged for two days. On the third day Cleomenes surrendered on condition that all those who were in the citadel should retire unmolested. This, though agreed to, was not performed by the Athenians. They fell upon such as were separated from the army, and put them to death without mercy. Among the number of those slain on this occasion was Timesitheus the brother of Cleomenes himself.

Two factions in Athens.

The Spartans support Isagoras;

The Spartan king was no sooner withdrawn from Athens, than he formed a strong combination in favour of Isagoras. 69 He engaged the Bœotians to attack Attica on the one side, and the Chalcidians on the other, while he at the head of a powerful Spartan army entered the territories of Eleusina. In this distress, the Athenians, not being able to cope with so many enemies at once, resolved to suffer their territories to be ravaged by the Chalcidians and Bœotians, contenting themselves with opposing the army commanded by Cleomenes in person. But this powerful confederacy was quickly dissolved: the Corinthians, who were allied with Cleomenes, doubting the justice of their cause, returned home; his other allies likewise beginning to waver, and his colleague Ariston the other king of Sparta, differing in sentiments, Cleomenes

but without success.

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menes was obliged to abandon the enterprise. The Spartans and their allies being withdrawn, the Athenians took a severe revenge of the Bœotians and Chalcidians, totally routing their forces, and carrying off a great number of prisoners. The prisoners taken in this war were put in irons, but afterwards set at liberty on paying a ransom of two minæ per head. Their fetters were, however, hung up in the citadel; and the Athenians consecrating the tenth of what they had received for ransom, purchased a statue, representing a chariot and four horses, which they set up in the portico of the citadel, with a triumphant inscription in token of their victory.

70
Bœotians and Chalcidians defeated.

These indignities rousing the Bœotians, they immediately vowed revenge, and engaged on their side the people of Ægina, who had an hereditary hatred at the Athenians; and while the latter bent all their attention to the Bœotian war, the Æginetans landing a considerable army, ravaged the coasts of Attica.

71
Attempt of the Spartans to restore Hippias.

But while the Athenians were thus employed against the Bœotians and Æginetans, a jealousy sprung up on the part of Lacedæmon, which was never afterwards eradicated. Cleomenes, after his unsuccessful expedition against Attica, produced at Sparta certain oracles which he said he had found in the citadel of Athens while he was besieged therein: the purport of these oracles was, that Athens would in time become a rival to Sparta. At the same time it was discovered, that Clysthenes had bribed the priestess of Apollo to cause the Lacedæmonians to expel the Pisistratidæ from Athens; which was sacrificing their best friends to those whom interest obliged to be their enemies. This had such an effect, that the Spartans, repenting their folly in expelling Hippias, sent for him from Sigeum, in order to restore him to his principality: but this not being agreed to by the rest of the states, they were forced to abandon the enterprise, and Hippias returned to Sigeum as he came.

72
Cause of the war with Persia.

About this time, too, Aristagoras the Milesian having set on foot a revolt in Ionia against the Persian king, applied to the Spartans for assistance; but they declining to have any hand in the matter, he next applied to the Athenians, and was by them furnished with 20 ships under the command of Melanthus, a nobleman universally esteemed. This rash action cost the Greeks very dear, as it brought upon them the whole power of the Persian empire; for no sooner did the king of Persia hear of the assistance sent from Athens to his rebellious subjects, than he declared himself the sworn enemy of that city, and solemnly besought God that he might one day have it in his power to be revenged on them.

The Ionian war being ended, by the reduction of that country again under the Persian government, the king of Persia sent to demand earth and water as tokens of submission from the Greeks. Most of the islanders yielded to this command out of fear, and among the rest the people of Ægina; upon which the Athenians accused the inhabitants of this island of treachery towards Greece, and a war was carried on with them for a long time. How it ended we are not informed; but its continuance was fortunate for Greece in general, as, by inuring them to war, and sea-affairs in particular, it prevented the whole of the Grecian states from being swallowed up by the Persians, who were now about to invade them.

Besides the displeasure which Darius had conceived against the Athenians on account of the assistance they had afforded the Ionians, he was further engaged to an expedition against Greece by the intrigues of Hippias. Immediately on his returning unsuccessfully from Lacedæmon, as above related, Hippias passed over into Asia, went to Artaphernes, governor of the adjacent provinces belonging to the Persian king, and excited him to make war upon his country, promising to be obedient to the Persian monarch provided he was restored to the principality of Athens. Of this the Athenians being apprised, sent ambassadors to Artaphernes, desiring leave to enjoy their liberty in quiet: but that nobleman returned for answer, that if they would have peace with the great king, they must immediately receive Hippias; upon which answer the Athenians resolved to assist the enemies of Darius as much as possible. The consequence of this resolution was, that Darius commissioned Mardonius to revenge him of the insults he thought the Greeks had offered him. But Mardonius having met with a storm at sea, and other accidents which rendered him unable to do any thing, Datis and Artaphernes the son of Artaphernes above mentioned, were commissioned to do what he was to have done.

73
Hippias applies to the Persians.

The Persian commanders, fearing again to attempt to double the promontory of Athos, where their fleet had formerly suffered, drew their forces into the plains of Cilicia: and passing from thence through the Cyclades to Eubœa, directed their course to Athens. Their charge from Darius was to destroy both Eretria and Athens; and to bring away the inhabitants, that they might be at his disposal. Their first attempt was on Eretria, the inhabitants of which sent to Athens for assistance on the first approach of the Persian fleet. The Athenians, with a magnanimity almost unparalleled at such a juncture, sent 4000 men to their assistance; but the Eretrians were so much divided amongst themselves, that nothing could be resolved on. One party among them was for receiving the Athenian succours into the city; another, for abandoning the city and retiring into the mountains of Eubœa; while a third sought to betray their country to the Persians for their own private interest. Seeing things in this situation, therefore, and that no good could possibly be done, one Æschines, a man of great authority among the Eretrians, generously informed the Athenian commanders that they might return home. They accordingly retired to Oropus, by which means they escaped destruction: for Eretria being soon after betrayed to the Persians, was pillaged, burnt, and its inhabitants sold for slaves.

74
They invade Greece.

75
Eretria destroyed.

On the news of this disaster the Athenians immediately drew together all the forces they were able, which after all amounted to no more than 9000 men. These, with 1000 Platæans who afterwards joined them, were commanded by ten general officers, who had equal power; among whom were Miltiades, Aristides, and Themistocles, men of distinguished valour and great abilities. But it being generally imagined that so small a body of troops would be unable to resist the formidable power of the Persians, a messenger was despatched

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Attica. patched to Sparta to entreat the immediate assistance of that state. He communicated his business to the senate in the following terms: "Men of Lacedæmon, the Athenians desire you to assist them, and not to suffer the most ancient of all the Grecian cities to be enslaved by the barbarians. Eretria is already destroyed, and Greece consequently weakened by the loss of so considerable a place." The assistance was readily granted; but at the same time the succours arrived so slowly, that the Athenians were forced to fight without them. In this memorable engagement in the plains of Marathon, whither Hippias had conducted the Persians, the latter were defeated with the loss of 6300 men, while the Greeks lost only 192. The Persians being thus driven to their ships, endeavoured to double Cape Sunium, in order to surprise Athens itself before the army could return: but in this they were prevented by Miltiades; who, leaving Aristides with 1000 men to guard the prisoners, returned so expeditiously with the other 9000, that he was at the temple of Hercules, which was but a small way distant, before the barbarians could attack the city.

76 Persians defeated at Marathon.

77 Integrity of Aristides.

After the battle, Aristides discharged the trust reposed in him with the greatest integrity. Though there was much gold and silver in the Persian camp, and the tents and ships they had taken were filled with all sorts of riches, he not only forbore touching any thing himself, but to the utmost of his power prevented others from doing it. Some, however, found means to enrich themselves; among the rest, one Callias, cousin-german to Aristides himself. This man being a torch-bearer, and, in virtue of his office, having a fillet on his head, one of the Persians took him for a king, and, falling down at his feet, discovered to him a vast quantity of gold hid in a well. Callias not only seized, and applied it to his own use, but had the cruelty to kill the poor man who dicovered it to him, that he might not mention it to others; by which infamous action he entailed on his posterity the name of *Laccopluti*, or *enriched by the well.*

78 Miltiades ungratefully treated by the Athenians.

After the battle of Marathon, all the inhabitants of Platæa were declared free citizens of Athens, and Miltiades, Themistocles, and Aristides were treated with all possible marks of gratitude and respect. This, however, was but very short-lived; Miltiades proposed an expedition against the island of Paros, in which having been unsuccessful, through what cause is not well known, he was, on his return, accused and condemned to pay 50 talents, the whole expence of the scheme; and, being unable to pay the debt, was thrown into prison, where he soon died of a wound received at Paros.

79 As likewise Aristides.

If any thing can exceed the enormity of such a proceeding as this, it was the treatment Aristides next received. Miltiades had proposed an expedition, which had not proved successful, and in which he might possibly have had bad designs; but against Aristides not so much as a shadow of guilt was pretended. On the contrary, his extraordinary virtue had procured him the title of *Just*, and he had never been found to swerve from the maxims of equity. His downfal was occasioned by the intrigues of Themistocles; who being a man of great abilities, and hating Aristides on account of the character he deservedly bore among his countrymen, took all opportunities of insinuating, that his rival had in fact made himself master of Athens without the parade of guards and royalty. "He gives laws to the people (said he); and what constitutes a tyrant, but giving laws?" In consequence of this strange argument, a strong party was formed against the virtuous Aristides, and it was resolved to banish him for 10 years by the ostracism. In this case, the name of the person to be banished was written upon a shell by every one who desired his exile, and carried to a certain place within the forum enclosed with rails. If the number of shells so collected exceeded 6000, the sentence was inflicted; if not, it was otherwise. When the agents of Themistocles had sufficiently accomplished their purpose, on a sudden the people flocked to the forum, desiring the ostracism. One of the clowns who had come from a borough in the country, bringing a shell to Aristides, said to him, "Write me Aristides upon this." Aristides, surprised, asked him if he knew any ill of that Athenian, or if he had ever done him any hurt? "Me hurt! (said the fellow), no, I don't so much as know him; but I am weary and sick at heart on hearing him everywhere called *the just*." Aristides, thereupon, took the shell, and wrote his own name upon it; and when informed that the ostracism fell upon him, modestly retired out of the forum, saying, "I beseech the gods that the Athenians may never see that day which shall force them to remember Aristides."

After the battle of Marathon, the war with Ægina was revived with great vigour; but the Æginetans generally had the superiority, on account of their great naval power. Themistocles observing this, was continually exhorting his countrymen to build a fleet, not only to make them an equal match for the Æginetans, but also because he was of opinion that the Persians would soon pay them another visit. At last, he had the boldness to propose, that the money produced by the silver mines, which the Athenians had hitherto divided among themselves, should be applied to the building of a fleet: which proposal being complied with, 100 galleys were immediately put upon the stocks; and this sudden increase of their maritime power proved the means of saving all Greece from slavery.

80 Themistocles advises the building of a fleet.

About three years after the banishment of Aristides, Xerxes king of Persia sent to demand earth and water: but Themistocles desiring to make the breach with that monarch still wider, put to death the interpreter for publishing the decree of the king of Persia in the language of the Greeks; and having prevailed upon the several states to lay aside their animosities and provide for their common safety, got himself elected general of the Athenian army.

81 Xerxes invades Greece.

When the news arrived that the Persians were advancing to invade Greece by the straits of Thermopylæ, and that they were for this purpose transporting their forces by sea, Themistocles advised his countrymen to quit the city, embark on board their galleys, and meet their enemies while yet at a distance. This they would by no means comply with; for which reason Themistocles put himself at the head of the army, and having joined the Lacedæmonians, marched towards Tempe. Here, having received advice that the straits of Thermopylæ were forced, and that both Bœotia and Thessaly

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Thessaly had submitted to the Persians, the army returned without doing any thing.

In this distress the Athenians applied to the oracle at Delphi: from whence they received at first a very severe answer, threatening them with total destruction; but after much humiliation, a more favourable one was delivered, in which, probably by the direction of Themistocles, they were promised safety in *walls of wood.* This was by Themistocles and the greatest part of the

82 Athens abandoned by its inhabitants,

citizens interpreted as a command to abandon Athens, and put all their hopes of safety in their fleet. Upon this, the opinion of Themistocles prevailing, the greatest part began to prepare for this embarkation; and had money distributed among them by the council of the Areopagus, to the amount of eight drachms per man: but this not proving sufficient, Themistocles gave out that somebody had stolen the shield of Minerva; under pretence of searching for which, he seized on all the money he could find. Some, however, there were who refused to embark with the rest, but raised to themselves fortifications of wood; understanding the oracle in its literal sense, and resolving to wait the arrival of the Persians, and defend themselves to the last. In the mean time Aristides was recalled, when the Athenians saw it their interest, lest he should have gone over to the Persians and assisted them with his advice.

83 and destroyed by the Persians.

The Persians having advanced to Athens soon after the inhabitants had deserted it, met with no opposition except from a few just now mentioned; who, as they would hearken to no terms of accommodation, were all

84 They are totally defeated at Salamis.

cut in pieces, and the city utterly destroyed. Xerxes, however, being defeated in a sea fight at Salamis, was forced to fly with prodigious loss. See SALAMIS. Themistocles was for pursuing him, and breaking down the bridge he had cast over the Hellespont; but this advice being rejected, he sent a trusty messenger to Xerxes, acquainting him that the Greeks intended to break down his bridge, and therefore desired him to make all the haste he could, lest by that means he should be shut up in Europe. According to Herodotus, he also advised the Athenians to quit the pursuit and return home, in order to rebuild their ruined houses. This advice, though misinterpreted by some, was certainly a very prudent one, as Xerxes, though once defeated, was still at the head of an army capable of destroying all Greece; and had he been driven to despair by finding himself shut up or warmly pursued, it was impossible to say what might have been the event. After this, Themistocles formed a scheme for the aggrandisement of Athens indeed, but a most unjust and infamous one. It was, in short, to make Athens mistress of the sea, by burning all the ships except those belonging to that republic. He told his countrymen, that he had something to propose of great consequence, but which could not be spoken publicly: whereupon he was desired to communicate it to Aristides, by whom the proposal was rejected; and Aristides having informed the Athenians that what Themistocles had said was very advantageous but very unjust, they desired him to think no more of it.

85 Themistocles honoured by the Lacedæmonians.

When the fleet returned to Salamis, extraordinary honours were paid to Themistocles by the Lacedæmonians. On his entering that city, they decreed him a wreath of olives as the prize of prudence; presented him with the most magnificent chariot in Sparta: and when he returned to Athens, he was escorted by 500 horse, an honour never paid to any stranger but himself. On his arrival at Athens, however, there were not wanting some who insinuated that the receiving such honours from the Lacedæmonians was injurious to the republic; but Themistocles, confiding in his innocence, treated these clamours with contempt, and exhorted his countrymen to entertain no doubts of their allies, but rather endeavour to preserve the great reputation they had acquired throughout all Greece.

The defeat of Xerxes at Salamis made Mardonius, who was left to carry on the war by land, more ready to treat with the Athenians than to fight them; and with this view he sent Alexander king of Macedon to Athens to make proposals of alliance with that republic, exclusively of all the other Grecian states. This

86 Athens a second time destroyed.

proposal, however, was rejected; and the consequence was, that Athens was a second time destroyed, the Spartans sending assistance so slowly, that the Athenians were forced to retire to Salamis; but they were soon

87 The Persians defeated at Platæa and Mycale.

freed from all apprehensions by the total defeat and death of Mardonius at Platæa; where Aristides, and the body of troops under his command, distinguished themselves in a most extraordinary manner.

The same day that the battle of Platæa was fought, the Persians were defeated in a sea-fight at Mycale in Ionia, wherein it was allowed that the Athenians who were there behaved better than any of the other Greeks; but when it was proposed to transport the Ionians into Europe, that they might be in perfect safety, and give them the territories of such Grecian states as had sided with the Persians, the Athenians refused to comply, fearing the Ionians would rival them in trade, or refuse the obedience they used to pay them; besides which, they would then lose the opportunity of plundering the Persians in case of any quarrel with Ionia. Before they returned home, however, the Athenians crossed over to the Chersonesus, and besieged Sestos. The siege was

88 Sestos taken by the Athenians.

long and troublesome: but at last the garrison, being pressed with hunger, and having no hopes of relief, divided themselves into two bodies, and endeavoured to make their escape; but were pursued, and all either killed or taken. *Oibazus*, one of their commanders, was sacrificed to a Thracian god; and the other, called *Artyactes*, impaled alive, and his son stoned before his face, because he had rifled the sepulchre of Protesilaus.

89 They rebuild their city.

After the victories at Platæa and Mycale, the Athenians returned without any apprehension, and began to rebuild their city in a more magnificent manner than before. Here they were no sooner arrived than a dispute was ready to be commenced about the form of government. The commons, with Themistocles at their head, were for a democracy; to which Aristides, rather than hazard the raising disturbances, consented. It was therefore proposed, that every citizen should have an equal right to the government; and that the archons should be chosen out of the body of the people, without preference or distinction: and this proposal being agreed to, put an end to all discontents for the present.

At this time also Themistocles proposed that the city of Athens should be fortified in the best manner possible, that it might not be liable to be again destroyed,

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Attica when the Persians should take it into their heads to invade Greece. At this proposal the Lacedæmonians were exceedingly alarmed; and therefore remonstrated,

90 Themistocles advises to fortify Athens, and deceives the Spartans who oppose it.

that should Athens once be strongly fortified, and the Persians become possessed of it, it would be impossible to get them out of it again. At last, seeing these arguments had no effect, they absolutely forbade the Athenians to carry their walls any higher. This command gave great offence; but Themistocles, considering the power of Sparta at that time, advised the Athenians to temporize; and to assure the ambassadors that they should proceed no farther in their work, till, by an embassy of their own, satisfaction should be given to their allies. Being named ambassador at his own desire to Sparta, with some other Athenians, Themistocles set out alone, telling the senate that it would be for the interest of the state to delay sending the other ambassadors as long as possible. When arrived at Sparta, he put off from time to time receiving an audience, on account of his colleagues not being arrived: but in the mean time the walls of Athens were building with the utmost expedition; neither houses nor sepulchres being spared for materials; and men, women, children, strangers, citizens, and servants, working without intermission. Of this the Lacedæmonians having notice, and the rest of the Athenian ambassadors being arrived, Themistocles and his colleagues were summoned before the ephori, who immediately began to exclaim against the Athenians for their breach of promise. Themistocles denied the charge: he said his colleagues assured him of the contrary: that it did not become a great state to give heed to vague reports, but that deputies ought to be sent from Sparta to inquire into the truth of the matter, and that he himself would remain as a hostage, to be answerable for the event. This being agreed to, he engaged his associates to advise the Athenians to commit the Spartan ambassadors to safe custody till he should be released; after which he publicly avowed the whole transaction, took the scheme upon himself, and told the Lacedæmonians that "all things are lawful for our country." The Spartans, seeing no remedy, concealed their resentment, and sent Themistocles home in safety.

91 Makes the Pyræus the port of Athens.

The next year, being the last of the 75th Olympiad, Themistocles observing the inconvenience of the port Phalerum, thought of making the *Pyræus* the port of Athens. This he did not at first think proper to mention publicly; but having signified to the people that he had something of importance to communicate, they appointed Xanthippus and Aristides to judge of his proposal. They readily came into his measures, and told the people that what Themistocles proposed would be of the utmost advantage to the state, at the same time that it might be performed with ease. Upon this they were desired to lay the matter before the senate; who coming unanimously into their measures, ambassadors were depatched to Sparta to insinuate there how proper it would be for the Greeks to have some great port, where a fleet might always watch the designs of the Persians; and thus having prevented any umbrage from their first undertakings, the work was set about with such expedition, that it was finished before the Lacedæmonians knew well what they were about.

At this time also the sovereignty of the sea was transferred from Sparta to Athens, through the haughty behaviour of Pausanias the Lacedæmonian. He had commanded at Platæa, and still enjoyed the supreme authority in the war which was all this time carrying on against the Persians; but being elated with his success at Platæa, and having entered into a treasonable correspondence with the enemy, he treated the captains under his command with the greatest haughtiness, giving the preference to the Spartans in such a manner that the rest of the Greeks could no longer bear his insolence. On the contrary, Aristides, and Cimon the son of Miltiades, who commanded the Athenians, by their obliging behaviour gained the favour of every body; so that the allies, having publicly affronted Pausanias, put themselves under the protection of the Athenian republic; and thenceforward the Athenians, and not the Lacedæmonians, had the supreme command.

92 Sovereignty of the sea transferred to Athens.

93 Aristides taxes Greece with extraordinary applause.

The Greeks being now sensible that they would always have occasion to be on their guard against the Persians, and that it was necessary to establish a fund by a common taxation of all the states, Aristides was pitched upon as the only person that could be trusted with the power of allotting to each of the states its proper quota. This difficult task he undertook, and executed in a manner unparalleled in the annals of history. All parties were pleased, and his taxation was styled *the happy lot of Greece*. The gross amount of it was 450 talents.

94 Themistocles banished.

It now came to the turn of Themistocles to experience the ingratitude of his countrymen. His services had been so essential, that the treatment he received may perhaps be a sufficient excuse for modern patriots when they connect their own interest with the service of their country. Themistocles had plainly saved the state from ruin by his advice; he had distinguished himself by his valour; had rendered Athens, by his policy, superior to the other states of Greece; and entirely subverted the Lacedæmonian scheme of power. Yet, notwithstanding all this, he was banished by the ostracism, without the smallest crime pretended, unless that he was hated by the Lacedæmonians, and that he had erected a temple, near his own house, dedicated to *Diana, the giver of the best counsel;* intimating that he himself had given the best counsel for the safety both of Athens and of all Greece, which was no more than the truth. Nay, he was not only driven out of Athens, but out of all Greece; so that he was forced to seek shelter from the king of Persia, against whom he had fought with so much valour. That monarch gave him a gracious reception; and he was never recalled, because the Greeks had no occasion for his services.

95 Success of Cimon against the Persians.

The war with Persia was not yet discontinued; the Greeks found their advantage in plundering and enriching themselves with the spoils of the king of Persia's subjects. For this reason, in the end of the 77th Olympiad, they equipped a navy, under a pretence of relieving such of the Greek cities in Asia as were subject to the Persians. Of this fleet Cimon, the son of Miltiades by the daughter of the king of Thrace, was appointed commander in chief. He had already tasted the justice and generosity of his countrymen, having been thrown into prison for his father's fine, from which he was released by *Callias*, whom his sister Elpinice married on account of his great wealth procured by no very honourable means. He accepted of the command, however,

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Attica. however, and gained such immense booty in this expedition, that the Athenians were thereby enabled to lay the foundation of those long-extended walls which united the port to the city. The foundation was laid in a moorish ground; so that they were forced to sink it very deep, and at a great expence; but to this Cimon himself contributed out of his own share of the spoils, which was very considerable. He also adorned the forum with palm trees, and beautified the academy with delightful walks and fountains.

96 He subdues the Chersonesus. The Persians having soon after this expedition invaded the Chersonesus, and with the assistance of the Thracians made themselves masters of it, Cimon was sent against them in a great hurry. He had only four ships; but nevertheless with these he took 13 of the Persian galleys, and reduced the whole of the Chersonesus. After this he marched against the Thracians, who revolting against the Athenians, had made themselves masters of the gold mines lying between the rivers Nyssus and Strymon. The Thracians were quickly obliged to yield; after which the Athenians sent a great colony to Amphipolis, a city of Thrace, which for some time made a considerable figure, but afterwards attempting to penetrate into the country of the *Edones*, great part of them were destroyed.

97 Makes Athens irresistible at sea. Cimon also fell upon the following expedient to make Athens irresistible at sea by the other states of Greece. Many of the Greek states, by virtue of Aristides's taxation, were bound to furnish men and galleys as well as to pay the tax for their support. But when they saw themselves out of danger from the Persians, most of them were very unwilling to furnish their quota of men. This the Athenian generals being offended with, were for having recourse to force; but Cimon permitted such as were desirous of staying at home to do so, and accepted a sum of money in lieu of a galley completely manned. By this means he inured the Athenians, whom he took on board his galleys, to hardship and discipline; while the allies who remained at home became enervated through idleness, and from being confederates, dwindled into tributaries, and almost slaves. In the last year of the 77th Olympiad, Cimon was sent to assist the Lacedæmonians against their Helotes, who had revolted from them. In this he was attended with his usual success; but, some time after, the Lacedæmonians being engaged in the siege of Ithome, sent again to the Athenians for succour, and Cimon was a second time sent to their relief; but the Spartans having received a sufficient support of troops from other quarters before the arrival of the Athenian general, he and his men were dismissed without doing any thing. This grievously offended the people of Athens, who thenceforward hated not only the Lacedæmonians, but all their own citizens who were thought to be friends to that state.

98 He is banished. It was not possible, however, that any person who had served the state should escape banishment at Athens. Cimon had gained great wealth both to the public and to himself. In his public character he had behaved with unimpeached honesty, and as a private citizen he dedicated his wealth to the most excellent purposes. He demolished the enclosures about his grounds and gardens, permitting every one to enter and take what fruits they pleased; he kept an open table, where both rich and poor were plentifully entertained. If he met a citizen in a tattered suit of clothes, he made some of his attendants exchange with him; or if the quality of the person rendered that kindness unsuitable, he caused a sum of money to be privately given him. All this, however, was not sufficient: he did not concur with every measure of the commonalty; and therefore the popular party determined not to banish him, but to put him to death. The crime laid to his charge was, that by presents from the Macedonians he was prevailed upon to let slip a manifest opportunity of enlarging his conquests, after taking from the Persians the gold mines of Thrace. To this accusation Cimon replied, that to the utmost of his power he had prosecuted the war against the Thracians, and other enemies of the state of Athens; but that, it was true, he had not made any inroads into Macedonia, because he did not imagine he was to act as a public enemy of mankind, and because he was struck with respect for a nation modest in their carriage, just in their dealings, and strictly honourable in their behaviour towards him and the Athenians: that if his countrymen looked upon this as a crime, he must abide their judgment; but, for his part, he could never be brought to think such conduct amiss. Elpinice, Cimon's sister, used all her interest in his behalf, and amongst others spoke to Pericles the celebrated statesman and orator. He was indeed Cimon's rival, and had no doubt assisted in stirring up the prosecution against him; but he did not desire his death; and therefore, though appointed to accuse him, Pericles spoke in such a manner that it plainly appeared he did not think him guilty; and, in consequence of this lenity, Cimon was only banished by the ostracism.

The Athenian power was now risen to such a height, that all the other states of Peloponnesus looked upon this republic with a jealous eye, and were continually watching every opportunity of making war upon it when the state was engaged in troublesome affairs, and seemed to be less able to resist. These attempts, however, so far from lessening, generally contributed to increase, the power of the Athenians; but in the year before Christ 458, the republic entered into a war with Sparta, which was scarcely put an end to but by the destruction of the city of Athens. For this war, there was no recent provocation on the part of the Spartans. They had sent a great army to assist the Dorians against the Phocians, and the Athenians took this opportunity to revenge themselves of former quarrels. Having therefore drawn in the Argives and Thessalians to be their confederates, they posted themselves on the isthmus, so that the Spartan army could not return without engaging them. The Athenians and their confederates amounted to 14,000, and the Spartans to 11,500. The Spartan general, however, not very willing to hazard a battle, turned aside to Tanagra, a city in Bœotia, where some of the Athenians who inclined to aristocracy entered into a correspondence with him. But before their designs were ripe for execution, the Athenian army marched with great expedition to Tanagra, so that a battle became inevitable. When the armies were drawn up in order of battle, Cimon presented himself before his countrymen in complete armour, and went to take post among those of his own tribe; but the popular party raised such a clamour against him, that he was forced to retire. Before he departed, however, he exhorted Euthippus and the rest of his friends to behave in such a manner that they

99 War between Athens and Sparta.

100 Athenians defeated.

might wipe off the aspersion thrown upon him, as if he had designed to betray his country's cause to the Lacedæmonians. Euthippus desired him to leave his armour, which he did; and a battle ensuing, the Athenians were defeated with great loss, and Euthippus with the rest of Cimon's friends were all killed in defence of his armour which they had surrounded. Another engagement soon followed, wherein both armies suffered so much, that they were glad to conclude a short truce, that each might have time to recruit their shattered forces.

101 They gain great advantages over the Spartans.

The scale of fortune now seemed to turn in favour of the Athenians. The Thebans, who had been deprived of the command of Bœotia on account of their having sided with Xerxes, were now restored to it by the Lacedæmonians. At this the Athenians were so displeased, that they sent an army under Myronides the son of Callias into Bœotia to overturn all that had been done. That general was met by the Thebans and their allies, who composed a numerous and well-disciplined army. Nevertheless, though the Athenian army was but a handful in comparison of their enemies, Myronides gained a complete victory over the allies, in some sense more glorious than either that of Marathon or Platæa. In these battles they had fought against effeminate and ill-disciplined Persians, but now they encountered and defeated a superior army composed of the bravest Greeks. After this victory, Myronides marched to Tanagra, which he took by storm, and razed to the ground: he then plundered Bœotia; defeated another army which the Bœotians had drawn together to oppose him; then fell upon the Locrians; and having penetrated into Thessaly, chastised the inhabitants of that country for having revolted from the Athenians; and from thence returned to Athens laden with riches and glory.

The next year Tolmides the Athenian admiral invaded Laconia, where he made himself master of several places; and on the back of this, Pericles invaded Peloponnesus with great success, burning, spoiling, or

102 Cimon recalled.

taking, whatever places he attempted. On his return he found the people greatly out of humour on account of Cimon's banishment; so he was immediately recalled.

Cimon was no sooner returned than he fell to his old employment of plundering the Persians; and, according to Plutarch, he had now nothing less in view than the conquest of the whole Persian empire. The Persian monarch finding he could have no rest, at last sent orders to Artabazus and Megabizus, his commanders, to conclude a treaty; which was done on the following conditions: 1. That the Greek cities in Asia should be free, and governed by their own laws. 2. That the Persians should send no army within three days journey of the sea. 3. That no Persian ship of war should sail between Thesalis and Cyrene, the former a city of Pamphylia, and the latter of Lycia.

103 His death.

While this treaty was going on, Cimon died, whether of sickness or of a wound he had received is not known; and after his death the Athenian affairs began to fall into confusion. It was now the misfortune of this state to be alike hated by her enemies and allies; the consequence of which was, that the latter were perpetually revolting whenever they thought they had an opportunity of doing so with impunity. The Megarians, at this time, who had been long under the protection or dominion of Athens, thought proper for some reason or other to disclaim all dependence on their former protectors, and have recourse to Sparta, with which state they entered into a strict alliance. This the Athenians revenged by ravaging the country of the Megarians; which soon brought on a renewal of the Lacedæmonian war that had been for a little time suspended. Pericles, however, procured the return of the first Lacedæmonian army, without bloodshed, by bribing Chandrides the young king of Sparta's tutor. In the winter, Tolmides resolved to undertake an expedition into Bœotia with a small body of troops: which design he put in execution contrary to the advice of Pericles; and his rashness was soon punished by his own death and the total defeat of his army. Notwithstanding this misfortune, however, Pericles soon after invaded and reduced Eubœa; and the Lacedæmonians, finding it was not for their interest to carry on the war, concluded a truce with the Athenians for 30 years.

104 A thirty years truce with the Lacedæmonians.

About this time Psammiticus, king of Egypt, sent by way of present to the people of Athens 40,000 bushels of wheat; which proved a great misfortune to the city: for Pericles, out of spite to Cimon, who had children by an Arcadian woman, had preferred a law whereby the Athenians of the half blood were disfranchised; and this law, on account of the distribution of the corn above mentioned, was prosecuted with such severity, that no less than 5000 persons, who till then had been considered as free men, were sold for slaves. This piece of cruelty has been of great service to the critics, as by means of it we know exactly the number of Athenian citizens, which at this time amounted to no more than 14,040 persons, though Athens was now aiming at no less than erecting an universal monarchy.

105 Cruelty of Pericles.

106 Number of the Athenian citizens.

Six years after the conclusion of the peace between Athens and Sparta, a war broke out between the Samians and Milesians about the city of Priene, seated under Mount Mycale in Ionia. How this war came to affect the Athenians is not certainly known; but, somehow or other, this republic was induced to take the part of the Milesians; and the island of Samos was reduced by Pericles, who established there a democracy, and left an Athenian garrison. He was no sooner gone, however, than the Samians disliking their new form of government, drove out the garrison he had left; but Pericles quickly returning, besieged and took their city, demolished their walls, and fined them of the whole expence of the war; part of which he obliged them to pay down, and took hostages for the remainder. When Pericles returned, he procured himself to be appointed to pronounce the public oration in honour of those who fell: which he did with such eloquence, that when he came down from the pulpit the women gathered about him, took him by the hand, and crowned him with garlands.

107 Samos reduced by Pericles.

A little after this commenced the war between the Corcyrians and Corinthians, which by degrees brought the Athenians into those engagements that proved the ruin of their state. The causes of this war were the following. An intestine war breaking out in the little territory of Epidamnum, a city of Macedonia, founded by the Corcyrians, one party called in to their assistance

108 War between the Corcyrians and Corinthians.

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sistance the Illyrians, and the other the Corcyrians. The latter neglecting the matter, Corinth was applied to, as the Corcyrians were a colony from that place. The Corinthians, partly out of pity to the Epidamnians, and partly out of spleen to the Corcyrians, sent a very great fleet to the assistance of the former, by which means that party which had applied to Corinth was thoroughly established. This being resented by the Corcyrians, they sent a fleet to Epidamnum to support the exiles; and accordingly this fleet began to act offensively on its entering the port, the chief commanders having instructions to propose terms of accommodation, to which the Corinthians would by no means agree. The next year the Corcyrians defeated at sea the Corinthians and their allies, and took Epidamnum by storm; after which they wasted the territories of the allies of the Corinthians, which greatly exasperated the latter. At Corinth, therefore, they began to make great preparations for carrying on the war, and pressed their confederates to do the same, that they might be in a condition to retrieve the honour they had lost, and humble this ungrateful colony which had thus insulted her mother city.

The Corcyrians were no sooner acquainted with these proceedings, than they despatched ambassadors to Athens with their complaints; and these were quickly followed by others from Corinth on the same errand.

109 Athens sides with the Corcyrians.

At first the people of Athens inclined to favour the Corinthians: but they soon changed their minds, and took part with the Corcyrians: they contented themselves, however, with entering into a defensive alliance with that little state, whereby they promised to assist each other, in case either party should be attacked; and in consequence of this treaty, they furnished the Corcyrians with ten galleys, under Lacedæmonius the son of Cimon, with whom were joined Diotenes and Proteus as colleagues.

As soon as the season of the year permitted, the Corinthians sailed for the coast of Corcyra with a fleet of 150 ships, under the command of Xenoclides, assisted by four other Corinthian admirals; each squadron of their allies being commanded by a chief of their own. The Corcyrian and Athenian fleet amounted to 120, but the Athenians had orders to give as little assistance as possible. The action was very brisk for some time: the Corcyrian right wing broke the left of the Corinthian fleet; and forcing some of the ships on shore, landed, pillaged their camp, and made a great number of them prisoners; on the other hand, the Corinthian ships in the right wing beat the Corcyrian ships there, they being but very faintly assisted by the Athenians, till the latter were at last obliged to defend themselves, which they did so well, that the Corinthians were glad to retire. The next day preparations were made on both sides for another engagement; but 20 ships coming from Athens to the assistance of the Corcyrians; the Corinthians declined the combat.

110 Potidæa besieged by the Athenians.

As soon as the Corcyrian war broke out, the Athenians sent orders to the citizens of Potidæa to demolish a part of their wall, to send back the magistrates they had received from Corinth, and to give hostages for their own behaviour. Potidæa was a town in Macedonia, founded by the Corinthians, but at that time in alliance with the Athenians.—Perdiccas king of Macedon, who hated the Athenians, took this opportunity to persuade the Potidæans to revolt. Accordingly they sent ambassadors to Athens to entreat the revocation of these orders; but at the same time sent deputies to Sparta, to join with the Corinthians and Megarians in their complaints against the Athenians. The Athenians upon this sent a considerable fleet against Potidæa, under the command of Callias, a nobleman of great courage. The Corinthians on their part despatched one Aristeus with a considerable body of troops to the assistance of that city. An engagement following, the Athenians were victors, but with the loss of their general. Phormio, who succeeded in the command, invested the city in form, and shut up its port with his fleet; but the Potidæans dreading to fall into the hands of the Athenians, made a most obstinate defence, while in the mean time they warmly solicited the Corinthians to perform their promises, and engage the rest of the states of Peloponnesus in their quarrel.

111 The Spartans demand reparation for the injuries offered to the states of Greece.

The Lacedæmonians having heard what the Corinthians and other little states of Greece had to say against the Athenians, sent ambassadors to the latter, demanding reparation for the injuries, with orders, in case of a refusal, to declare war. The terms demanded were, in the first place, the expulsion of those Athenians who were allied to the family of Megacles so often mentioned. This article was on account of Pericles; for he was the son of Xanthippus the Athenian commander at Mycale by Agariste niece to the famous Clysthenes, who corrupted the priestess of Apollo in order to procure the expulsion of the Pisistratidæ. They next insisted that the siege of Potidæa should be raised; thirdly, that the inhabitants of Ægina should be left free; and lastly, that a decree made against the Megarians, whereby they were forbid the ports and markets of Athens, should be revoked, and all the Grecian states under the dominion of Athens set at liberty.

112 Their terms rejected by advice of Pericles.

These terms the Athenians were persuaded by Pericles to reject. The arguments used by him were in substance as follows: That whatever the Lacedæmonians might pretend as to the injustice of the complaints of the allies, the true ground of this resentment was the prosperity of the Athenian republic, which the Spartans always hated, and now sought an opportunity of humbling: that it must be owing to the Athenians themselves if this design succeeded, because for many reasons Athens was better able to engage in a long and expensive war than the Peloponnesians. He then laid before the people an exact account of their circumstances; putting them in mind, that the treasure brought from Delos amounted to 10,000 talents; and that though 4000 of these had been expended on the stately gate of their citadel, yet that 6000 were still in hand; that they were also entitled to the subsidies paid by the confederate states; that the statues of their gods, the Persian spoils, &c. were worth immense sums; that private men were arrived at vast fortunes; and that, considering their trade by sea, they had a certain annual increase of wealth; that they had on foot an army of 12,000 men, and in their colonies and garrisons 17,000; that their fleet consisted of 300 sail; whereas the Peloponnesians had no such advantages. For these reasons he proposed as the most feasible and likewise

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Attica. likewise the most equitable satisfaction that could be given, that they would reverse their decree against Megara, if the Lacedæmonians would allow free egress and regress in their city to the Athenians and their allies; that they would leave all those states free who were free at the making of the last peace with Sparta, provided the Spartans would also leave all states free who were under their dominion; and that future disputes should be submitted to arbitration. In case these offers should be rejected, he advised them to hazard a war; telling them, that they should not think they ran that hazard for a trifle, or retain a scruple in their minds as if a small matter moved them to it, because on this small matter depended their safety, and the reputation of their constancy and resolution; whereas, if they yielded in this, the next demand of the Lacedæmonians would be of a higher nature; for having once discovered that the Athenians were subject to fear, they would thence conclude that nothing could be denied to Sparta; whereas a stiff denial in this case would teach them to treat Athens for the future on terms of equality. He enforced these reasons by showing that their ancestors had always acted on the like principles, and in all cases preferred their glory to their ease, and their liberty to their possessions.

113 Attempt of the Thebans on Platæa.

This was the origin of the Peloponnesian war, which makes so great a figure in ancient history. The immediate preliminary to general hostilities was an attempt of the Thebans to surprise Platæa. With this view they sent Eurymachus with 300 Thebans to assist such of the Platæans as they had drawn over to their interest, in making themselves masters of the place. In this design, they succeeded very well at first, the Platæans, who had promised to open the gates, keeping their words exactly, so that they were instantly in possession of the city. The other party, however, perceiving how small a number they had to contend with, unanimously rose upon them, killed a great many, and forced the rest to surrender themselves prisoners of war. Another party came from Thebes to assist their countrymen; but they arrived too late: the Platæans, however, foreseeing that they would waste their country, promised to release their prisoners if they would forbear to spoil their lands. On this the Thebans withdrew; and the Platæans cruelly put to death all their prisoners, to the number of 180, with Eurymachus their chief, alleging that they had not promised their release but in case of peace. The Athenians, as soon as they had notice of this attempt of the Thebans, caused all the Bœotians in their territory to be arrested; and when they understood how the Platæans had delivered themselves, they sent a great convoy of provisions to that city, and a numerous body of troops to escort their wives and children to Athens.

114 They are massacred.

115 Account of the allies on both sides.

Both parties now prepared in earnest for war, both sent ambassadors to the Persians, and both sought to rouse their allies. Most of the Greek states inclined to favour the Spartans, because they acted on this occasion as the deliverers of Greece, and because they either had been, or feared that they would be, oppressed by the Athenians. With the Spartans joined all the Peloponnesians, except the Argives and part of the Achæans; without Peloponnesus, the Megarians, Phocians, Locrians, Bœotians, Ambraciots, Leucadians, and Anactorians, declared themselves on their side. On the other hand, the Chians, Lesbians, Platæans, Messenians, Acarnanians, Corcyrians, Zacynthians, Carians, Dorians, Thracians, most part of the islands, and all the Cyclades excepting Melos and Thera, with Eubœa and Samos, joined the Athenians.

116 First year of the war.

The Peloponnesian war commenced 431 years before Christ. The Lacedæmonian army was assembled at the isthmus, and consisted of no less than 60,000 men; but before Archidamus king of Sparta, who commanded in chief, would enter Attica, he despatched a herald to Athens. The herald was sent back without any answer, by which all hopes of peace were cut off. As Archidamus was a friend to Pericles, the latter apprehended that he might forbear plundering his estates. With this he immediately acquainted the people; telling them at the same time, that in such a case he made a present of his lands to the public. He then advised the citizens to take no care of defending their country-seats, but to attend only to the city, busy themselves in the equipping of ships, and settle a thorough resolution not to be intimidated with the first evils of war. This proposal the Athenians readily complied with, and appointed Pericles commander in chief, with nine more generals to assist him.

The first year, the Spartan army committed great ravages in Attica, Pericles having no force capable of opposing it, and refusing to engage on disadvantageous terms, notwithstanding prodigious clamours were raised against him by his countrymen. The allies, however, had no great reason to boast of the advantages they gained this year: an Athenian fleet ravaged the coasts of Peloponnesus; another infested the Locrians, drove out the inhabitants of Ægina, and repeopled the island from Athens. They likewise reduced Cephalenia, and some towns in Acarnania and Leucas which had declared for the Lacedæmonians; and in the autumn, when the Peloponnesians were retired, Pericles entering the Megarian territory, did all the mischief that could be expected from a provoked enemy.

117 Second year. A dreadful plague at Athens.

The spring of the second year was very fatal to Athens, by a dreadful plague which destroyed great numbers of the citizens, while the Peloponnesians under Archidamus wasted every thing abroad. In the midst of these distresses, however, Pericles retained his courage, and would suffer none of his countrymen to stir without the city either to escape the plague or infest the enemy. He caused a great fleet to be equipped, on board which he embarked 4000 foot and 300 horse, with which he sailed to Epidaurus. Upon this the enemy withdrew their forces out of Attica; but Pericles was able to do no great matter on account of the plague, which made so great havock among his men, that he brought back to Athens only 1500 of the 4000 he carried out. By this misfortune the Athenians were thrown into despair; they immediately sued for peace, which the Spartans were now too proud to grant; then turning their rage upon Pericles, they dismissed and fined him. Soon after, Pericles's children and almost all his relations died of the plague; so that this great statesman was overwhelmed with melancholy, and for some time shut himself up from public view: at last, through the persuasion of Alcibiades and some others, he showed himself to the people. They received him with acclamations, and at his request repealed the unjust

118 Athenians sue for peace.

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just law he had made, whereby all Athenians of the half blood were disfranchised, and then reinstated him in all

119 Pericles requests the repeal of his law.

his former honours. Hereupon he inrolled the only son he had left, who before had been counted a bastard on account of his mother being a Milesian.

This year also the island of Zacynthus was wasted by the Peloponnesians; and the city of Potidæa submitted to the Athenians, after the inhabitants had been driven to such extremity as to feed upon human flesh. The Athenians permitted the men to depart with one garment, and the women with two; after which, the town was repeopled by a colony from Athens.

120 Third year. Pericles dies.

The third year of the Peloponnesian war was remarkable for the death of the great Pericles, who was taken off by the plague. Platæa also was besieged by

121 Platæa besieged.

Archidamus; but without success, even though the greatest part of it was set on fire; the Platæans resolving to submit to every kind of misery rather than abandon the Athenian cause. In the end, therefore, the king of Sparta was obliged to turn the siege into a blockade; and having thrown up an intrenchment fortified with a deep ditch, he left a sufficient number of men to guard his lines, and then returned back to Peloponnesus.

122 Fourth year. Desperate attempt of the Platæans.

The following summer, the Peloponnesians under the command of Archidamus invaded Attica, where they wasted every thing with fire and sword; at the same time the whole island of Lesbos, except the district of Methymna, revolted from the Athenians, who hereupon invested the city of Mitylene. All this time the city of Platæa was blocked up by the Peloponnesians; and its inhabitants being now greatly distressed for want of provisions, the garrison, consisting of 400 natives and 80 Athenians, came to the desperate resolution of forcing a passage through the enemy's lines. When they came to attempt this, however, many of them were intimidated: but 300 persisted in their resolution; and of these 212 got safe through and marched to Athens, but the rest were compelled to retire.

123 Fifth year. Mitylene, &c. taken by the Athenians.

In the beginning of the fifth year, the Peloponnesians sent 40 ships to the relief of Mitylene; but without effect, for the place had surrendered before the fleet could come to its assistance. Paches, the Athenian commander, likewise chased away the Peloponnesian fleet upon its arrival; and returning to Lesbos sent the Lacedæmonian minister, whom he found in Mitylene, together with a deputations, to Athens. On their arrival, the Lacedæmonian was immediately put to death; and in a general assembly of the people, it was resolved, that all the Mitylenians who were arrived at man's estate should be put to death, and the women and children sold for slaves. The next day, however, this cruel decree was reversed, and a galley sent with all expedition to countermand the bloody orders. This last vessel, however, could not get before the other: but Paches, being a man of great humanity, had taken a day to consider on the orders he had received; during which time the last-mentioned galley arrived; in consequence of which, only about 1000 of the most forward rebels were put to death; the walls of the city were also demolished, their ships taken away, and their lands divided among the Athenians, who let them again to their old masters at very high rents. The same summer the Athenians seized the island of Minoas, lying over against the territory of Megara; and likewise the port of Nisæa, which last they fortified, and it proved afterwards a place of the utmost importance to them. At this time also the Platæans, driven to the last extremity, surrendered to the Lacedæmonians, by whom they were, to the number of 208, including 25 Athenians, put to death, and their women sold for slaves. Their city was soon after razed by their implacable enemies the Thebans, who left only an inn to show where it stood. The fame of Platæa, however, induced Alexander the Great afterwards to rebuild it.

124 Platæa taken and razed.

125 Sedition of Corcyra.

In this year happened the famous sedition of Corcyra, whence other seditions, when their effects rendered them terrible, have been called *Corcyrian*. It hath been already observed, that the war between the Corcyrians and Corinthians brought on the general war throughout Peloponnesus. A great number of Corcyrians were in the beginning of this war carried away prisoners into Peloponnesus, where the chief of them were very well treated, but the rest sold for slaves. The reason of this conduct of the Corinthians was a design they had formed of engaging these Corcyrians to influence their countrymen to side with them and their allies. With this view they treated them with all imaginable lenity and tenderness, instilling into them by degrees a hatred of democratic government; after which they were told, that they might obtain their liberty upon condition of using all their influence at home in favour of the allies, and to the prejudice of Athens. This the Corcyrians readily promised and endeavoured to perform. At first, those who were for an aristocracy prevailed, and murdered all those of the opposite party that fell into their hands, in which they were assisted by a fleet of Peloponnesians: but the Athenians sending first one fleet and then another to the assistance of the distressed party, the Peloponnesians were forced to withdraw; after which the democratic party sufficiently revenged themselves, and destroyed their antagonists without mercy. The worst of all was, that this example once set, the several states of Greece felt in their turns the like commotions, which were always heightened by agents from Sparta and Athens; the former endeavouring to settle aristocracy, and the latter democracy, wherever they came.

126 Athenians engage in a war with Sicily.

While the Athenians were thus engaged in a war wherein they were already overmatched, they foolishly engaged in a new one, which in the end proved more fatal than all the rest. The inhabitants of Sicily were split into two factions; the one called the *Doric*, at the head of which was the city of Syracuse; the other the *Ionic*, which owned the Leontines for their chiefs: the latter perceiving themselves too weak without foreign aid, sent one Gorgias, a celebrated orator, to apply to Athens for relief; and he by his fine speeches so captivated the giddy and inconstant Athenians, that they ran headlong into a war which they were unable to maintain while engaged with all the Peloponnesians. Enticed by this new prospect, therefore, and grasping at the conquest of Sicily, as well as of all Greece, they sent a fleet to the assistance of the Leontines, under the command of Lachetes and Chabrias; and they were no sooner sailed than another fleet for the same purpose was begun to be fitted out. All this time the plague continued to rage with great violence at Athens, cutting off this year 4090 citizens, besides

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sides a much greater number of the meaner sort of people.

127 Sixth year. The sixth year of the Peloponnesian war was remarkable for no great exploit: Agis the son of Archidamus, king of Sparta, assembled an army in order to invade Attica, but was prevented from so doing by many great earthquakes which happened throughout Greece.

128 Seventh year. Pylus fortified by the Athenians. The next year, however, he entered Attica with his army, while the Athenians on their part sent a fleet under the command of Demosthenes, to infest the coasts of Peloponnesus. As this fleet passed by Laconia, the commander took notice that the promontory of Pylus, which was joined to the continent by a narrow neck of land, had before it a barren island about two miles in circumference, in which, however, there was a good and safe port, all winds being kept off by the headland, or by the isle. These advantages made him apprehend, that a garrrison left here would give the Peloponnesians so much trouble, that they would find it more advisable to protect their own country than to invade that of their neighbours. Accordingly, having raised a strong fortification, he himself with five ships staid to defend it, while the rest of the fleet proceeded on their intended expedition.

129 Besieged. On the news of this event, the Peloponnesian army immediately returned to besiege Pylus. When they arrived before the place they took possession of the harbour, and then caused a chosen body of Spartans take possession of the island of Sphacteria, after which they attacked the fort with great vigour. Demosthenes and his garrison defended themselves with great valour;

130 Spartan fleet destroyed. and an Athenian fleet arriving very seasonably, offered battle to the Peloponnesian fleet. This being refused, the Athenians boldly sailed into the harbour, broke and sunk most of the vessels therein, after which they besieged the Spartans in Sphacteria. The Peloponnesians now began to treat with their enemies, and a truce was concluded during the time that negociations were carried on at Athens. One of the articles of this truce was, that the Peloponnesians should deliver up all their ships, on condition of having them punctually returned in case the treaty did not take effect. The Athenians having heard the Spartan ambassadors, were inclined to put an end to this destructive war: but Cleon, one of their orators, a warm and obstinate man, persuaded his countrymen to insist on very unreasonable terms; upon which the ambassadors

131 Treachery of the Athenians. returned, and by doing so put an end to the truce. The Peloponnesians then demanded their vessels; but the Athenians refused to deliver them, under pretence of their having broke the truce.

132 They attack Sphacteria. Hostilities being thus recommenced on both sides, the Lacedæmonians attacked the Athenians at Pylus, while the latter attacked the Spartans at Sphacteria. The Spartans, though but a handful of men, and under every imaginable discouragement, behaved with such

133 Cleon the orator appointed general. bravery, that the siege proceeded very slowly, so that the people of Athens became very uneasy. They began then to wish they had embraced the offers of the Spartans, and to rail vehemently against Cleon, who, to excuse himself, said it would be easy for the general of the forces they were at that time sending to attack the Spartans in the isle, and reduce them at once. Nicias, who had been appointed to this command, replied that if Cleon believed he could do such great things he would do well to go thither in person: the latter imagining this only meant to try him, said he was ready to go with all his heart; whereby Nicias catched him, and declared that he had relinquished his charge. Cleon thereupon said, that he was no general; but Nicias told him that he might become one; and the people, pleased with the controversy, held the orator to his word. Cleon then advancing, told them he was so little afraid of the enemy, that, with a very inconsiderable force, he would undertake, in conjunction with those already at Pylus, to bring to Athens the Spartans who gave them so much trouble in 20 days. The people laughed at these promises: however, 134

they furnished him with the troops he desired; and to He takes

their surprise, Cleon brought the Spartans prisoners to the place.

Athens within the time appointed.

This summer, likewise, an Athenian fleet was sent 135 End of the Corcyrian sedition.

to Sicily, with instructions to put in at Corcyra, and assist the government against the Lacedæmonian faction which still subsisted in that island. This they effectually performed; for by their means the exiles fell into the hands of the other party: these they imprisoned; and then drew them out by 20 at a time, to suffer death, which was inflicted with all the circumstances of cruelty that party-rage could suggest. When only 60 remained, they entreated the Athenians to put them to death, and not to deliver them up to their countrymen; but upon this the Corcyrians surrounded the place where they were confined, endeavouring to bury them under their darts; upon which the unhappy captives all put an end to their own lives.

In the eighth year Nicias reduced the isle of Cythe- 136 Eighth year. Success of the Athenians.

ra on the coast of Laconia; as likewise Thyræa, on the confines of that country. The latter had been given to the Æginetans when expelled from their own country by the Athenians: and they were now condemned to death, as inveterate enemies of the Athenian state and nation.—In Sicily, one Hermocrates of Syracuse persuaded all the inhabitants of the island to adjust their differences among themselves; upon which the Athenian generals returned home, and for so doing two of them were banished, and the third sentenced to pay a heavy fine.

The Athenians next laid siege to Megara under the conduct of Hippocrates and Demosthenes; but Brasidas a Spartan general coming to its relief, a battle ensued, by which, though neither party got the better, 137

the Lacedæmonian faction prevailed in Megara, and Spartan party prevails in Megara.

many who favoured the Athenians were forced to withdraw. After this, such as had been banished for adhering to the Lacedæmonians were allowed to return, on their taking an oath to forget what was past, and attempt nothing that might disturb their country. As soon as they were settled, however, they forgot their oath; and causing 100 of those who were most obnoxious to be apprehended, forced the people to condemn them to death. They then changed the whole form of government, introduced an oligarchy, and possessed themselves of the supreme power.

In Bœotia some commotions were raised in favour of 138 Athenians lose their power in Bœotia.

the Athenians; but their generals Hippocrates and Demosthenes being defeated by the opposite party, all hopes ceased of the Athenian power being established in Bœotia. In the mean time Brasidas reduced the city of Amphipolis, which greatly alarmed the Athenians,

ans, who thereupon sent new supplies of men, money, and ships to the Macedonian coast; but all their care could not prevent a great desertion from their interest in those parts, where the conduct and valour of Brasidas carried all before him.

139 Ninth year. A truce concluded and broken.

In the ninth year, the Spartans made new proposals of peace, which the Athenians were now more inclined to accept than formerly; and finding their affairs very much unsettled by the loss of Amphipolis, a truce for a year was quickly agreed on, while negociations were in the mean time carrying on for a general peace. This pacific scheme, however, was very soon overthrown by the following accident in Thrace. The city of Scione, and that of Menda, revolted to Brasidas; who, knowing nothing of the truce, sought to draw over Potidæa also. The Athenians, pretending that Scione revolted two days after the truce was concluded, made heavy complaints, asserting that this was a breach of the truce, and that both it and Menda should be restored to them. This not being effected by negociations, an army was sent against the two cities by which Menda was reduced; but Scione making an obstinate defence, the siege was turned into a blockade.

140 Cleon defeated and killed by Brasidas.

In the tenth year Brasidas made an attempt upon Potidæa; which having failed, the Athenians began to recover some courage. The truce expiring on the day of the Pythian games, Cleon persuaded the Athenians to send an army into Thrace under his own command. It consisted of 1200 foot and 300 horse, all Athenian citizens, who embarked on board 30 galleys. Brasidas had an army much inferior; but observing that the Athenian general was become careless, and neglected discipline, he attacked him. In this engagement Cleon was killed, and the Athenians were defeated with the loss of 600 men, while the Spartans lost only seven; but among these was their brave commander Brasidas, whose death affected them almost as much as the loss of their army did the Athenians.

141 A fifty years peace.

As the death of Cleon deprived the Athenians of one of their best speakers, and one who had been very industrious in promoting the war, they were now much more disposed than formerly to hearken to terms of accommodation. Amongst the Spartans, too, there was a party, at the head of whom was Plistonax their king, who earnestly wished for peace; and as Nicias laboured no less assiduously at Athens to bring about this desirable event, a peace was at last concluded for fifty years between the two nations. The conditions were, that a restitution of places and prisoners should be made on both sides; excepting that Nisæa should remain to the Athenians, who had taken it from the Megarians, and that Platæa should continue with the Thebans, because they absolutely would not give it up. The Bœotians, Corinthians, and Megarians, refused to be included in this peace: but the rest of the allies yielded to it; and it was accordingly ratified, receiving the name of the *Nician* peace, from Nicias who had so vigorously promoted it.

142 New discontents.

By this means, however, tranquillity was far from being restored. Such of the states of Peloponnesus as were dissatisfied, began immediately to league among themselves, and to set on foot a new confederacy, the head of which was to be the state of Argos. The Lacedæmonians, too, found it impossible to perform exactly the articles of agreement; the city of Amphipolis, in particular, absolutely refused to return under the Athenian government; for which reason the Athenians refused to evacute Pylus. In the winter, new negociations were entered into on all sides, but nothing determined, and universal murmuring and discontent took place. These discontents were not a little heightened by Alcibiades, who now began to rival Nicias, and, perceiving the Lacedæmonians paid their court mostly to his rival, took all opportunities to incense his countrymen against that nation. Nicias, on the other hand, who wished for nothing so much as peace, used all his endeavours to bring about a reconciliation. The artifices of Alcibiades, however, added to the turbulent and haughty disposition of both nations, rendered this impossible; so that though Nicias went on purpose to Sparta, he returned without doing any thing.

143 Heightened by Alcibiades.

144 His measures for the safety of Attica.

Alcibiades having thus disposed every thing according to his wishes, and a war being inevitable, he began to take the most prudent methods for preserving his country in safety. With this view he entered into a league for 100 years with the Argives, which he hoped would keep the war at a distance; he next passed over into the territories of Argos, at the head of a considerable army; and laboured, both at that city and at Patræ, to persuade the people to build walls to the sea, that so they might the more easily receive assistance from the Athenians. But though great preparations for war were now made, nothing was undertaken this year; only the Argives thought to have made themselves masters of Epidaurus, but were hindered by the Lacedæmonians putting a garrison into it.

145 Fourteenth year. War renewed.

The next year (the 14th after the Peloponnesian war was first begun) a Spartan army, under the command of Agis, entered the territory of Argos, where the confederate army lay; but just as the engagement was about to begin, a truce was suddenly concluded by two of the Argive generals and the king of Sparta. With this neither party was pleased, and both the king and generals were very ill treated by their citizens. On the arrival of some fresh troops from Athens, therefore, the Argives immediately broke the truce; but the allied army was soon after defeated with great slaughter by Agis; notwithstanding which, however, the Eleans and Athenians invested Epidaurus. In the winter a strong party in Argos joined the Lacedæmonians; in consequence of which that city renounced her alliance with Athens, and concluded one with Sparta for 50 years. In compliment to their new allies, also, the Argives abolished democracy in their city, establishing an aristocracy in its place, and assisted the Lacedæmonians with a considerable body of troops to force the Sicyonians to do the same.

146 Athenians, &c. defeated at Mantinea.

147 Fifteenth year.

In the beginning of the 15th year, the Argives, with a levity seemingly natural to all the Greeks, renounced their alliance with Sparta, abolished aristocracy, drove all the Lacedæmonians out of the city, and renewed their league with Athens. The Athenians, in the mean time, being convinced of the treachery of Perdiccas king of Macedon, renounced their alliance with him, and declared war against him.

148 Sixteenth year. Melos reduced by the Athenians.

Next year Alcibiades terminated the disputes in the city of Argos, by the banishment of the Spartan faction; after which he sailed to the island of Melos, whose inhabitants had acted with the greatest invete-

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Attica. racy against his countrymen: perceiving, however, that the reduction of the island would be a work of time, he left a considerable body of forces there, and returned to Athens. In his absence the capital of Melos surrendered at discretion, and the inhabitants were treated with the utmost cruelty: all the men capable of bearing arms being slaughtered, and the women and children carried into captivity.

149 Seventeenth year. Athenian army in Sicily lost, and Alcibiades flies to Sparta.

In the beginning of the 17th year, Nicias was appointed commander of an expedition against the Syracusans, along with Alcibiades and Lamachus as colleagues. But while the necessary preparations were making, all things were thrown into confusion by the defacing of the Hermæ, or statues of Mercury, of which there was a great number in the city. The authors of this sacrilege could by no means be discovered, though rewards were offered for this purpose: at last the suspicion fell upon Alcibiades; and for this weighty reason he was commanded to return from Sicily to take his trial. Alcibiades, however, knew the temper of his countrymen too well to trust himself to their mercy; and therefore, instead of returning to Athens, he fled immediately to Sparta, where he met with a gracious reception; while the infatuated Athenians were severely punished by the loss of their army, generals, and fleet, in Sicily, which the superior abilities of Alcibiades would in all probability have prevented.

150 Nineteenth and twentieth years, &c.

The 19th and 20th years of the war were spent by the Athenians in equipping a new fleet in order to repair their vast losses; but Alcibiades hurt their interests very much, by persuading Tissaphernes the Persian to league with the Spartans against them: at the same time he persuaded several of the Ionian states to revolt from Athens, but they were in a short time obliged again to submit. Notwithstanding all these services, however, Alcibiades had rendered himself so hateful to Agis, by debauching his wife, that he soon found himself obliged to fly to the Persians, where Tissaphernes gave him a very favourable reception, and profited much by his advice, which was, to let the Greeks weaken one another by their mutual wars, and that the Persians ought never to see one state totally destroyed, but always to support the weaker party.

151 Alcibiades flies to Persia.

152 Proposes the abolition of democracy at Athens.

When Tissaphernes had acquiesced with these counsels, Alcibiades privately wrote to some of the officers in the Athenian army at Samos, that he had been treating with the Persians in behalf of his countrymen, but did not choose to return till the democracy should be abolished; and to incline the citizens to comply with this measure, he told them that the Persian king disliked a democracy, but would immediately assist them if that was abolished, and an oligarchy erected in its stead.

On the arrival of Pisander and other deputies from the army, with the proposals of Alcibiades, the Athenians without hesitation resolved to overturn that democracy which they had all along so strenuously defended. The issue of their present debate was, that Pisander with ten deputies should return to Alcibiades, in order to know on what terms the king of Persia would make an alliance with them: but that cunning Athenian having perceived that Tissaphernes was by no means disposed to assist the Athenians on account of their having been lately successful, he set up such high demands in the king of Persia's name, that the Athenians of themselves broke off the treaty, and thus Alcibiades preserved the friendship of both parties.

Pisander having engaged the army at Samos in his scheme of overturning democracy, that form of government was abolished first in the cities subject to Athens, and lastly in the capital itself. Pisander's new scheme was, That the old form of government should be totally dissolved: that five prytanes should be elected: that these five should choose 100: and that each of the hundred should choose three: that the 400 thus elected should become a senate with full power; but should occasionally consult with 5000 of the most wealthy citizens, who should thenceforward be esteemed only *the people;* and that no authority should remain with the lowest class. Though the people were not very fond of this change, those who conducted it, being men of great parts, found means to establish it by force; for when the people were gone out of the city to their ordinary employments, the 400, having each a dagger concealed under his vest, attended by a guard of 120 men, entered the senate house, dissolved the old senate, and without ceremony turned them out; after which the commons, not knowing whom to submit to, or to whom to apply, made no opposition.

153 New form of government established.

The first step of the new governors was to destroy all their enemies; who, however, were not very numerous, so that little blood was shed. They next sent ambassadors to Agis to sue for peace; but he, taking for granted that the Athenians would never defend an oligarchy, gave no answer to the ambassadors, but immediately marched towards the capital with a design to attack it. On his arrival, however, he was quickly convinced of his mistake, being repulsed with loss, and obliged to retire to his old post.

154 The army declare for a democracy, and recal Alcibiades.

In the mean time the Athenian army declared again for a democracy; and having recalled Alcibiades, invested him with full power, and insisted on his immediate return to Athens to restore the ancient government. This measure he refused to comply with, and persuaded them to stay where they were, in order to save Ionia: he also prevailed on them to allow some deputies, who had been sent from the new governors of Athens, to come and deliver their message. To these deputies Alcibiades replied, that they should immediately return to Athens, and acquaint the 400, that they were commanded immediately to resign their power and restore the senate; but that the 5000 might retain theirs, provided they used it with moderation.

155 Great confusion at Athens.

By this answer the city was thrown into the utmost confusion; but the new government party prevailing, ambassadors were despatched to Sparta with orders to procure peace on any terms. This, however, was not to be effected; and Phrynicus, the head of the embassy, and likewise of the new government party, was murdered on his return. After his death, Theramenes, the head of the other party, seized the chiefs of the 400; upon which a tumult ensued that had almost proved fatal to the city itself. The mob, however, being at last dispersed, the 400 assembled, though in great fear, and sent deputies to the people, promising to set all things to rights. In consequence of this deputation,

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tion, a day was appointed for convoking a general assembly, and settling the state; but when that day came, news was brought that the Lacedæmonian fleet appeared in view, and steered directly for Salamis. Thus all was again thrown into confusion; for the people, instead of deliberating on the subject proposed, ran in crowds down to the port, and perceiving the Spartans made towards Eubœa, a fleet of 36 ships was immediately despatched under the command of Thymochares, to engage the enemy. This fleet was utterly defeated, 22 of the Athenian ships being taken, and most of the others sunk or disabled; but what was worse, this defeat was followed by the revolt of all the country of Eubœa except Orcus.

156 Athenian fleet destroyed by the Spartans.

When these dismal tidings arrived at Athens, every thing was given up for lost; and had the Lacedæmonians taken this opportunity of attacking the city, they had undoubtedly succeeded, and thus put an end to the war: but being at all times slow, especially in naval affairs, they gave the Athenians time to equip a new fleet, and to retrieve their affairs. One good effect of this disaster, however, was the putting an end for a time to the internal dissensions of this turbulent people; insomuch that Thucydides the historian is of opinion, that the republic never enjoyed so much quiet as at this time.

157 Exploits of Alcibiades.

Alcibiades now showed his abilities and inclination to serve his country in an eminent manner. By his intrigues he so effectually embroiled the Persians and Peloponnesians with each other, that neither party knew whom to trust. Thrasybulus, with 55 ships, gained a victory over the Peloponnesian fleet consisting of 73: after which he took eight galleys coming from Byzantium; which city had revolted from the Athenians, but was soon after taken, and the inhabitants severely fined. The fleet being afterwards joined by Alcibiades, nine more of the Peloponnesian galleys were taken, the Halicarnassians were constrained to pay a large sum of money, and Cos was strongly fortified: which transactions ended the 21st year of the Peloponnesian war.

In the succeeding years of this famous war, the Athenians had at first great advantages. Thrasybulus gained a signal victory at sea; and Alcibiades gained two victories, one by sea and another by land, in one day; took the whole Peloponnesian fleet, and more spoil than his men could carry away. The Spartans were now humbled in their turn, and sued for peace; but the Athenians were so intoxicated with their success, that they sent back the ambassadors without an answer: which they soon had sufficient reason to repent of. The beginning of the Athenian misfortunes was the taking of Pylus by the Spartans. The Athenians had sent a fleet under the command of one Anytus to its defence: but he was driven back by contrary winds; upon which he was condemned to death, because he could not cause the wind blow from what quarter he pleased: this sentence, however, was remitted on his paying a vast sum of money. This misfortune was quickly followed by another. The Megarians surprised Nysæa; which enraged the Athenians so much, that they immediately sent an army into that country, who defeated the Megarians who opposed them with great slaughter, and committed horrid devastations.

158 The Spartans sue for peace.

159 They take Pylus.

These misfortunes as yet, however, were overbalanced by the great actions of Alcibiades, Thrasybulus, and Theramenes. When Alcibiades returned, he brought with him a fleet of 200 ships, and such a load of spoils as had never been seen in Athens since the conclusion of the Persian war. The people left their city destitute, that they might crowd to the port, to behold Alcibiades as he landed; old and young blessed him as he passed; and next day when he made a harangue to the assembly, they directed the record of his banishment to be thrown into the sea, absolved him from the curses he lay under, and created him general with full power. Nor did he seem inclined to indulge himself in ease, but soon put to sea again with a fleet of 100 ships. He had not been long gone, however, before all this was forgot. Alcibiades sailed to the Hellespont with part of his fleet, leaving the rest under the command of Antiochus his pilot, but with strict orders to attempt nothing before his return. This command the pilot paid no regard to, but provoked Lysander the Lacedæmonian admiral to an engagement, and in consequence of his temerity was defeated with the loss of 15 ships, himself being killed in the engagement. On the news of this defeat Alcibiades returned, and endeavoured to provoke the Lacedæmonians to a second battle; but this Lysander prudently declined; and in the mean time, the Athenians, with unparalleled ingratitude and inconstancy, deprived Alcibiades of his command, naming ten new generals in his room.

160 Alcibiades enters Athens in triumph.

161 He is disgraced.

162 The Athenians gain a great victory, and put six of their generals to death.

This was the last step the Athenians had to take for perfecting their ruin. Conon, who succeeded to the command, was defeated by Callicratides, Lysander's successor; but being afterwards strongly reinforced, the Lacedæmonians were entirely defeated with the loss of 77 ships. Such a victory might at this time have inspired the Athenians with some kind of gratitude towards the generals who gained it; but instead of this, on pretence of their not having assisted the wounded during the engagement, eight of them were recalled; two were wise enough not to return; and the six who trusted to the justice of their country were all put to death.

163 They are utterly defeated by Lysander;

The next year Lysander was appointed commander of what fleet the Peloponnesians had left, with which he took Thasus and Lampsacus. Conon was despatched against him with 180 ships, which being greatly superior to Lysander's fleet, that general refused to come to an engagement, and was blocked up in the river Ægos. While the Athenians lay there, they grew quite idle and careless; insomuch that Alcibiades, who had built a castle for himself in the the neighbourhood, entreated them to be more on their guard, as he well knew Lysander's abilities. They answered, that they wondered at his assurance, who was an exile and a vagabond, to come and give laws to them; telling him, that if he gave them any farther trouble, they would seize and send him to Athens. At the same time they looked on victory as so certain, that they consulted what they should do with their prisoners; which, by the advice of Philocles their general, was to cut off all their right hands, or, according to Plutarch, their right thumbs; and Adiamantus, one of their officers, rendered himself very obnoxious by saying, that such idle discourse did not become Athenians. The

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consequences of such conduct may be easily imagined. Lysander fell unexpectedly upon them, and gained a most complete victory; Conon, with eight galleys only, escaping to Cyprus; after which Lysander returned to Lampsacus, where he put to death Philocles with 3000 of his soldiers, and all the officers except Adiamantus. This execution being over, he reduced all the cities subject to Athens; and with great civility sent home their garrisons, that so the city might be overstocked with inhabitants, and destitute of provisions, when he came to besiege it; which he did soon after by sea, while Agis, with a great army, invested it by land. 164

who takes Athens.

For a long time the Athenians did not so much as desire a peace; but at last were forced to send deputies to Agis, who sent them to Sparta, where no terms could be granted except they consented to demolish their walls. They next sent to Lysander, who after a long attendance referred them to Sparta; and thither Theramenes with some other deputies was immediately sent. On their arrival, they found the council of the confederates sitting, who all except the Spartans gave their votes that Athens should be utterly destroyed; but they would not consent to the ruin of that city, which had deserved so well of Greece. On the return of Theramenes, peace was concluded, on condition that the long walls and the fortifications of the port should be demolished; that they should give up all their ships but 12, receive all they had banished, and follow the fortune of the Lacedæmonians. These severe terms were punctually executed. Lysander caused the walls to be pulled down, all the music in his army playing, on that very day of the year on which they had beat the Persians at Salamis. He likewise established an oligarchy expressly against the will of the people; and thus the ruin of Athens ended the 27th year of the Peloponnesian war, and the 404th before Christ.

165 *Terms of peace.*

166 *The thirty tyrants.*

As soon as Lysander had demolished the long walls, and the fortifications of the Piræus, he constituted a council of thirty, with power, as was pretended, to make laws, but in truth to subjugate the state. These are the persons so famous in history, under the title of *the thirty tyrants*. They were all the creatures of Lysander; who, as they derived their rise from conquest and the law of the sword, exercised their offices in a suitable manner; that is, with the highest testimonies of pride, insolence, and cruelty. Instead of making laws, they governed without them; appointed a senate and magistrates at their will; and, that they might do all things without danger of controul, they sent for a garrison from Lacedæmon; which was accordingly granted them, under the command of Callidius, upon their promise to pay the soldiers regularly. One of the first steps they took was to punish all informers; which, though severe, was popular; but when, through flattery and bribes, they had wholly drawn over Callidius to their party, they suffered bad men to live in quiet, and turned their rage against the good.

167 *Critias and Theramenes, their opposite characters.*

Critias and Theramenes were at the head of the thirty, men of the greatest power and abilities in Athens. The former was ambitious and cruel without measure; the latter was somewhat more merciful: the former pushed on all the bloody schemes framed by his confederates; and carried into execution many of his own; the latter always opposed them, at first with moderation, at last with vehemence. He said, that power was given them to rule, and not to spoil, the commonwealth; that it became them to act like shepherds, not like wolves; and that they ought to beware of rendering themselves at once odious and ridiculous, by attempting to domineer over all, being such a handful of men as they were. The rest, disliking much the former part of his discourse, catched hold of the latter, and immediately chose out 3000, whom they made the representatives of the people, and to whom they granted this notable privilege, that none of them should be put to death but by judgment of the senate, thereby openly assuming a power of putting any other of the Athenian citizens to death by their own authority. A glorious use they made of this new-assumed privilege; for as many as they conjectured to be no friends to the government in general, or to any of themselves in particular, they put to death, without cause, and without mercy. Theramenes openly opposing this, and absolutely refusing to concur in such measures, Critias accused him to the senate as a man of unsteady principles, sometimes for the people, sometimes against them, always for new things and state-revolutions. Theramenes owned, that he had sometimes changed his measures, but alleged that he had always done it to serve the people. He said that it was solely with this view he made the peace with Sparta, and accepted the office of one of the thirty: that he had never opposed their measures while they cut off the wicked; but when they began to destroy men of fortune and family, then he owned he had differed with them, which he conceived to be no crime against the state. 168

Theramenes put to death.

While Theramenes was speaking, Critias withdrew, perceiving that the senate were thoroughly convinced of the truth of what Theramenes had said: but he quickly returned with a guard, crying out, that he had struck Theramenes's name out of the list of the 3000; that the senate had, therefore, no longer cognizance of the cause, when the thirty had already judged and condemned him to death. Theramenes perceiving that they intended to seize him, fled to the altar, which was in the midst of the senate-house, and laying his hands thereon, said, "I do not seek refuge here because I expect to escape death, or desire it; but that, tearing me from the altar, the impious authors of my murder may interest the gods in bringing them to speedy judgment, and thereby restore freedom to my country." The guards then dragged him from the altar, and carried him to the place of execution, where he drank the poison with undaunted courage, putting the people in mind with his last breath, that as they had struck his name out of the 3000, they might also strike out any of theirs. His death was followed by a train of murders, so that, in a short time, 60 of the worthiest and most eminent citizens of Athens fell by the cruelty of the thirty. Among these, the most pitied was Niceratus the son of Nicias; a man universally beloved for his goodness, and universally admired for his virtues. As for the Spartans, they, losing their former generosity, were extremely pleased with these things, and, by a public decree, commanded that such as fled from the thirty tyrants should be carried back bound to Athens: which extraordinary proceeding frightened all Greece; but the Argives and Thebans only had courage

courage to oppose it: the former received the Athenian exiles with humanity and kindness, the latter punished with a mulct such of their citizens as did not rise and rescue the Athenian prisoners, who in pursuance of the Lacedæmonian decree were carried bound through their territories.

Thrasybulus, and such as with him had taken shelter in the Theban territory, resolved to hazard every thing, rather than remain perpetual exiles from their country; and though he had but 30 men on whom he could depend, yet considering the victories he had heretofore obtained in the cause of his country, he made an irruption

169 Thrasybulus seizes Phyla.

into Attica, where he seized Phyla, a castle at a very small distance from Athens, where in a very short space his forces were augmented to 700 men; and though the tyrants made use of the Spartan garrison in their endeavours to reduce him and his party, yet Thrasybulus prevailed in various skirmishes, and at last obliged them to break up the blockade of Phyla, which they had formed. The thirty and their party conceiving it very advantageous for them to have the possession of Eleusina, marched thither, and having persuaded the people to go unarmed out of their city, that they might number them, took this opportunity most inhumanly to murder them. The forces of Thrasybulus increasing daily, he at length possessed himself of the Piræus, which he fortified in the best manner he could; but the tyrants being determined to drive him from thence, came down against him with the utmost force they could raise. Thrasybulus defended himself with great obstinacy; and in the end they were forced to retreat, having lost before the place not only a great number

170 Critias killed.

of their men, but Critias the president of the thirty, another of the same body, and one who had been a captain of the Piræus.

When they came to demand the dead from Thrasybulus, in order for their interment, he caused a crier he had with him to make a short speech in a very loud voice to the people, entreating them to consider, that as they were citizens of Athens without, so those against whom they fought, and those who sought to preserve themselves within the fort, were Athenian citizens also; wherefore, instead of thinking how to ruin and destroy their brethren, they ought rather to consult how all differences might be composed, and especially ought to rid themselves of those bloody tyrants, who, in the short time they had had the administration in their hands, had destroyed more than had fallen in the Peloponnesian war. The people, though moved by these discourses, differed among themselves; the consequence of

171 The tyrants expelled

which was, that they expelled the thirty, and chose ten men out of each tribe to govern in their stead, whereupon the tyrants retired to Eleusina. The citizens, however, though they changed the government, made no agreement with those in the Piræus; but sent away deputies to Sparta, as did all the tyrants from Eleusina, complaining, that the Athenians had revolted,

172 Attempt of the Spartans to reduce Athens a second time.

and desiring their assistance to reduce them. The Spartans sent thereupon a large sum of money to encourage their confederates, and appointed Lysander commander in chief, and his brother to be admiral; resolving to send sea and land forces to reduce Athens a second time; intending, as most of the Greek states suspected, to add it now to their own dominions. It is very probable that this design of theirs would have taken effect, if Pausanias king of Sparta, envying Lysander, had not resolved to obstruct it. With this view, he procured another army to be raised against the Athenians, of which himself had the command, and with which he marched immediately to besiege the Piræus. While he lay before the place, and pretended to attack it, he entered into a private correspondence with Thrasybulus, informing him what propositions he should make in order to force the Lacedæmonians, who were suspected by their allies, to grant them peace.

173 How frustrated.

The intrigues of Pausanias had all the success he could wish. The Ephori who were with him in the camp concurred in his measures, so that in a short space a treaty was concluded on the following terms: That all the citizens of Athens should be restored to their houses and privileges, excepting the thirty, the ten which had succeeded them and who had acted no less tyrannically than they, and the eleven who during the time of the oligarchy had been constituted governors or keepers of the Piræus: that all should remain quiet for the future in the city; and that, if any were afraid to trust to this agreement, they should have free leave to retire to Eleusina. Pausanias then marched away with the Spartan army, and Thrasybulus at the head of his forces marched into Athens, where having laid down their arms, they sacrificed with the rest of the citizens in the temple of Minerva, after which the popular government was restored. Yet quiet was not thoroughly established. The exiles at Eleusina having endeavoured by the help of money to raise an army of foreigners, by whose aid they might recover the authority they had lost: but first depending on their friends in the city, they sent some of the principal persons amongst them as deputies, to treat with the citizens; but strictly instructed them to sow jealousies and excite discords among them. This the latter quickly perceiving, put these persons to death: and then remonstrating to those at Eleusina, that these contentions would undoubtedly end either in their own or the destruction of their country, they offered immediately to pass an act of oblivion, which they would confirm with an oath.

This being accepted, those who had withdrawn returned to the city, where all differences were adjusted, and both parties most religiously observed the agreement they had made, and thereby thoroughly resettled the state. In this whole transaction, the virtue of Thrasybulus deserves chiefly to be admired.

174 Virtue of Thrasybulus.

When he first seized the castle of Phyla, the tyrants privately offered to receive him into their number instead of Theramenes, and to pardon at his request any 12 persons he should name: but he generously answered, That his exile was far more honourable than any authority could be, purchased on such terms; and by persisting in his design, accomplished, as we have seen, the deliverance of his country. A glorious deliverance it was; since, as Isocrates informs us, they had put 1400 citizens to death contrary to and without any form of law, and driven 5000 more into banishment; procuring also the death of Alcibiades, as many think, though at a great distance from them.

From this time to the reign of Philip of Macedon, the Athenians continued in a pretty prosperous situation, though they never performed any such great exploits

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as formerly. By that monarch and his son Alexander all Greece was in effect subdued, and the history of all the Grecian states from that time becomes much less interesting. Of the history of Athens from that time to the present, the following elegant abridgement is given by Dr Chandler *. "On the death of Alexander, the Athenians revolted, but were defeated by Antipater, who garrisoned Munychia. They rebelled again, but the garrison and oligarchy were reinstated. Demetrius the Phalerean, who was made governor, beautified the city, and they erected to him 360 statues; which on his expulsion they demolished, except one in the Acropolis. Demetrius Poliocertes withdrew the garrison, and restored the democracy; when they deified him, and lodged him in the Opisthodomos or the back part of the Parthenon, as a guest to be entertained by their goddess Minerva. Afterwards they decreed, that the Piræus, with Munychia, should be at his disposal; and he took the Museum. They expelled his garrison, and he was persuaded by Craterus a philosopher to leave them free. Antigonus Gonatas, the next king, maintained a garrison in Athens: but on the death of his son Demetrius, the people, with the assistance of Aratus, regained their liberty; and the Piræus, Munychia, Salamis, and Sunium, on paying a sum of money.

* *Travels into Greece*, p. 28. &c.

175 History of Athens from the time of Alexander the Great to the present.

"Philip, son of Demetrius, encamping near the city, destroying and burning the sepulchres and temples in the villages, and laying their territory waste, the Athenians were reduced to solicit protection from the Romans, and to receive a garrison, which remained until the war with Mithridates king of Pontus, when the tyrant Aristion made them revolt.

176 Athens besieged and taken by Sylla.

"Archelaus the Athenian general, unable to withstand the Roman fury, relinquished the *long walls*, and retreated into the Piræus and Munychia. Sylla laid siege to the Piræus and to the city, in which Aristion commanded. He was informed that some persons had been overheard talking in the Ceramicus, and blaming Aristion for his neglect of the avenues about the Heptachalcos, where the wall was accessible. Sylla resolved to storm there, and about midnight entered the town at the gate called *Dypylon* or *the Piræan*; having levelled all obstacles in the way between it and the gate of the Piræus. Aristion fled to the Acropolis, but was compelled to surrender by the want of water; when he was dragged from the temple of Minerva, and put to death. Sylla burned the Piræus and Munychia, and defaced the city and suburbs, not sparing even the sepulchres.

"The civil war between Cæsar and Pompey soon followed, and their natural love of liberty made them side with Pompey. Here again they were unfortunate, for Cæsar conquered. But Cæsar did not treat them like Sylla. With that clemency which made so amiable a part of his character, he dismissed them by a fine allusion to their illustrious ancestors, saying, that he spared the living for the sake of the dead.

"Another storm followed soon after this; the wars of Brutus and Cassius with Augustus and Antony. Their partiality for liberty did not here forsake them: they took part in the contest with the two patriot Romans, and erected their statues near their own ancient deliverers Harmodius and Aristogiton, who had slain Hipparchus. But they were still unhappy, for their enemies triumphed.

"They next joined Antony, who gave them Ægina and Cea, with other islands. Augustus was unkind to them; and they revolted four years before he died. Under Tiberius the city was declining, but free, and regarded as an ally of the Romans. The high privilege of having a lictor to precede the magistrates was conferred on it by Germanicus; but he was censured as treating with too much condescension a mixture of nations, instead of genuine Athenians, which race was then considered as extinct.

"The emperor Vespasian reduced Achaia to a province paying tribute and governed by a proconsul. Nerva was more propitious to the Athenians; and Pliny, under Trajan his successor, exhorts Maximus to be mindful whither he was sent, to rule genuine Greece, a state composed of free cities. 'You will revere the gods and heroes their founders. You will respect their pristine glory, and even their age. You will honour them for the famous deeds, which are truly, nay for those which are fabulously, recorded of them. Remember, it is Athens you approach.' This city was now entirely dependent on Rome, and was reduced to sell Delos and the islands in its possession.

"Hadrian, who was at once emperor and an archon of Athens, gave the city laws, compiled from Draco, Solon, and the codes of other legislators; and displayed his affection for it by unbounded liberality. Athens reflourished, and its beauty was renewed. Antoninus Pius who succeeded, and Antoninus the Philosopher, were both benefactors.

"The barbarians of the north, in the reign of Valerian, besieging Thessalonica, all Greece was terrified, and the Athenians restored their city wall, which had been dismantled by Sylla, and afterwards neglected.

"Under the next emperor, who was the archon Gallienus, Athens was besieged, the archontic office ceased; and the stratægus or general, who had before acted as overseer of the agora or market, then became the supreme magistrate. Under Claudius his successor, the city was taken, but soon recovered.

"It is related, that Constantine, when emperor, gloried in the title of *general of Athens*; and rejoiced exceedingly on obtaining from the people the honour of a statue with an inscription, which he acknowledged by an yearly gratuity of many bushels of grain. He conferred on the governor of Attica and Athens the title of *grand duke*, μεγας δουξ. That office was at first annual, but afterwards hereditary. His son Constans bestowed several islands on the city, to supply it with corn.

"In the time of Theodosius I. 380 years after Christ, the Goths laid waste Thessaly and Epirus; but Theodore, general of the Achæans, by his prudent conduct preserved the cities of Greece from pillage, and the inhabitants from being led into captivity. A statue of marble was erected to him at Athens by order of the city; and afterwards one of brass, by command of the emperor, as appears by an inscription in a church dedicated to a saint of the same name, not far from the French convent. It is on a round pedestal, which supports a flat stone serving for the holy table. Eudocia the wife of Theodosius II. was an Athenian.

177 By Alaric the Goth.

"The fatal period now approached, and Athens was about to experience a conqueror more savage even than

than Sylla. This was Alaric king of the Goths: who, under the emperors Arcadius and Honorius, overran Greece and Italy, sacking, pillaging, and destroying. Then the Peloponnesian towns were overturned, Arcadia and Lacedæmon were laid waste, the two seas by the isthmus were burnished with the flames of Corinth, and the Athenian matrons were dragged in chains by barbarians. The invaluable treasures of antiquity, it is related, were removed; the stately and magnificent structures converted into piles of ruin; and Athens was stripped of every thing splendid or remarkable. Synesius, a writer of that age, compares the city to a victim of which the body had been consumed, and the hide only remained.

"After this event, Athens became an unimportant place, and as obscure as it once had been famous. We read that the cities of Hellas were put into a state of defence by Justinian, who repaired the walls, which at Corinth had been subverted by an earthquake, and at Athens and in Bœotia were impaired by age; and here we take a long farewell of this city. A chasm of near 700 years ensues in its history, except that, about the year 1130, it furnished Roger the first king of Sicily with a number of artificers, whom he settled at Palermo, where they introduced the culture of silk, which then passed into Italy. The worms had been brought from India to Constantinople in the reign of Justinian.

"Athens, as it were, re-emerges from oblivion in the 13th century, under Baldwin, but besieged by a general of Theodorus Lascaris, the Greek emperor. It was taken in 1427 by Sultan Morat. Boniface, marquis of Montferrat, possessed it with a garrison; after whom it was governed by Delves of the house of Arragon. On his death, it was seized, with Macedonia, Thessaly, Bœotia, Phocis, and the Peloponnesus, by Bajazet; and then, with the island Zante, by the Spaniards of Catalonia in the reign of the Greek emperor Andronicus Palæologus the elder. These were dispossessed by Reinerius Acciaioli, a Florentine; who, leaving no legitimate male issue, bequeathed it to the state of Venice. His natural son, Antony, to whom he had given Thebes with Bœotia, expelled the Venetians. He was succeeded in the dukedom by his kinsman Nerius, who was displaced by his own brother named *Antony*, but recovered the government when he died. Nerius, leaving only an infant son, was succeeded by his wife. She was ejected by Mahomet on a complaint from Francus son of the second Antony, who confined her at Megara, and made away with her; but her son accusing him to Mahomet the Second, the Turkish army under Omar advanced, and he surrendered the citadel in 1455; the Latins refusing to succour him unless the Athenians would embrace their religious tenets. Mahomet, it is related, when he had finished the war with the despot of the Morea, four years after, surveyed the city and Acropolis with admiration. The janizaries informed him of a conspiracy; and Francus Acciaioli, who remained lord of Bœotia, was put to death. In 1464 the Venetians landed at the Piræus, surprised the city, and carried off their plunder and captives to Eubœa.

178 By the Turks.

"It is remarkable, that after these events Athens was again in a manner forgotten. So lately as about the middle of the 16th century, the city was commonly believed to have been utterly destroyed, and not to exist, except a few huts of poor fishermen. Crusius, a learned and inquisitive German, procured more authentic information from his Greek correspondents residing in Turkey, which he published in 1584, to awaken curiosity and to prompt farther discoveries. One of these letters is from a native of Nauplia, a town near Argos in the Morea. This writer says that he had been often at Athens, and that it still contained many things worthy to be seen, some of which he enumerates, and then subjoins; "But why do I dwell on this place? It is as the skin of an animal which has been long dead."

It now remains to give some idea of the character, government, and religion of this once so famous people.

179 Character of the ancient Athenians.

The Athenians, says Plutarch, are very subject to violent anger; but they are soon pacified. They are likewise easily impressed with humanity and compassion. That this was their temper, is proved by many historical examples. We shall produce a few. The sentence of death pronounced against the inhabitants of Mitylene, and revoked the next day: The condemnation of Socrates, and that of the ten chiefs, each followed by quick repentance and most pungent grief.

The minds of the same people, adds Plutarch, are not formed for laborious researches. They seize a subject, as it were, by intuition; they have not patience and phlegm enough to examine it gradually and minutely. This part of their character may seem surprising and incredible. Artisans, and other people of their rank, are in general slow of comprehension. But the Athenians of every degree were endowed with an inconceivable vivacity, penetration, and delicacy of taste. Even the Athenian soldiers could repeat the fine passages of the tragedies of Euripides. Those artisans and those soldiers assisted at public debates, were bred to political affairs, and were equally acute in apprehension and in judgment. We may infer the understanding of the hearers of Demosthenes from the genius of his orations, which were laconic and poignant.

As their inclination, continues Plutarch, leads them to assist and support people of low condition, they like discourse seasoned with pleasantry, and productive of mirth. The Athenians patronize people of low degree; because from them their liberty is in no danger, and because such patronage tends to support a democratical constitution. They love pleasantry; which turn of mind proves that they are a humane social people, who have a taste for raillery and wit, and are not soured with that reserve which marks the despot or the slave.

They take pleasure in hearing themselves praised; but they can likewise patiently bear raillery and censure. We know with what art and success Aristophanes and Demosthenes applied their praise and their irony to the Athenian people. When the republic enjoyed peace, says the same Plutarch in another place, it encouraged the adulation of its orators: but when it had important affairs to discuss, when the state was in danger, it became serious; and preferred to its eloquent sycophants, the honest orators who opposed its follies and its vices; such ingenious and bold patriots as a Pericles, a Phocion, and a Demosthenes.

The Athenians, continues Plutarch, often make their governors tremble, and show great humanity to their

their enemies. They were very attentive to the information and instruction of those citizens who were most eminent for their policy and eloquence; but they were on their guard against the superiority of their talents; they often checked their boldness, and repressed their exuberant reputation and glory. That this was their temper, we are convinced by the ostracism: which was established to restrain the ambition of those who had great talents and influence, and which spared neither the greatest nor the best men. The detestation of tyranny and of tyrants, which was inherent in the Athenians, rendered them extremely jealous of their privileges, made them zealous and active in defence of their liberty, whenever they thought it was violated by men in power.

As to their enemies, they did not treat them with rigour. They did not abuse victory by a brutal inhumanity to the vanquished. The act of amnesty, which they passed after the usurpation of the 30 tyrants, proves that they could easily forgive injuries. It was this mildness, this humanity of disposition, which made the Athenians so attentive to the rules of politeness and decorum. In their war with Philip, having seized one of his courtiers, they read all the letters he bore, except one from Olympias to her husband, which they sent back unopened. Such was their veneration of love and conjugal secrecy; those sacred rights, which no enmity, no hostility, warrants us to violate!

The views of conquest cherished by a small republic, were extensive and astonishing; but this people, so great, so ambitious in their projects, were, in other respects, of a different character. In the expences of the table, in dress, in furniture, in houses, in short, in private life, they were frugal, simple, modest, poor; but sumptuous and magnificent whenever the honour of the state was concerned. Their conquests, their victories, their riches, their connections with the inhabitants of Asia Minor, never reduced them to luxury, to riot, to pomp, to profusion. Xenophon remarks, that a citizen was not distinguished from a slave by his dress. The wealthiest citizen, the most renowned general, was not ashamed to go himself to market.

The taste of the Athenians, for all the arts and sciences, is well known. When they had delivered themselves from the tyranny of Pisistratus, and after this had defeated the vast efforts of the Persians, they may be considered as at the summit of their national glory. For more than half a century afterwards they maintained, without controul, the sovereignty of Greece; and that ascendant produced a security, which left their minds at ease, and gave them leisure to cultivate every thing liberal or elegant. It was then that Pericles adorned the city with temples, theatres, and other beautiful public buildings. Phidias, the great sculptor, was employed as his architect, who, when he had erected edifices, adorned them himself, and added statues and basso-relievos, the admiration of every beholder. It was then that Polignotus and Myro painted; that Sophocles and Euripides wrote; and not long after, that they saw the divine Socrates.

Human affairs are, by nature, prone to change; and states, as well as individuals, are born to decay. Jealousy and ambition insensibly fomented wars, and success in these wars, as in others, was often various. The military strength of the Athenians was first impaired by the Lacedæmonians; after that it was again humiliated, under Epaminondas, by the Thebans: and last of all it was wholly crushed by the Macedonian Philip.

Nor, when their political sovereignty was lost, did their love of literature and the arts sink along with it. Just at the close of their golden days of empire flourished Xenophon and Plato, the disciples of Socrates; and from Plato descended that race of philosophers called the *Old Academy*. Aristotle, who was Plato's disciple, may be said not to have invented a new philosophy, but rather to have tempered the sublime and rapturous mysteries of his master with method, order, and a stricter mode of reasoning. Zeno, who was himself also educated in the principles of Platonism, only differed from Plato in the comparative estimate of things, allowing nothing to be intrinsically good but virtue, nothing intrinsically bad but vice, and considering all other things to be in themselves indifferent. He too and Aristotle accurately cultivated logic, but in different ways; for Aristotle chiefly dwelt upon the simple syllogism; Zeno upon that which is derived out of it, the compound or hypothetic. Both too, as well as other philosophers, cultivated rhetoric along with logic; holding a knowledge in both to be requisite for those who think of addressing mankind with all the efficacy of persuasion. Zeno elegantly illustrated the force of these two powers by a simile taken from the hand: the close power of logic he compared to the fist, or hand comprest: the diffuse power of logic, to the palm, or hand open.

The new academy was founded by Arcesilas, and ably maintained by Carneades. From a mistaken imitation of the great parent of philosophy Socrates (particularly as he appears in the dialogues of Plato), because Socrates doubted some things, therefore Arcesilas and Carneades doubted all.—Epicurus drew from another source; Democritus had taught him atoms and a void: by the fortuitous concourse of atoms he fancied he could form a world; while by a feigned veneration he complimented away his gods, and totally denied their providential care, lest the trouble of it should impair their uninterrupted state of bliss. Virtue he recommended, though not for the sake of virtue, but pleasure; pleasure, according to him, being our chief and sovereign good. See Aristotle, Epicurus, Plato, Socrates, &c.

We have already mentioned the alliance between philosophy and rhetoric. This cannot be thought wonderful, if rhetoric be the art by which men are persuaded, and if men cannot be persuaded without a knowledge of human nature: for what but philosophy can procure us this knowledge? It was for this reason the ablest Greek philosophers not only taught, but wrote also treatises upon rhetoric. They had a farther inducement, and that was the intrinsic beauty of their language as it was then spoken among the learned and polite. They would have been ashamed to have delivered philosophy, as it has been too often delivered since, in compositions as clumsy as the common dialect of the mere vulgar.

The same love of elegance, which made them attend to their style, made them attend even to the places

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Attica.

ces where their philosophy was taught. Plato delivered his lectures in a place shaded with groves, on the banks of the river Ilissus; and which, as it once belonged to a person called *Academus*, was called after his name, the ACADEMY. Aristotle chose another spot of a similar character, where there were trees and shade; a spot called the LYCEUM. Zeno taught in a portico or colonnade, distinguished from other buildings of that sort (of which the Athenians had many) by the name of the *Variegated Portico*, the walls being decorated with various paintings of Polygnotus and Myro, two capital masters of that transcendant period. Epicurus addressed his hearers in those well known gardens, called, after his own name, *The gardens of Epicurus*.

These places of public institution were called among the Greeks by the name of *Gymnasia;* in which, whatever that word might have originally meant, were taught all those exercises, and all those arts, which tended to cultivate not only the body but the mind. As man was a being consisting of both, the Greeks could not consider that education as complete, in which both were not regarded, and both properly formed. Hence their Gymnasia, with reference to this double end, were adorned with two statues, those of Mercury and of Hercules, the corporeal accomplishments being patronized (as they supposed) by the god of strength, the mental accomplishments by the god of ingenuity.

It was for the cultivation of every liberal accomplishment that Athens was celebrated (as we have said) during many centuries, long after her political influence was lost and at an end.

She was the place of education, not only for Greeks but for Romans. It was hither that Horace was sent by his father; it was here that Cicero put his son Marcus under Cratippus, one of the ablest philosophers then belonging to that city. The sects of philosophers which we have already described, were still existing when St Paul came thither. We cannot enough admire the superior eloquence of that apostle, in his manner of addressing so intelligent an audience. We cannot enough admire the sublimity of his exordium; the propriety of his mentioning an altar which he had found there; and his quotation from Aratus, one of their well known poets. Nor was Athens only celebrated for the residence of philosophers, and the institution of youth: men of rank and fortune found pleasure in a retreat, which contributed so much to their liberal enjoyment.

We shall finish this picture of the Athenians by the addition of one object more, to which every one will admit they have a right; an object which was prominent and striking, in all their actions and in all their enterprises: We mean their ardent love of liberty. This was their predominant quality; the main spring of their government. From the beginning of the Persian war, they sacrificed every thing to the liberty of Greece. They left, without hesitation, their cities, their houses, to fight at sea the common enemy, from whom they were in danger of servitude. What a glorious day was it for Athens, when all her allies, growing flexible to the advantageous offers which were made to them by the king of Persia, she replied by Aristides, to the ambassadors of that monarch,—"That it was impossible for all the gold in the world to tempt the republic of Athens: to prevail with her to sell her liberty, and that of Greece." It was by these generous sentiments that the Athenians not only became the bulwark of Greece, but likewise guarded the rest of Europe from a Persian invasion.

These great qualities were blended with great failings, seemingly incompatible with patriotism. For the Athenians, notwithstanding their tenacious jealousy of the rights of their country, were a volatile, inconstant, capricious people.

180 Religion.

There never was a people more attentive to the worship of the gods than the Athenians. The worship of their principal deities was diffused over all Greece, and even beyond its limits.

Each temple had its particular religious rites: the pomp, the ceremonies, the duration, and the succession of the solemn feasts were all appointed by fixed rules. The worship paid to each divinity, whether public or private, was founded on traditions, or on laws constantly obeyed. The feast of Bacchus, the Panathenæa, the feast of the mysteries of Eleusis, were celebrated according to established rules, most of which were as ancient as the feasts themselves. The old customs, of which the priests were the guardians, were observed in the temples. It is probable that the priests were consulted on affairs in which the worship of a deity was interested, and that their answer was decisive. We are certain that the Eumolpidæ had this authority. They were the interpreters of the ancient laws on which the worship of Ceres was founded, its magnificence, and its mode—laws which were not written, as Lysias informs us, but were perpetuated by a constant observation. The abuses which had gradually crept into the celebration of those feasts, had given rise to several new regulations; to that of the orator Lycurgus, for example, and to the law of Solon, which enjoined the senate to repair to Eleusis on the second day of the feast: but neither these, nor the other particular regulations which we find in Samuel Petit's collection of Attic laws, could make a religious code. There was no general system which comprehended all the branches of their religion, which, by combining all its articles, might regulate their belief and conduct, and direct the judges in their decisions.

181 Crimes against religion, why sometimes punished with severity.

Crimes against religion were only punished as they affected the state; and consequently they were tried by the magistrate. Mere raillery, though somewhat profane, was thought productive of no worse consequence than offending the ministers of the gods. The Athenians acknowledged no other religion than the hereditary public worship; no other gods than those they had received from their ancestors; no other ceremonies but those which had been established by the laws of the state, and practised by their country from time immemorial. They were only solicitous to preserve this worship, which was closely interwoven with their government, and made a part of its policy. They were likewise attentive to the ceremonial pomp; because order, the regular vigour of legislation, depends greatly on the awe impressed by externals. But as to the inconsistent and monstrous romance of fable, foreign opinions, popular traditions, and poetical fictions, which formed a religion quite different from that of the state —in it they were very little interested, and allowed every one to think of it as he pleased.

This explanation will reconcile a seeming contradic-

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Attica. tion in the conduct of the Athenians, who gave great license to their poets, and severely punished the citizens who were guilty of impiety. Aristophanes, who made as free with the gods as with the great, was applauded by the Athenians. They condemned Socrates to death, who revered the Deity, but disapproved the public manner of worshipping him. The life of Æschylus was in danger, from a suspicion that he had revealed some of the secrets of Eleusis in one of his pieces. The wit of Aristophanes's drama was unpunished.

182 Priests, their duty

The priests were not confined to the care of the altars; they who were vested with the sacerdotal dignity, which was only incompatible with professions merely useful and lucrative, might likewise hold the most important offices of the commonwealth. This we could prove by a great number of examples; we shall cite that of Xenophon the illustrious historian and philosopher: he was likewise a famous general, and he was a priest. He was performing the sacerdotal function when he received the news of his son's death, who was killed at the battle of Mantinea.

The sacred ministry was not only compatible with civil offices, but likewise with the profession of arms. The priest and the soldier were often blended. Callias, the priest of Ceres, fought at Platæa. This custom was not peculiar to the Athenians. The Lacedæmonians, after the battle which we have just mentioned, made three graves for their slain; one for the priests, one for the other Spartans, and one for the Helots.

183 Sacred revenues, &c.

As the ordinary business of life was incompatible with the sacerdotal dignity, the priests had a revenue fixed to their office. We know that a part of the victims was their right, and that apartments were assigned them near the temples. But, besides these advantages, they had a salary proportioned to the dignity of their functions, and to the rank of the deities whom they served. Their salary was probably paid from the revenue of the temples. Those revenues, which kept the temples in repair, and defrayed the sacrificial expences, were very considerable. They were of many different kinds.

A great part of the sacred revenues arose from fines, which individuals were condemned to pay for various offences; fines, of which the tenth part was appropriated to Minerva Polias, and the fiftieth to the other gods, and to the heroes whose names their tribes bore. Besides, if the Prytanes did not hold the assemblies conformably with the laws, they were obliged to pay a fine of 1000 drachms to the goddess. If the Proedri, i. e. the senators whose office it was to lay before the assembly the matters on which they were to deliberate, did not discharge that duty according to the rules prescribed to them, they were likewise condemned to pay a fine, which, as the former, was applied to the use of Minerva. By these fines her temple must have been greatly enriched.

Besides this revenue, which was the common property of the gods, and which varied according to the number and degrees of the misdemeanours, the temples had their permanent revenues: We mean the produce of the lands which were consecrated to the deities. We do not here allude to the lands consecrated to the gods, which were never to be cultivated: such as the territory of Cirrha, proscribed by a solemn decree of the Amphictyons; the land betwixt Megara and Attica, which was consecrated to the goddesses of Eleusis, and many others. We would speak only of those which were cultivated, the fruits of which enriched the temples.

There were likewise lands belonging to the state, the produce of which was destined to defray the expence of the sacrifices which were offered in the name of the republic. There were likewise first fruits which the public officers levied on all lands, for the use of the gods. All these emoluments made a part of the revenue of the temples.

The gods, besides the revenues immediately appertaining to their temples, had certain rights which were granted them by particular compact. The Lepreatæ, for instance, were obliged to pay every year a talent to Olympian Jupiter, on account of a treaty of alliance which they made with the Eleans in one of their wars. The inhabitants of Epidaurus, to obtain leave from the Athenians to cut down olive-trees for statues, which the Pythian priestess had commanded them to make, engaged to send deputies every year to Athens, to offer sacrifices in their name to Minerva and to Neptune. But this prerogative was rather honorary than lucrative.

The tenth part of the spoils taken in war was likewise the property of Minerva. Sacred vessels were bought with the effects of the 30 tyrants. In short, the gods were profited by almost every public accident. But what contributed most to enrich the famous temples of Greece, was the money which was constantly brought to them by individuals, in consequence of vows they had made, or to pay for sacrifices which were offered in their names. The credulity of the people was an inexhaustible fund. That credulity enriched the temples of Delos and Eleusis, and supported the magnificence of Delphi. And those immense treasures which were the fruit of superstition, were often a prey to avarice.

These revenues were not deposited with the priests; nor did they expend them. A moderate salary was all their gain; and to offer sacrifices to the deities whose ministers they were, was all their employment.

It is very probable that all the sacred revenues were paid into the hands of officers who were appointed to receive them, and who were to give an account of the discharge of their trust. Nay, we cannot doubt of this, after reading a passage in Aristotle, who, speaking of the officers of the temples, expressly mentions those who are intrusted with the money appertaining to the gods. Citizens, without doubt, of approved integrity, were chosen to this office; and their duty must have been, to keep the temples in repair and order, and to disburse and keep an account of the ordinary sacred expences.

As to the solemn feasts, which were incredibly magnificent, such as the feast of Bacchus, and the Panathenæa, they were celebrated at the expence of the choregus; i. e. of the chief of the choir of each tribe; for each tribe had its poet and its musicians, who sung, emulating each other, hymns in honour of the deity. The richest citizens were appointed chiefs of the different choirs; and as their office was very expensive, to indemnify them in some degree, the choregus of the

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the victorious tribe had the privilege of engraving his name on the tripod which that tribe suspended to the roof of the temple. This office, though ruinous, was eagerly solicited; and naturally, in a republican state. It led to honours, like the curule dignity at Rome; and it greatly tended to ingratiate its possessor with a people who were more affected with pleasures than with essential services, and who, consequently, would more highly esteem a profuse choregus than a victorious general.

With regard to the fines, which were in the whole, or in part, the property of Minerva and of the other deities, there were at Athens public treasurers appointed to receive them. They were ten in number, and they were nominated by lot. They were called *Treasurers of the goddess*, or *Receivers of the sacred money*. That money they received in the presence of the senate; and they were empowered to diminish or to annihilate the fine, if they thought it unjust. The statue of Minerva, that of the Victories, and the other invaluable pledges of the duration of the state, were deposited with them.

The treasury in which the money consecrated to the gods was kept, was in the citadel, behind the temple of Minerva Polias; and from its situation it was termed *Opisthodomus*. It was surrounded with a double wall. It had but one door, the key of which was kept by the Epistates, or chief of the Prytanes: his dignity was very considerable; but it lasted only one day. In this treasury a register was kept, in which were written the names of all those who were indebted to the state; he who owed the smallest fine was not omitted. If the debtors proved insolvent, they were prosecuted with extreme rigour, and often punished with a cruelty which religion could not excuse; though the interest of the gods was the motive, or rather the pretext. The sacred treasurers held a considerable rank among the magistrates who received the public finances. Of these magistrates there were many kinds, as there were many sorts of revenues.

The Athenian priests did not compose an order distinct and separate from the other orders of the state. They did not form a body united by particular laws, under a chief whose authority extended to all his inferiors. The dignity of sovereign pontiff was unknown at Athens; and each of the priests served his particular temple, unconnected with his brethren. The temples, indeed, of the principal deities; those of Minerva, for instance, of Neptune, of Ceres, and of Proserpine, had many ministers; and in each of them a chief presided, who had the title of *High Priest*. The number of subaltern ministers was in proportion to the rank of the deity; but the priests of one temple were altogether a separate society from those of another. Thus at Athens there was a great number of high priests, because many deities were worshipped there, whose service required many ministers. The power of each priest was confined to his temple; and there was no sovereign pontiff, the minister general of the gods, and the president at all the feasts.

It naturally follows from this account, that the ministers of the gods at Athens were not judges in matters of religion. They were neither authorized to take cognizance of crimes committed against the deity, nor to punish them. Their function was to offer sacrifices to the gods, and to entreat their acceptance of the adorations of the people. But the punishment of impiety, of sacrilege, of the profanation of mysteries, and of other irreligious crimes, was not entrusted to their zeal.

The priests were not only incapable of avenging crimes against religion by a criminal process; they even could not, without an express order either from the senate or the people, exercise their right of devoting criminals to the infernal gods. It was in consequence of a civil sentence pronounced against Alcibiades, that the Eumolpidæ launched their anathema against him. It was in virtue of another decree that they revoked their imprecations, when his countrymen wanted his service, and therefore restored him to their favour.

Religious causes, according to M. de Bougainville, fell under the jurisdiction of the Heliastæ.

The government, though often altered, continued pretty much on the plan established by Solon. 184

People divided into different tribes, &c.

The people of Athens were freemen, sojourners, or slaves. The citizens, called in Greek *Politai*, were very numerous; but what may seem strange, were as many in the time of Cecrops as in the most flourishing state of the commonwealth, hardly ever exceeding 20,000. It was Solon who decreed that none should be accounted free but such as were Athenians both by father and mother. After his time it fell into desuetude, till revived by Pericles; and was again at his instance repealed. After the expulsion of the 30 tyrants, Solon's law was restored. A person born of a stranger was styled *Nothos*, a bastard; whereas the son of a free woman was called *Cnesios*, i. e. *legitimate*. There was in Cynosarges a court of judicature, to which causes of illegitimacy properly belonged; and the utmost care was taken to prevent any from being enrolled Athenian citizens, who had not a clear title thereto. The citizens were divided by Cecrops into four tribes: the first called *Cecropes*, from Cecrops; the second, *Antochthon*, from a king of that name; the third, *Actai*, from Acteus, another king of Athens, or rather from *Acte*, which signifies a *shore;* the fourth, *Puralia:* these names were altered by Cranaus, and again by Ericthonius. In the reign of Erictheus, they were again changed; the soldiers were called *Oblitai*, the craftsmen *Ergatai*, the farmers *Georgoi*, the graziers and shepherds *Aigicorai:* in this state they were when Solon settled the commonwealth, and appointed the senate to be composed of 400, 100 out of each tribe. Clysthenes increased the number of the tribes to ten; and made the senate consist of 500, taking 50 out of each tribe. In succeeding times, two other tribes were added. Each tribe was subdivided into its *Demoi* or wards: and with respect to these it was that Solon instituted the public feasts before-mentioned, at which sometimes the whole tribe assembled, sometimes several wards, and sometimes only the inhabitants of one ward.

The second sort of inhabitants we mentioned were called *Metoicoi*, i. e. *sojourners;* these were persons who lived always at Athens, yet were not admitted free denizens: as for such as did not constantly reside in Athens, they were styled *Xenoi;* i. e. *strangers*. The sojourners were obliged to choose out of the citizens protectors, who were styled *Patrons;* they paid services to the state, and besides these an annual tribute of 12 drachms for every man, and six for every woman; but such as had sons, and paid for them, were

exempted.

exempted. If people fell to poverty, and were not able to pay the tribute, they were seized by the tax-masters, and actually sold for slaves; which, as Diogenes Laertius tells us, was the fate of Xenocrates the philosopher. The sojourners in Attica were under the same law as those in Athens. As to servants, they were freemen, who through indigency were driven to receive wages, and while they were in this state had no vote in the assembly. As to slaves, they were absolutely the property of their masters, and as such were used as they thought fit: They were forbidden to wear clothes, or to cut their hair like their masters; and, which is indeed amazing, Solon prohibited them to love boys, as if that had been honourable: They were likewise debarred from anointing or perfuming themselves, and from worshipping certain deities: They were not allowed to be called by honourable names; and in most other respects were used like dogs. They stigmatized them at their pleasure, that is, branded them with letters in the forehead and elsewhere. However, Theseus's temple was allowed them as a sanctuary, whither, if they were exceedingly ill used, they might fly, and thereby oblige their owners to let them be transferred to another master. In this and many other respects the Athenian slaves were in a much better condition than those throughout the rest of Greece: they were permitted to get estates for themselves, giving a small premium to their masters, who were obliged to make them free if they could pay their ransom; they likewise obtained the same favour from the kindness of their masters, or for having rendered military services to the states. When they were made free, they were obliged to choose patrons; and had likewise the privilege of choosing a curator, who, in case their patrons injured them, was bound to defend them.

185 General assembly of the people.

The general assembly of the people, which Solon made the dernier resort, was called the *Ecclesia;* and consisted of all the freemen of Athens, excepting such as were *atimoi* or infamous. The meetings of these assemblies were either ordinary or extraordinary. The ordinary were such as were appointed by law, the extraordinary such as necessity required. Of the first there were four in 35 days. In the first assembly they approved or rejected magistrates, heard proposals for the public good, and certain causes. In the second they received petitions, and heard every man's judgement on the matters that were before them. In the third they gave audience to foreign ambassadors. The fourth was employed altogether in affairs relating to the gods and their worship. The extraordinary meetings were appointed by the magistrates when occasion required, whereas to the ordinary assemblies the people came of their own accord. The first were held either in the market-place, in the Pnyx a place near the citadel, or in the theatre of Bacchus: as to the latter, the magistrates who appointed the extraordinary meeting appointed also the place where it should be held. If any sudden tempest rose, or any earthquake happened, or any sign notoriously inauspicious appeared, the assembly was immediately adjourned, to prevent the people from apprehending unhappy consequences from their deliberations. But if the weather was fair and serene, and nothing happened out of the ordinary course of things, they proceeded to purify the place where the assembly was held, which was done by sprinkling it round with the blood of young pigs; then the crier made a solemn prayer for the prosperity of the republic, and that heaven would bestow a happy issue on their counsels and undertakings: he then pronounced a bitter execration against any who should in that assembly propound what might be disadvantageous to the state. Those ceremonies being over, they proceeded to business.

186 Method of giving their opinions.

There were several magistrates who had the overseeing and regulating these assemblies. These were, first, the Epistate, or president of the assembly, who was chosen by lot out of the Proedri: his office was to give the signal for the people's voting. Next to him were the Prytanes, i. e. a committee of the senate, who of course were present on this occasion: by their order a programma, or scheme of the business to be proposed at the assembly, was previously set up in some public place, that every man might know what business to apply his thoughts to. The Proedri were nine in number, appointed by lots out of all the tribes to which the Prytanes did not belong: they had the right of proposing to the people what they were to deliberate upon, and their office ended with the assembly; there sat with them assessors, who were to take care that nothing they proposed was detrimental to the commonwealth. The first step to business was the crier's reading the decree of the senate whereon the assembly was to deliberate; when he had finished this, he made proclamation in these words: *Who of the men above 50 will make an oration?* When the old men had done speaking, the crier made proclamation again that any Athenian might then offer his sentiments, whom the law allowed so to do; that is, all such as were above 30 years old, and were not infamous. If such a one rose up to speak, the Prytanes interposed, and bid him be silent; and if he did not obey them, the lictors pulled him down by force. When the debates were over, the president permitted the people to vote; which they did by casting first beans, but in after times pebbles, into certain vessels: these were counted, and then it was declared that the decree of the senate was either rejected or approved: after which, the Prytanes dismissed the assembly.

187 The senate.

The senate was instituted by Solon to prevent the dangerous consequences of leaving the supreme power in the people. At the time of his institution, it was to consist of 400, 100 out of each tribe; it was increased to 500, when the tribes were augmented to 10; and when they came to 12, it was also swelled to 600. They were elected by lots after this manner: At a day appointed, towards the close of the year, the president of each tribe gave in a list of such persons belonging thereto, as were fit for and desired to appear for this dignity: these names were engraven on tables of brass, and a number of beans equal to the number of the amount of them, among which were 100 white ones, put into a vessel; and then the names of the candidates and the beans were drawn one by one, and such as were drawn by the white beans were received into the senate. After the senate was elected, they proceeded to appoint the officers who were to preside in the senate: these were the Prytanes before mentioned; and they were elected thus: The names of the ten tribes were thrown into one vessel, and nine black beans and a white one into another vessel. Then the names of the tribes

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Attica. tribes were drawn with the beans. The tribe to which the white bean answered, presided first; and the rest according to the order in which they were drawn.

188 Prytanes. The Prytanes, while the senate consisted of 500, were 50 in number. For the farther avoiding of confusion, therefore, 10 of these presided a week, during which space they were called *Proedri*; and out of these an Epistate or president was chosen, whose office lasted but one day, and by law no man could hold it more than once: the reason of this was, that he had in his custody the public seal, the keys of the citadel, and the charge of the exchequer. The reader must distinguish between the Epistates and Proedri last mentioned, and those spoken of in the former paragraph, because, though their titles were the same, their offices were perfectly distinct. The senate assembled by direction of the Prytanes once every day, excepting festivals, and sometimes oftener, in the senate-house, which was thence called *Prytaneum*.

189 Laws how established, &c. When a member of the senate made a motion for a new law, it was immediately engraven on tablets, that the members when they came next might be prepared to speak to it. At the subsequent assembly the Epistates opened the matter; after which every senator that pleased delivered his sentiments; then any of the Prytanes drew up the decree, and repeated it aloud: after which they proceeded to vote; and if there was a majority of white beans, then it became *psephisma*, and was afterwards propounded to the people: if they approved it, it became a law; otherwise it was of no force longer than the senate who decreed it subsisted. The power of the senate was very great; for they took the account of magistrates at the expiration of their offices; they directed the provisions made for poor citizens out of the public treasure; they had the superintendency of public prisons, and a power of punishing such as committed acts morally evil, though not prohibited by any law; they had the care likewise of the fleet; and besides all these they had many other branches of authority, which it is not necessary for us to mention. Before they took their seats, they were constrained to undergo a very strict examination, wherein the whole course of their lives was inquired into; and if the least slur on their reputation appeared, they were set aside. When this examination was over, they took an oath, whereby they bound themselves to promote in all their counsels the public good, to advise nothing contrary to the laws, and to execute their functions exactly. The highest fine the senate could impose was 500 drachms: if they thought the offender deserved a heavier mulct, they then transmitted the cause to the Thesmothetæ, who punished them as they thought fit. The senators, when their year was out, gave an account of their management to the people: but that they might have the less to do, they always punished such of their number as they found had offended by expulsion; and in this they were mighty exact. Yet an expelled senator was notwithstanding eligible to any other office, the most trivial omission being sufficient to occasion a dismission from the senatorial dignity; and therefore, when the tribes chose their senators, they also chose a certain number of subsidiaries, out of which, when a senator was expelled, another was substituted in his place. Each senator was allowed a drachm every day: for it was a constant rule with the Athenians, that the public ought to pay for every man's time; and therefore such of the poor Athenians as thought fit to demand it, had three oboli for going to the assembly. If during their administration any ships of war were built, the senators had crowns decreed them; but if not, they were forbid to sue for them.

Next to the senate was the court of AREOPAGUS; for a description of which see that article.

190 Archons, Nomophylaces, &c. The chief magistrates of Athens were Archons, and inferior to them there were many others; of whom it will be necessary to mention some. In the first place they had Nomophylaces, who were also styled *the eleven*, because they were so many in number, one chosen out of each tribe, and a clerk or secretary who made up the eleventh. Their duty it was to look to the execution of the laws: they had authority to seize robbers and other capital offenders; and if they confessed, to put them to death. Dr Potter thinks they resembled our sheriffs. The Phylarchi were the presidents of the Athenian tribes; but in time this became a military title. The Philobasileus was an officer in each tribe, who did the same things within his jurisdiction as the Basileus did with respect to the state. The Demarchi were the principal magistrates in wards. The Lexarchi were six in number, and were bound to take care that the people came duly to the assemblies; in their custody was the public register of the citizens names. They had under them Toxotæ, who were lictors or bailifs; they were sometimes 1000 in number: these men were necessary: but, like most of their sort, were in a manner infamous, as may be gathered from the comedies of Aristophanes; they were generally Scythians, raw-boned, brawny fellows, ready to execute any thing they were commanded. The Nomothetæ were 1000 in number; their business was to watch over and inspect into the laws. There were two sorts of orators in the service of the state. Some were appointed to defend an old law, when a motion was made to repeal it; these had their fee from the state, but the same man was incapable of being elected twice. Besides these, there were 10 settled orators called *Rhetores*, elected by lot; their business was to plead public causes in the senate house. For this they had their stated fees; and with respect to their qualifications, the

191 Laws regarding orators. law run thus: "Let no one be a public orator who hath struck his parents, denied them maintenance, or shut them out of his doors; who hath refused to serve in the army; who hath thrown away his shield; who hath been addicted to lewd women, notoriously effeminate, or has run out his patrimony. If any man who has been guilty of these crimes dare to deliver an oration, let him be brought to trial upon the spot. Let an orator have children lawfully begotten, and an estate within Attica; if in his oration he talks impertinently, makes idle repetitions, affects an unbecoming raillery, digresses from the point in question, or, after the assembly is over, abuses the president, let the Proedri fine him 50 drachms; and if that is not thought enough, let him be brought before the next assembly and fined again."

192 Courts of justice. We shall conclude this draught of the Athenian government with an account of their courts of justice, which, exclusive of the Areopagus, were 10 in number; four had cognizance of criminal, and six of civil causes. These 10 courts were numbered with the 10 first

Attica.

first letters of the alphabet, and were thence styled, *Alpha*, *Beta*, *Gamma*, &c. When an Athenian was at leisure to hear causes, he wrote his own name, that of his father, and the ward to which he belonged, upon a tablet; this he presented to the Thesmothetæ, who returned it again to him with another tablet, with the letter which fell to his lot; then he went to the crier of the court, who presented him a sceptre, and gave him admission. When the causes were over, every judge went and delivered his sceptre to the Prytanes, and received a stated fee for every cause that was tried. But this was intended only to compensate their loss of time; so that there might be no appearance of covetousness, a man was forbid to sit in two courts on the same day. The first criminal court after the Areopagus was that of the *Ephetæ*. It consisted of 51 members, all upwards of 51 years old. Draco gave it a very extensive jurisdiction; but Solon took away from them the power of judging in any other causes than those of manslaughter, accidental killing, and lying in wait to destroy: the Basileus entered all causes in this court. The second criminal court was called *Delphinium*, because it was held in the temple of Apollo Delphinius; it had cognizance of such murders as were confessed by the criminal, but at the same time justified under some pretence or other. The *Prytaneum* was the third criminal court. It held plea of such cases where death ensued from inanimate things; causes were heard here with the same solemnity as in other courts; and on judgment given, the thing, whatever it was, that had occasioned the death of a man, was thrown out of the territory of Athens. The last criminal court was styled *Phreatum*. It sat in a place near the sea shore; and such persons were brought before this court as had committed murders in their own country and fled to Attica; the proceedings of this court were so severe, that they did not permit the criminal to come on shore, but obliged him to plead his cause in his vessel; and if he was found guilty, he was committed to the mercy of the winds and seas.

Of the judicatures for hearing civil causes, the first was the *Parabaston*, so called, as some think, because in it no matter could be heard if the cause of action was above one drachm. The *Cainon*, or new court, was the second tribunal. The third was styled the *court of Lycus*, because it assembled in a temple dedicated to that hero, whose statue, represented with the face of a wolf, was set up in all courts of justice. The *Trigonon* was so called, because it was triangular in its form. The court *Metidius* derived its appellation from the architect who built it. The sixth and last court was called *Heliæa*; it was by far the greatest, and is generally believed to have derived its name from the judges sitting in the open air exposed to the sun. All the Athenians who were free citizens were allowed by law to sit in these courts as judges; but before they took their seats were sworn by Apollo Patrius, Ceres, and Jupiter the king, that they would decide all things righteously and according to law, where there was any law to guide them; and by the rules of natural equity, where there was none. The Helæastic court consisted at least of 50, but its usual number was 500, judges; when causes of very great consequence were to be tried, 1000 sat therein; and now and then the judges were increased to 1500, and even to 2000.

Atticus, Attila.

ATTICUS, Titus Pomponius, one of the most honourable men in ancient Rome. He understood the art of managing himself with such address, that without leaving his state of neutrality, he preserved the esteem and affection of all parties. His strict friendship with Cicero did not hinder him from having great intimacy with Hortensius. The contests at Rome between Cinna's party and that of Marius induced him to go to Athens, where he continued for a long time. He was very fond of polite learning, and kept at his house several librarians and readers. He might have obtained the most considerable posts in the government; but chose rather not to meddle, because in the corruption and faction which then prevailed he could not discharge them according to the laws. He wrote Annals. He married his daughter to Agrippa; and attained to the age of 77.

ATTILA, king of the Huns, surnamed *the scourge of God*, lived in the fifth century. He may be ranked amongst the greatest conquerors, since there was scarcely any province of Europe which did not feel the weight of his victorious arms.

Gibbon's Rome, vol. iii. p. 357.

Attila deduced his noble, perhaps his regal, descent from the ancient Huns, who had formerly contended with the monarchs of China. His features, according to the observation of a Gothic historian, bore the stamp of his national origin: and the portrait of Attila exhibits the genuine deformity of a modern Calmuck; a large head, a swarthy complexion, small deep-seated eyes, a flat nose, a few hairs in the place of a beard, broad shoulders, and a short square body, of nervous strength, though of a disproportioned form. The haughty step and demeanour of the king of the Huns expressed the consciousness of his superiority above the rest of mankind; and he had a custom of fiercing rolling his eyes, as if he wished to enjoy the terror which he inspired. Yet this savage hero was not inaccessible to pity; his suppliant enemies might confide in the assurance of peace or pardon; and Attila was considered by his subjects as a just and indulgent master. He delighted in war: but after he had ascended the throne in a mature age, his head, rather than his hand, achieved the conquest of the north; and the fame of an adventurous soldier was usefully exchanged for that of a prudent and successful general. The effects of personal valour are so inconsiderable, except in poetry or romance, that victory, even among barbarians, must depend on the degree of skill, with which the passions of the multitude are combined and guided for the service of a single man. The arts of Attila were skilfully adapted to the character of his age and country. It was natural enough, that the Scythians should adore with peculiar devotion, the god of war; but as they were incapable of forming either an abstract idea, or a corporeal representation, they worshipped their tutelar deity under the symbol of an iron scimitar. One of the shepherds of the Huns perceived, that a heifer, who was grazing, had wounded herself in the foot; and curiously followed the track of the blood, till he discovered, among the long grass, the

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the point of an ancient sword; which he dug out of the ground, and presented to Attila. That magnanimous, or rather that artful, prince, accepted with pious gratitude, this celestial favour; and, as the rightful possessor of the *sword of Mars*, asserted his divine and indefeasible claim to the dominion of the earth. If the rites of Scythia were practised on this solemn occasion, a lofty altar, or rather pile of faggots, 300 yards in length and in breadth, was raised in a spacious plain; and the sword of Mars was placed erect on the summit of this rustic altar, which was annually consecrated by the blood of sheep, horses, and of the hundredth captive. Whether human sacrifices formed any part of the worship of Attila, or whether he propitiated the god of war with the victims which he continually offered in the field of battle, the favourite of Mars soon acquired a sacred character, which rendered his conquests more easy and more permanent; and the barbarian princes confessed, in the language of devotion or flattery, that they could not presume to gaze with a steady eye on the divine majesty of the king of the Huns. His brother Bleda, who reigned over a considerable part of the nation, was compelled to resign his sceptre and his life. Yet even this cruel act was attributed to a supernatural impulse; and the vigour with which Attila wielded the sword of Mars, convinced the world that it had been reserved alone for his invincible arm. But the extent of his empire affords the only remaining evidence of the number and importance of his victories; and the Scythian monarch, however ignorant of the value of science and philosophy, might perhaps lament that his illiterate subjects were destitute of the art which could perpetuate the memory of his exploits.

If a line of separation were drawn between the civilized and the savage climates of the globe; between the inhabitants of cities who cultivated the earth, and the hunters and shepherds who dwelt in tents; Attila might aspire to the title of supreme and sole monarch of the Barbarians. He alone, among the conquerors of ancient and modern times, united the two mighty kingdoms of Germany and Scythia: and those vague appellations, when they are applied to his reign, may be understood with an extensive latitude. Thuringia, which stretched beyond its actual limits as far as the Danube, was in the number of his provinces: he interposed, with the weight of a powerful neighbour, in the domestic affairs of the Franks; and one of his lieutenants chastised, and almost exterminated, the Burgundians of the Rhine. He subdued the islands of the ocean, the kingdoms of Scandinavia, encompassed and divided by the waters of the Baltic; and the Huns might derive a tribute of furs from that northern region, which has been protected from all other conquerors by the severity of the climate, and the courage of the natives. Towards the east, it is difficult to circumscribe the dominion of Attila over the Scythian deserts: yet we may be assured, that he reigned on the banks of the Volga; that the king of the Huns was dreaded not only as a warrior but as a magician; that he insulted and vanquished the khan of the formidable Geougen; and that he sent ambassadors to negociate an equal alliance with the empire of China. In the proud review of the nations who acknowledged the sovereignty of Attila, and who never entertained during his lifetime the thought of a revolt, the Gepidæ and the Ostrogoths were distinguished by their numbers, their bravery, and the personal merit of their chiefs. The renowned Ardaric king of the Gepidæ, was the faithful and sagacious counsellor of the monarch; who esteemed his intrepid genius, whilst he loved the mild and discreet virtues of the noble Walamir king of the Ostrogoths. The crowd of the vulgar kings, the leaders of so many martial tribes, who served under the standard of Attila, were ranged in the submissive order of guards and domestics round the person of their master. They watched his nod; they trembled at his frown: and at the first signal of his will, they executed without murmur or hesitation his stern and absolute commands. In time of peace, the dependent princes, with their national troops, attended the royal camp in regular succession; but when Attila collected his military force, he was able to bring into the field an army of five, or, according to another account, of seven hundred thousand Barbarians.

The death of Attila was attended with singular circumstances. He had married a new wife, a beautiful virgin named *Ildico*. His nuptials were celebrated with great festivity, at his palace beyond the Danube, and he retired late to bed oppressed with wine. In the night, a blood-vessel burst in his lungs, which suffocated him. The bride was found in the morning sitting by the bedside, lamenting his death and her own danger. The body of Attila was exposed in the plain, while the Huns, singing funeral songs to his praise, marched round it in martial order. The body, enclosed in three coffins, of gold, silver, and iron, was privately interred during the night; and to prevent the violation of his remains by the discovery of the place where he was buried, all the captive slaves who were employed in the solemnity were barbarously massacred. This happened about the year 453. With Attila ended the empire of the Huns. His sons, by dissension and civil war, mutually destroyed each other, or were dispossessed by more powerful and independent chieftains.

For a farther account of his exploits, see the article Huns.

ATTIRE, in hunting, signifies the head or horns of a deer. The attire of a stag, if perfect, consist of bur, pearls, beam, gutters, antler, sur-antler, royal, surroyal, and crotchets; of a buck, of the bur, beam, brow-antler, advancer, palm, and spellers.

ATTITUDE, in *Painting* and *Sculpture*, the gesture of a figure or statue; or it is such a disposition of their parts as serves to express the action and sentiments of the person represented.

ATTIUM, in *Ancient Geography*, a promontory on the north-west of Corsica, (Ptolemy). It still retains some traces of its ancient name, being now called *Punta di Acciuolo* (Cluverius).

ATTLEBURY, a town in the county of Norfolk in England. E. Long. 0. 40. N. Lat. 52. 23.

ATTOLLENS, in *Anatomy*, an appellation given to several muscles, otherwise called *levatores* and *elevatores*. See Anatomy, *Tables of the Muscles*.

ATTORNEY at law, answers to the Procurator or Proctor of the civilians and canonists: And he is one who is put in the place, stead, or turn, of another, to manage his matters of law. Formerly every suitor

suitor was obliged to appear in person, to prosecute or defend his suit (according to the old Gothic constitution), unless by special license under the king's letters patent. This is still the law in criminal cases. And an idiot cannot to this day appear by attorney, but in person; for he hath not discretion to enable him to appoint a proper substitute: and upon his being brought before the court in so defenceless a condition, the judges are bound to take care of his interests, and they shall admit the best plea in his behalf that any one present can suggest. But, as in the Roman law, *cum olim in usu fuisset, alterius nomine agi non posse, sed quia hoc non minimam incommoditatem habebat, cœperunt homines per procuratores litigare;* so, with us, on the same principle of convenience, it is now permitted in general, by divers ancient statutes, whereof the first is statute West. 2. c. 10. that attorneys may be made to prosecute or defend any action in the absence of the parties to the suit. These attorneys are now formed into a regular corps; they are admitted to the execution of their office by the superior courts of Westminster hall; and are in all points officers of the respective courts in which they are admitted; and as they have many privileges on account of their attendance there, so they are peculiarly subject to the censure and animadversion of the judges. No man can practise as an attorney in any of those courts, but such as is admitted and sworn an attorney of that particular court: an attorney of the court of king's bench cannot practise in the court of common pleas; nor *vice versa.* To practise in the court of chancery, it is also necessary to be admitted a solicitor therein: and by the statute 22 Geo. II. c. 46. no person shall act as an attorney at the court of quarter-sessions, but such as has been regularly admitted in some superior court of record. So early as the statute 4 Hen. IV. c. 18. it was enacted, that attorneys should be examined by the judges, and none admitted but such as were virtuous, learned, and sworn to do their duty. And many subsequent statutes have laid them under farther regulations.

Letter of attorney pays by different acts, 6s. By 25 Geo. III. c. 80. the following duties are to be paid by every solicitor, attorney, notary, proctor, agent, or procurator, viz. for every warrant to prosecute for a debt of 40s. or to defend, a stamp duty of 2s. 6d. And they are to take out certificates annually; and if resident in London, Westminster, the bills of mortality, or Edinburgh, they are now obliged to pay 5l. for the same; and in every other part of Great Britain, 3l. The duties are under the management of the commissioners of stamps: and every acting solicitor, and other persons as above, shall annually deliver in a note of his name and residence, to the proper officer of the court in which he practises; the entering officers are to certify notes delivered, and issue annual certificates, stamped as above, which must be renewed ten days before the expiration. Refusing to issue, or improperly issuing certificates, is a penalty of 50l. and damages to the party aggrieved. Acting without a certificate, or giving in a false place of residence, is a penalty of 50l. and incapacity to sue for fees due. A stamped memorandum shall be given to the proper officer, of the names of the parties in every action; and in such cases as used to require precipes. Officers who receive stamped memorandums, are to file the same, on penalty of 50l. and persons not acting conformable to this act forfeit 5l.

Attorney-General, is a great officer under the king, made by letters patent. It is his place to exhibit informations, and prosecute for the crown, in matters criminal; and to file bills in the exchequer, for any thing concerning the king in inheritance or profits; and others may bring bills against the king's attorney. His proper place in court, upon any special matters of a criminal nature, wherein his attendance is required, is under the judges on the left hand of the clerk of the crown: but this is only upon solemn and extraordinary occasions; for usually he does not sit here, but within the bar in the face of the court.

ATTOURNMENT, or Attornment, in *Law*, a transfer from one lord to another of the homage and service a tenant makes; or that acknowledgment of duty to a new lord.

ATTRACTION, in *Natural Philosophy*, a general term used to denote the cause by which bodies tend towards each other, and cohere till separated by some other power.

The principle of attraction, in the Newtonian sense of it, seems to have been first surmised by Copernicus, "As for gravity," says Copernicus, "I consider it as nothing more than a certain natural appetence (*appetentia*) that the Creator has impressed upon all the parts of matter, in order to their uniting or coalescing into a globular form, for their better preservation; and it is credible that the same power is also inherent in the sun and moon, and planets, that those bodies may constantly retain that round figure in which we behold them." *De Rev. Orb. Cœlest.* lib. i. cap. 9. And Kepler calls gravity a corporeal and mutual affection between similar bodies, in order to their union. *Ast. Nov. in Introd.* And he pronounces more positively, that no bodies whatsoever were absolutely light, but only relatively so; and consequently, that all matter was subjected to the law of gravitation. *Ibid.*

The first in this country who adopted the notion of attraction was Dr Gilbert in his book *De Magnete;* and the next was the celebrated Lord Bacon, *Nov. Organ.* lib. ii. aphor. 36. 45. 48. *Sylv.* cent. i. exp. 33. In France it was received by Fermat and Roberval; and in Italy by Galileo and Borelli. But till Sir Isaac Newton appeared, this principle was very imperfectly defined and applied.

It must be observed, that though this great author makes use of the word attraction, in common with the school philosophers; yet he very studiously distinguishes between the ideas. The ancient attraction was supposed a kind of quality, inherent in certain bodies themselves, and arising from their particular or specific forms. The Newtonian attraction is a more indefinite principle; denoting not any particular kind or manner of action, nor the physical cause of such action; but only a tendency in the general, a *conatus accedendi*, to whatever cause, physical or metaphysical, such effect be owing, whether to a power inherent in the bodies themselves, or to the impulse of an external agent. Accordingly, that author, in his *Philosoph. Nat. Prin. Math.* notes, "that he uses the words *attraction*, *impulse*, and *propension* to the centre, indifferently; and cautions the reader not to imagine that by

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Attraction. by attraction he expresses the modus of the action, or the efficient cause thereof, as if there were any proper powers in the centres, which in reality are only mathematical points; or as if centres could attract." Lib. i. p. 5. So he "considers centripetal powers as attractions, though, physically speaking, it were perhaps more just to call them impulses." *Ib.* p. 147. He adds, "that what he calls attraction may possibly be effected by impulse, though not a common or corporeal impulse, or after some other manner unknown to us." *Optic.* p. 322.

Attraction, if considered as a quality arising from the specific forms of bodies, ought, together with sympathy, antipathy, and the whole tribe of occult qualities, to be exploded. But when we have set these aside, there will remain innumerable phenomena of nature, and particularly the gravity or weight of bodies, or their tendency to a centre, which argue a principle of action seemingly distinct from impulse, where at least there is no sensible impulsion concerned. Nay, what is more, this action in some respects differs from all impulsion we know of; impulse being always found to act in proportion to the surfaces of bodies, whereas gravity acts according to their solid content, and consequently must arise from some cause that penetrates or pervades the whole substance thereof. This unknown principle, unknown we mean in respect of its cause, for its phenomena and effects are most obvious, with all the species and modifications thereof, we call *attraction;* which is a general name, under which all mutual tendencies, where no physical impulse appears, and which cannot therefore be accounted for from any known laws of nature, may be ranged.

And hence arise divers particular kinds of attraction; as, *Gravity*, *Magnetism*, *Electricity*, &c. which are so many different principles acting by different laws, and only agreeing in this, that we do not see any physical causes thereof; but that, as to our senses, they may really arise from some power or efficacy in such bodies, whereby they are enabled to act even upon distant bodies, though our reason absolutely disallows of any such action.

Attraction may be divided, with respect to the law it observes, into two kinds.

1. That which extends to a sensible distance. Such are the attraction of gravity, found in all bodies; and the attraction of magnetism and electricity, found in particular bodies. The several laws and phenomena of each, see under their respective articles.

The attraction of gravity, called also among mathematicians the *centripetal force*, is one of the greatest and most universal principles in all nature. We see and feel it operate on bodies near the earth, and find by observation that the same power (i. e. a power which acts in the same manner, and by the same rules, viz. always proportionably to the quantities of matter, and as the squares of the distances reciprocally) does also obtain in the moon, and the other planets primary and secondary, as well as in the comets; and even that this is the very power whereby they are all retained in their orbits, &c. And hence, as gravity is found in all the bodies which come under our observation, it is easily inferred, by one of the settled rules of philosophizing, that it obtains in all others: and as it is found to be as the quantity of matter in each body, it must be in every particle thereof; and hence every particle in nature is proved to attract every other particle, &c. See ATTRACTION, ASTRONOMY *Index*. Attraction.

From this attraction arises all the motion, and consequently all the mutation, in the material world. By this heavy bodies descend, and light ones ascend; by this projectiles are directed, vapours and exhalations rise, and rains, &c. fall. By this rivers glide, the air presses, the ocean swells, &c. In effect, the motions arising from this principle make the subject of that extensive branch of mathematics, called *mechanics* or *statics*, with the parts or appendages thereof, hydrostatics, pneumatics, &c.

2. That which does not extend to sensible distances. Such is found to obtain in the minute particles whereof bodies are composed, which attract each other at or extremely near the point of contact, with a force much superior to that of gravity, but which at any distance from it decreases much faster than the power of gravity. This power a late ingenious author chooses to call the *attraction of cohesion*, as being that whereby the atoms or insensible particles of bodies are united into sensible masses.

This latter kind of attraction owns Sir Isaac Newton for its discoverer; as the former does for its improver. The laws of motion, percussion, &c. in sensible bodies under various circumstances, as falling, projected, &c. ascertained by the later philosophers, do not reach to those more remote intestine motions of the component particles of the same bodies, whereon the changes of the texture, colour, properties, &c. of bodies depend: so that our philosophy, if it were only founded on the principle of gravitation, and carried so far as that would lead us, would necessarily be very deficient.

But beside the common laws of sensible masses, the minute parts they are composed of are found subject to some others, which have been but lately taken notice of, and are even yet imperfectly known. Sir Isaac Newton, to whose happy penetration we owe the hint, contents himself to establish that there are such motions in the *minima naturæ*, and that they flow from certain powers or forces, not reducible to any of those in the great world. In virtue of these powers, he shows, "That the small particles act on one another even at a distance; and that many of the phenomena of nature are the result thereof. Sensible bodies, we have already observed, act on one another divers ways: and as we thus perceive the tenor and course of nature, it appears highly probable that there may be other powers of the like kind; nature being very uniform and consistent with herself. Those just mentioned reach to sensible distances, and so have been observed by vulgar eyes; but there may be others which reach to such small distances as have hitherto escaped observation; and it is probable electricity may reach to such distances, even without being excited by friction.

The great author just mentioned proceeds to confirm the reality of these suspicions from a great number of phenomena and experiments, which plainly argue such powers and actions between the particles, e. g. of salts and water, sulphuric acid and water, nitric acid and iron, sulphuric acid and nitre. He also shows, that these powers, &c. are unequally strong between diffe-

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rent bodies; stronger, e. g. between the particles of potash and those of nitric acid than those of silver, between nitric acid and zinc than iron, between iron and copper than silver or mercury. So sulphuric acid acts on water, but more on iron or copper, &c.

The other experiments which countenance the existence of such principle of attraction in the particles of matter are innumerable.

These actions, in virtue whereof the particles of the bodies above mentioned tend towards each other, the author calls by a general indefinite name *attraction;* which is equally applicable to all actions whereby distant bodies tend towards one another, whether by impulse or by any other more latent power: and from hence he accounts for an infinity of phenomena, otherwise inexplicable, to which the principle of gravity is inadequate.

"Thus (adds our author) will nature be found very conformable to herself and very simple; performing all the great motions of the heavenly bodies by the attraction of gravity, which intercides those bodies, and almost all the small ones of their parts, by some other attractive power diffused through the particles thereof. Without such principles, there never would have been any motion in the world; and without the continuance thereof, motion would soon perish, there being otherwise a great decrease or diminution thereof, which is only supplied by these active principles.

We need not say how unjust it is in the generality of foreign philosophers to declare against a principle which furnishes so beautiful a view, for no other reason but because they cannot conceive how one body should act on another at a distance. It is certain, philosophy allows of no action but what is by immediate contact and impulsion (for how can a body exert any active power there where it does not exist? to suppose this of any thing, even the Supreme Being himself, would perhaps imply a contradiction): yet we see effects without seeing any such impulse; and where there are effects, we can easily infer there are causes, whether we see them or not. But a man may consider such effects without entering into the consideration of the causes, as indeed it seems the business of a philosopher to do: for to exclude a number of phenomena which we do see, will be to leave a great chasm in the history of nature; and to argue about actions which we do not see, will be to build castles in the air.—It follows, therefore, that the phenomena of attraction are matter of physical consideration, and as such entitled to a share in the system of physics; but that the causes thereof will only become so when they become sensible, i. e. when they appear to be the effect of some other higher causes (for a cause is no otherwise seen than as itself is an effect, so that the first cause must from the nature of things be invisible): we are therefore at liberty to suppose the causes of attraction what we please, without any injury to the effects.—The illustrious author himself seems a little irresolute as to the causes; inclining sometimes to attribute gravity to the action of an immaterial cause (*Optics*, p. 343, &c.) and sometimes to that of a material one (Ib. p. 325.).

In his philosophy, the research into causes is the last thing, and never comes under consideration till the laws and phenomena of the effect be settled; it being to these phenomena that the cause is to be accommodated. The cause even of any, the grossest and most sensible action, is not adequately known. How impulse or percussion itself produces its effects, i. e. how motion is communicated by body to body, confounds the deepest philosophers; yet is impulse received not only into philosophy, but into mathematics: and accordingly the laws and phenomena of its effects make the greatest part of common mechanics.

The other species of attraction, therefore, in which no impulse is remarkable, when their phenomena are sufficiently ascertained, have the same title to be promoted from physical to mathematical consideration; and this without any previous inquiry into their causes, which our conceptions may not be proportionate to: let their causes be occult, as all causes strictly speaking are, so that their effects, which alone immediately concern us, be but apparent.

Our great philosopher, then, far from adulterating science with any thing foreign or metaphysical, as many have reproached him with doing, has the glory of having thrown every thing of this kind out of his system, and of having opened a new source of sublimer mechanics, which duly cultivated might be of infinitely greater extent than all the mechanics yet known. It is hence alone we must expect to learn the manner of the changes, productions, generations, corruptions, &c. of natural things; with all that scene of wonders opened to us by the operations of chemistry.

Some of our own countrymen have prosecuted the discovery with laudable zeal: Dr Keill particularly has endeavoured to deduce some of the laws of this new action, and applied them to solve divers of the more general phenomena of bodies, as cohesion, fluidity, elasticity, softness, fermentation, coagulation, &c.; and Dr Freind, seconding him, has made a further application of the same principles, to account at once for almost all the phenomena that chemistry presents: so that some philosophers are inclined to think that the new mechanics should seem already raised to a complete science, and that nothing now can occur but what we have an immediate solution of from the attractive force.

But this seems a little too precipitate: A principle so fertile should have been further explored. Attraction in the gross is so complex a thing, that it may solve a thousand different phenomena alike. The notion is but one degree more simple and precise than action itself; and, till more of its properties are ascertained, it were better to apply it less and study it more. It may be added, that some of Sir Isaac Newton's followers have been charged with falling into that error which he industriously avoided, viz. of considering attraction as a cause or active property in bodies, not merely as a phenomenon or effect.

For an account of the mathematical laws of attraction, see ATTRACTION, SUPPLEMENT.

ATTRACTION of Mountains. See MOUNTAINS.

Elective ATTRACTION. See CHEMISTRY *Index.*

ATTREBATII. See ATREBATII.

ATTRIBUTE, in a general sense, that which agrees with some person or thing; or a quality determining something to be after a certain manner. Thus understanding is an attribute of mind, and extension an attribute of body. That attribute which the mind conceives

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conceives as the foundation of all the rest, is called its *essential attribute;* thus extension is by some, and solidity by others, esteemed the essential attribute of body or matter.

ATTRIBUTES, in *Theology*, the several qualities or perfections of the Divine nature.

ATTRIBUTES, in *Logic*, are the predicates of any subject, or what may be affirmed or denied of any thing.

ATTRIBUTES, in *Painting* and *Sculpture*, are symbols added to several figures, to intimate their particular office and character. Thus the eagle is an attribute of Jupiter; a peacock, of Juno; a caduce, of Mercury; a club, of Hercules; and a palm, of Victory.

ATTRIBUTIVES, in *Grammar*, are words which are significant of attributes; and thus include adjectives; verbs, and particles, which are attributes of substances; and adverbs, which denote the attributes only of attributes. Mr Harris, who has introduced this distribution of words, denominates the former *attributives of the first order*, and the latter *attributives of the second order*.

ATTRITION, the rubbing or striking of bodies one against another, so as to throw off some of their superficial particles.

ATURÆ, an ancient town in the district of Novempopulana in Aquitania, on the river Aturus; now Aire in Gascony, on the Adour. E. Long. 0. 3. N. Lat. 43. 40.

ATWOOD, GEORGE, a mathematician and mechanician. See SUPPLEMENT.

AVA, a kingdom of Asia, in the peninsula beyond the Ganges. The king is very powerful, his dominions being bounded by Bengal and the sea on the west, Siam on the south, Tonquin and Cochin China on the east, and by Tibet and China on the north. Several large rivers run through this country, which annually overflow their banks like the Nile, and thus render it extremely fertile. Here are mines of lead and copper, together with some of gold and silver, besides large quantities of the finest oriental rubies, sapphires, emeralds, &c. See ASIA, N° 81, &c.

AVA, formerly the metropolis of the kingdom of the same name, is situated in E. Long. 96. 30. N. Lat. 21. 0. It is pretty large; the houses built with timber or bamboo canes, with thatched roofs, and floors made of teak plank or split bamboo. The streets are very straight, with rows of trees planted on each side. The king's palace is an exact quadrangle, each side of which is 800 paces, and is surrounded with a brick wall; but the palace itself is of stone. It has four gates: the golden gate, through which all ambassadors enter; the gate of justice, through which the people bring petitions, accusations, or complaints; the gate of grace, through which those pass who have received any favours, or have been acquitted of crimes laid to their charge; and the gate of state, through which his majesty himself passes when he shows himself to the people.

AVA AVA, a plant so called by the inhabitants of Otaheite, in the South sea, from the leaves of which they express an intoxicating juice. It is drunk very freely by the chiefs and other considerable persons, who vie with each other in drinking the greatest number of draughts.

AVADOUTAS, a sect of Indian Bramins, who in austerity surpass all the rest. The other sects retain earthen vessels for holding their provisions, and a stick to lean on; but none of these are used by the Avadoutas; they only cover their nakedness with a piece of cloth; and some of them lay even that aside, and go stark naked, besmearing their bodies with cow-dung. When hungry, some go into houses, and, without speaking, hold out their hand; eating on the spot whatever is given them. Others retire to the sides of holy rivers, and there expect the peasants to bring them provisions, which they generally do very liberally.

AVAIL OF MARRIAGE, in *Scots Law*, that casualty in wardholding, by which the superior was entitled to a certain sum from his vassal, upon his attaining the age of puberty, as the value or avail of his tocher.

AVALANCHES, a name given to prodigious snowballs that frequently roll down the mountains in Savoy, particularly Mount Blanc, to the extreme danger of such adventurous travellers as attempt to ascend those stupendous heights. Some of the avalanches are about 200 feet diameter; being fragments of the ice-rocks which break by their own weight from the tops of the precipices. See *Mount* BLANC.

AVALON, a small but ancient city of France, in the department of the Yonne, and containing 4200 inhabitants in 1815. E. Long. 3. 50. N. Lat. 47. 48.

AVANIA, in the Turkish legislature, a fine for crimes and on deaths, paid to the governor of the place. In the places wherein several nations live together under a Turkish governor, he takes this profitable method of punishing all crimes among the Christians or Jews, unless it be the murder of a Turk.

AVARICUM, an ancient town of the Bituriges in Gallia Celtica, situated on the rivulet Avara, in a very fertile soil (Cæsar.) Now *Bourges*, in Berry. E. Long. 2. 30. N. Lat. 47. 10.

AVAST, in the sea language, a term requiring to stop or to stay.

AVAUNCHERS, among hunters, the second branches of a deer's horns.

AUBAGNE, a town of Provence in France, situated on the river Veaune, on the road from Marseilles to Toulon. The states formerly held their session at this place. E. Long. 5. 52. N. Lat. 43. 17.

AUBAINE, in the old customs of France, a right vested in the king, by virtue of which he claimed the inheritance of all foreigners that died within his dominions, notwithstanding of any testament the deceased could make. An ambassador was not subject to the right of aubaine; and the Swiss, Savoyards, Scots, and Portuguese were also exempted. This ancient privilege of the crown was abolished in 1819.

AUBE, a department in the east of France, comprehending part of the ancient Champagne. It contains 305 square leagues, and had a population of 238,819 in 1815. Troyes is the chief town.

AUBENAS, a town of France, in the department of Ardeche, situated on the river Ardeche, at the foot of the mountains called the *Cevennes*. E. Long. 4. 32. N. Lat. 44. 40.

AUBENTON, a town of France, in the department of Aisne, situated on the river Aube. E. Long. 4. 25. N. Lat. 49. 51.

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AUBETERRE, a town of France, in the Angumois, on the river Dronne. E. Long. 0. 10. N. Lat. 45. 15.

AUBIGNE, a town of France, in the department of Cher, situated on the river Verre, in a flat and agreeable country. It is surrounded with high strong walls, wide ditches, and high counterscarps. The castle is within the town, and is very handsome. E. Long. 2. 20. N. Lat. 47. 29.

AUBIN DU COMIER, a town of Erance, in the department of Isle and Vilaine. W. Long. 1. 15. N. Lat. 48. 15.

AUBIN, in *Horsemanship*, a broken kind of gait, between an amble and a gallop, accounted a defect.

AUBONNE, a town of Switzerland, in the canton of Bern. E. Long. 5. 54. N. Lat. 46. 30. It is situated near a river of the same name, seven miles north of the lake of Geneva, upon an eminence which has a gentle declivity, at the foot of which runs the river with an impetuous torrent. The town is built in the form of an amphitheatre; on the upper part of which stands a very handsome castle with a fine court, and a portico supported by pillars of a single stone each; above there is a covered gallery that runs round the court; and as the castle stands high, there is a most delightful prospect, not only of the town and neighbouring fields, but of the whole lake of Geneva and the land that surrounds it. At Thonen, in Savoy, on the other side of the lake, is a town covered with tin, which makes a glittering appearance when the sun is in a certain position; and the castle of Aubonne has likewise a tower of the same kind, which at certain hours makes a similar appearance to the Savoyards. The bailiage of Aubonne contains several villages, which are mostly at the foot of the mountain Jura. In one part of this mountain there is a very deep cave, wherein those that go down find a natural and perpetual icehouse. At the bottom is heard a great noise like that of a subterraneous river, which is supposed to be that of the river Aubonne, because it first appears, with several sources, about 100 paces from the foot of that mountain.

AUBREY, JOHN, a famous English antiquary, descended from an ancient family in Wiltshire, was born in 1626. He made the history and antiquities of England his peculiar study and delight; and contributed considerable assistance to the famous *Monasticon Anglicanum*. He succeeded to several good estates; but law-suits and other misfortunes consumed them all, so that he was reduced to absolute want. In this extremity he found a valuable benefactress in the Lady Long of Draycot in Wilts, who gave him an apartment in her house, and supported him to his death, which happened about the year 1700. He was a man of considerable ability, learning, and application, a good Latin poet, an excellent naturalist, but somewhat credulous, and tinctured with superstition. He left many works behind him. He wrote, 1. Miscellanies. 2. A Perambulation of the county of Surry, in five volumes, octavo. 3. The Life of Mr Hobbes of Malmsbury. 4. *Monumenta Britannica*, or a discourse concerning Stonehenge, and Roll Rich stones in Oxfordshire. 5. *Architectonica Sacra*; and several other works still in manuscript.

AUBURN, a market-town of Wiltshire, in England. W. Long. 1. 20. N. Lat. 53. 20.

AUBUSSON, a small town of France, in the province of La Marche, and the government of the Lyonnois, now the department of Creuse. Its situation is very irregular, on the river Creuse, in a bottom surrounded with rocks and mountains. A manufacture of tapestry is carried on here, and the town contained a population of 3520 souls in 1815. E. Long. 2. 15. N. Lat. 45. 58.

AUCAUGREL, the capital of the kingdom of Adel in Africa, seated on a mountain. E. Long. 44. 25. N. Lat. 9. 10.

AUCH, a city of France, the capital of the county of Armagnac, now the department of Gers, and the metropolis of all Gascony. The archbishop formerly assumed the title of primate of Aquitain. It lies on the summit and declivity of a very steep hill, which is surrounded by other hills that rise at a small distance; and through the vale below runs a rivulet, called the *Gers*. The inhabitants amount to 8800; the buildings are modern and elegant; the streets, though in general narrow, yet are clean and well paved. In the centre of the city stands the cathedral, which is one of the most magnificent in France, both as to its construction and the internal decorations. The painted windows are only inferior to those of Gouda in Holland. The chapels are of equal beauty, and ornamented at a prodigious expence. The revenues of the see of Auch amounted formerly to three hundred thousand livres per annum. It contains manufactures of serge and the coarse woollens called *barat*; there are also tanneries, and the environs are noted for producing the excellent pear called *bon chretien*.

AUCTION, a kind of public sale, very much in use for household goods, books, plate, &c. By this method of sale the highest bidder is always the buyer. This was originally a kind of sale among the ancient Romans, performed by the public crier *sub hasta*, i. e. under a spear stuck up on that occasion, and by some magistrate, who made good the sale by delivery of the goods.

AUDEANISM, the same with anthropomorphism. See ANTHROPOMORPHITES.

AUDEUS, the chief of the Audeans, obtained the name of a heretic, and the punishment of banishment, for celebrating Easter in the manner of the Jews, and attributing a human form to the Deity. He died in the country of the Goths, about the year 370.

AUDIENCE given to ambassadors, a ceremony observed in courts at the admission of ambassadors or public ministers to a hearing.

In England, audience is given to ambassadors in the presence chambers; to envoys and residents, in a gallery, closet, or in any place where the king happens to be. Upon being admitted, as is the custom of all courts, they make three bows; after which they cover and sit down; but not before the king is covered and sat down, and has given them the sign to put on their hats. When the king does not care to have them covered, and sit, he himself stands uncovered; which is taken as a slight. At Constantinople, ministers usually have audience of the prime vizier.

AUDIENCE

Audience is also the name of a court of justice established in the West Indies by the Spaniards, answering in effect to the parliament in France. These courts take in several provinces, called also *audiences*, from the name of the tribunal to which they belong.

Audience is also the name of an ecclesiastical court held by the archbishop of Canterbury, wherein differences upon elections, consecrations, institutions, marriages, &c. are heard.

AUDIENDO & terminando, a writ, or rather a commission to certain persons, when any insurrection or great riot is committed in any place, for the appeasing and punishment thereof.

AUDIENTES, or Auditores, in church history, an order of catechumens; consisting of those newly instructed in the mysteries of the Christian religion, and not yet admitted to baptism.

AUDIT, a regular hearing and examination of an account by some proper officers, appointed for that purpose.

AUDITOR, in a general sense, a hearer, or one who listens or attends to any thing.

Auditor, according to our *Law*, is an officer of the king, or some other great person, who, by examining yearly the accounts of the under officers, makes up a general book, with the difference between their receipts and charges, and their allowances to allocations.

Auditor of the Receipts, is an officer of the exchequer who files the tellers bills, makes an entry of them, and gives the lord treasurer a certificate of the money received the week before. He also makes debentures to every teller, before they receive any money, and takes their accounts. He keeps the black book of receipts, and the treasurer's key of the treasury, and sees every teller's money locked up in the new treasury.

Auditors of the Revenue, or of the exchequer, officers who take the accounts of those who collect the revenues and taxes raised by parliament, and take the accounts of the sheriffs, escheators, collectors, tenants, and customers, and set them down in a book, and perfect them.

Auditors of the Prest and Imprest, officers of the exchequer, who take and make up the accounts of Ireland, Berwick, the mint, and of any money impressed to any man for the king's service. They received poundage on all accounts passed by them, which amounted to a prodigious sum, especially in time of war. But the office is now abolished, and 7000l. a-year given to the incumbents.

Auditors Collegiate, *Conventual*, &c. officers formerly appointed in colleges, &c. to examine and pass their accounts.

AUDITORES, in church history. See Audientes.

The auditores formed one branch of the Manichean sect, which was divided into *elect* and *auditors;* corresponding, according to some writers, to *clergy* and *laity;* and, according to others, to the *faithful* and *catechumens* among the Catholics. By the Manichean rule, a different course of life was prescribed to the elect from that of the auditors. The latter might eat flesh, drink wine, bathe, marry, traffic, possess estates, bear magistracy, and the like; all which things were forbidden to the elect. The auditors were obliged to maintain the elect, and kneeled down to ask their blessing. Beausobre observes, that the elect were ecclesiastics, and in general, such as made profession of observing certain counsels, called *evangelic;* such as the clergy and monks; and they were called the *perfect* by Theodoret. The auditors were the laity, and so denominated, because they heard in the church, whilst others taught and instructed.

AUDITORIUM, in the ancient churches, was that part of the church where the audientes stood to hear and be instructed.

The auditorium was that part now called *navis ecclesiæ**. In the primitive times, the church was so strict in keeping the people together in that place, that the person who went from thence in sermon-time, was ordered by the council of Carthage to be excommunicated.

* See Nave.

AUDITORY, something relating to the sense of hearing.

Auditory, or Audience, an assembly of people who attend to hear a person who speaks in public.

Auditory is also used for the bench whereon a magistrate or judge hears causes.

Auditory, in ancient churches. See Auditorium.

Auditory Passage, (*meatus auditorius*), in *Anatomy;* the entrance of the ear. See Anatomy *Index*.

Auditory Nerves. See Anatomy *Index*.

AUDRAN, Claude, a French engraver, the first of the celebrated artists of that name, was the son of Lewis Audran, an officer belonging to the wolf-hunters, in the reign of Henry IV. of France; and was born at Paris in 1592. He never made any great progress in that art; so that his prints are held in little or no estimation. Yet though he acquired no great reputation by his own works, it was no small honour to him to be the father of three great artists, Germain, Claude, and Girard; the last of whom has immortalized the name of the family. Claude Audran retired from Paris to Lyons, where he resided, and died in 1677.

Audran, *Carl*, a very eminent engraver, was brother to the preceding, though some assert he was only his cousin-german; and was born at Paris in 1594. In his infancy he discovered much taste, and a great disposition for the arts; and to perfect himself in engraving, which he appears to have been chiefly fond of, he went to Rome, where he produced several prints that did him great honour. At his return, he adopted that species of engraving which is performed with the graver only. He settled at Paris, where he died in 1674, without having ever been married. The Abbé Marolles, who always speaks of this artist with great praise, attributes 130 prints to him: amongst which, the *annunciation*, a middle-sized plate, upright, from Hannibal Carracci; and the *assumption*, in a circle, from Domenichino, are the most esteemed. In the early part of his life he marked his prints with C, or the name of Carl, till his brother Claude published some plates with the initial only of his baptismal

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Audran.

tismal name; when, for distinction's sake, he used the letter K, or wrote his name Karl, with the K instead of the C.

AUDRAN, *Germaine*, the eldest son of Claude, mentioned in the preceding article but one, was born in 1631 at Lyons, where his parents then resided. Not content with the instructions of his father, he went to Paris, and perfected himself under his uncle Carl; so that, upon his return to Lyons, he published several prints which did great honour to his graver. His merit was in such estimation, that he was made a member of the academy established in that town, and chosen a professor. He died at Lyons in 1710, and left behind him four sons, all artists; namely, Claude, Benoist, John, and Louis.

AUDRAN, *Claude*, the second of this name, and second son to Claude above mentioned, was born at Lyons in 1639, and went to Rome to study painting; where he succeeded so well, that at his return he was employed by Le Brun to assist him in the battles of Alexander, which he was then painting for the king of France. He was received into the Royal Academy in the year 1675, and died unmarried at Paris in 1684. His virtues (says Abbe Fontenai) were as praiseworthy as his talents were great. M. Heineken mentions this artist as an engraver, without specifying any of his works in that line.

AUDRAN, *Girard*, or *Gerard*, the most celebrated artist of the whole family of the Audrans, was the third son of Claude Audran mentioned in a preceding article, and born at Lyons in 1640. He learned from his father the first principles of design and engraving; and following the example of his brother, he left Lyons and went to Paris, where his genius soon began to manifest itself. His reputation there brought him to the knowledge of Le Brun, who employed him to engrave the *battles of Constantine*, and the *triumph* of that emperor; and for these works he obtained apartments at the Gobelins. At Rome, whither he went for improvement, he is said to have studied under Carlo Maratti, in order to perfect himself in drawing; and in that city, where he resided three years, he engraved several fine plates. M. Colbert, that great encourager of the arts, was so struck with the beauty of Audran's works whilst he resided at Rome, that he persuaded Louis XIV. to recal him. On his return, he applied himself assiduously to engraving; and was appointed engraver to the king, from whom he received great encouragement. In the year 1681 he was named counsellor of the Royal Academy; and died at Paris in 1703. He had been married; but left no male issue behind him.

Strutt's Dictionary.

The great excellency of this artist above that of any other engraver was, that though he drew admirably himself, yet he contracted no manner of his own; but transcribed on copper simply, with great truth and spirit, the style of the master whose pictures he copied. On viewing his prints you lose sight of the engraver, and naturally say, it is Le Brun, it is Poussin, it is Mignard, or it is Le Sueur, &c. as you turn to the prints which he engraved from those masters. Let any one examine the *battles* above-mentioned from Le Brun, the *preservation of the young Pyrrhus* from Nicholas Poussin, the *pest* from Mignard, and the *martyrdom of St Lawrence* from Le Sueur, and then judge candidly of the truth of this observation. The following judicious observations by the abbé Fontenai, taken chiefly from M. Basan, with some small variation and additions, will fully illustrate the merits of Gerard Audran. "This sublime artist, far from conceiving that a servile arrangement of strokes, and the too frequently cold and affected clearness of the graver, were the great essentials of historical engraving, gave worth to his works by a bold mixture of free hatchings and dots, placed together apparently without order, but with an inimitable degree of taste; and has left to posterity most admirable examples of the style in which grand compositions ought to be treated. His greatest works, which have not a very flattering appearance to the ignorant eye, are the admiration of true connoisseurs and persons of fine taste. He acquired the most profound knowledge of the art by the constant attention and study which he bestowed upon the science of design, and the frequent use he made of painting from nature. This great man always knew how to penetrate into the genius of the painter he copied from; often improved upon, and sometimes even surpassed him. Without exception, he was the most celebrated engraver that ever existed in the historical line. We have several subjects which he engraved from his own designs, that manifested as much taste as character and facility. But, in the *battles of Alexander*, he surpassed even the expectations of Le Brun himself." These consist of three very large prints, lengthwise, each consisting of four plates, which join together, from Le Brun; namely, *the passage of the Granicus; the battle of Arbela; Porus brought to Alexander*, after his defeat. To this set are added two more large prints lengthwise, on two plates each, also from Le Brun, as follow: *Alexander entering the tent of Darius;* and *The triumphal entry of Alexander into Babylon*. The former was engraved by Gerard Edelink, and the latter by Gerard Audran. It is to be remarked of all these plates, that those impressions are generally most esteemed which have the name of Goyton the printer marked upon them. The *Pest*, from Peter Mignard, a large plate, lengthwise, also deserves particular notice. In the first impressions, the figure in the clouds is Juno with her peacock behind her; in the latter, the peacock is obliterated, and the wings of an angel are added to the figure.

AUDRAN, *Benoit*, the second son of Germain Audran, was born at Lyons in 1661, where he learned the first principles of design and engraving under the instruction of his father. But soon after going to Paris, his uncle Gerard Audran took him under his tuition; and Benoit so greatly profited by his instructions, that though he never equalled the sublime style of his tutor, yet he deservedly acquired great reputation. Nay, the abbé Fontenai adds this eulogium: "We admire in his works a share of those beauties which we find in the engravings of the illustrious Gerard." He was honoured with the appellation of the king's engraver, and received the royal pension. He was made an academician, and admitted into the council in 1715. He died unmarried at Louzouer, where he had an estate, in 1721. His manner was founded upon the bold clear style of his uncle. His outlines were firm and determined; his drawing correct; the heads of his figures are in general very expressive; and the

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the other extremities well marked. His works, when compared with those of his uncle, appear to want that mellowness and harmony which are so conspicuous in the latter; they are more dry; and the round dots with which he finished his flesh upon the lights are often too predominant. In his most finished plates, we find the mechanical part of the engraving extremely neat, and managed with great taste and judgment. Among his neatest prints may be reckoned that which represents *Alexander sick*, drinking from the cup which his physician presents to him: a circular plate, from Le Sueur.

AUDRAN, *John*, the third son of Germain Audran, was born at Lyons in 1667; and, after having received instructions from his father, went to Paris to perfect himself in the art of engraving under his uncle Gerard Audran. At the age of 20 years, the genius of this great artist began to display itself in a surprising manner; and his future success was such, that in 1707, he obtained the title of engraver to the king, and had a pension allowed him by his majesty, with apartments in the Gobelins; and the following year he was made a member of the Royal Academy. He was 80 years of age before he quitted the graver: and near 90 when he died at his apartments assigned him by the king. He left three sons behind him; one of whom was also an engraver, as we shall see below. "The most masterly and best prints of this artist (in Mr Strutt's opinion) are those which are not so pleasing to the eye at first sight. In these the etching constitutes a great part; and he has finished them in a bold rough style. The scientific hand of the master appears in them on examination. The drawing of the human figure, where it is shown, is correct. The heads are expressive and finely finished; the other extremities well marked. He has not, however, equalled his uncle. He wants that harmony in the effect; his lights are too much and too equally covered; and there is not sufficient difference between the style in which he has engraved his back grounds and his draperies. This observation refers to a fine print by him of Athaliah, and such as he engraved in that style. At other times he seems almost to have quitted the point, and substituted the graver. But here I think he has not so well succeeded. The effect is cold and silvery: see, for example, the *Andromache* from Sylvestre. One of his best finished prints, in this neat style, seems to me to be *Cupid* and *Psyche* from Ant. Coypel."

AUDRAN, *Louis*, the last son of Germain Audran, was born at Lyons in 1670; from whence he went to Paris, after the example of his brothers, to complete his studies in the school of his uncle Gerard. He died suddenly at Paris in 1712, before he had produced any great number of prints by his own hand. He assisted, it is presumed, his brothers in their more extensive works. Among the most esteemed prints by this artist are *the seven acts of mercy*, on seven middling sized plates, lengthwise, from Sebastian Bourdon.

AUDRAN, *Benoit*, the second engraver of that name, was the son of John Audran, and nephew to the former Benoit: and was also established at Paris. He engraved but a few plates. It is necessary, however, to be careful not to confound him with his uncle. But a little attention will easily prevent this mistake; for the second Benoit is vastly inferior to the first in point of merit. We have some few portraits by this artist: and among other plates, the *descent from the cross*, from a picture of Poussin.

AVEIRO, a considerable city of Portugal, seated near the head of a small gulf formed by the tide at the mouth of the river Vouga. This river forms a small haven with a bar, over which vessels may pass that do not draw above eight or nine feet water. The city stands in a long plain well watered, and very fertile. This plain is nine miles broad, from Porto to Coimbra; and is bounded on the east by a chain of mountains called *Sara d'Alcoba*, which reach from the one town to the other. Near this city there is salt made in sufficient quantity to serve two or three provinces. Here is a remarkable nunnery, where none are received but the daughters of the ancient nobility. The inhabitants of Aveiro have the singular privilege, that no stranger whatever can pass a night there without leave of the magistrate. W. Long. 8. 34. N. Lat. 40. 30.

AVELLANE, in *Heraldry*, a cross, the quarters of which somewhat resemble a filbert-nut. Sylvanus Morgan says, that it is the cross which ensigns the mound of authority, or the sovereign's globe.

AVELLINO, a city of Italy, in the kingdom of Naples, with a bishop's see. It was almost ruined by an earthquake in 1694. It is, however, at present a pretty considerable place, extending a mile in length down the declivity of a hill, with ugly streets, but tolerable houses. The churches have nothing to recommend them, being crowded with monstrous ornaments, in a barbarous style, which the Neapolitans seem to have borrowed from the Spaniards. The cathedral is a poor building, in a wretched situation, with little to attract the eye. The good people here need not run to Naples to see the blood of St Januarius: for they have a statue of St Lawrence, with a phial of his blood, which for eight days in August entertains them with a similar miraculous liquefaction. Their only edifice of note is a public granary, of the Composite order, adorned with antique statues, and a very elegant bronze one of Charles II. of Spain, while a boy, cast by Cavalier Cosimo. The number of inhabitants amounts to 8000, some say 10,000. The bishop's revenue is about 6000 ducats (1125l.) a-year. The magistracy consists of a syndic and four eletti, all annual; which offices are engrossed by a certain number of families of some distinction, that neither intermarry nor associate with the rest of the burghers. There is a considerable manufacture of cloth here of various qualities and colours, but chiefly blue. Many wealthy merchants have a concern in this business, some with a capital of eighty thousand ducats (15,000l.). The poor women who spin the wool must work very hard to earn above four grana a-day. The second article of trade is maccaroni and paste of many kinds, which being of an excellent quality, are in high repute all over the country. Wooden chairs are also made and sold here in great quantities. Avellino abounds with provisions of every sort; each street is supplied with wholesome water; the wine is but indifferent. The soil of this district, which consists chiefly of volcanic substances, produces little corn, but fruit in abundance, of which the apple is deservedly held in great esteem. The most profitable, however, of all its fruit-trees is the hazel. Nut bushes cover the face of the valley, and in

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good years bring in a profit of sixty thousand ducats (11,250l.). The nuts are mostly of the large round species of filbert, which we call *Spanish*. These bushes were originally imported into Italy from Pontus, and known among the Romans by the appellation of *Nux Pontica*, which in process of time was changed into that of *Nux Avellana*, from the place where they had been propagated with the greatest success. The proprietors plant them in rows, and by dressing, form them into large bushes of many stems. Every year they refresh the roots with new earth, and prune off the straggling shoots with great attention.

AVE-MARIA, the angel Gabriel's salutation of the Virgin Mary, when he brought her the tidings of the incarnation.—It is become a prayer or form of devotion in the Romish church. The chaplets and rosaries are divided into so many ave-marias, and so many pater-nosters, to which the Papists ascribe a wonderful efficacy.

AVENA, OATS. See BOTANY *Index*.

AVENACEOUS, something belonging to or partaking of the nature of oats.

AVENAGE, in *Law*, a certain quantity of oats paid by a tenant to a landlord, instead of rent or some other duties.

AVENCHE, an ancient city of Switzerland, in the canton of Bern, formerly the capital of all Switzerland, but now shows its former greatness only by its ruins. E. Long. 7. 7. N. Lat. 46. 50.

AVENES, a small but strong town in French Flanders, in the county of Hainault, seated on the river Thespis. It contains about 2700 inhabitants; but the houses are wretchedly built, and the streets irregular. It was fortified by M. Vauban in a strong regular manner. About this place is a prodigious number of white stones proper for building, and used by sculptors for statues: they are known by the name of *Stones of Avenes*. E. Long. 3. 50. N. Lat. 50. 10.

AVENIO, an ancient town of the Cavares, and one of the most opulent in Gallia Narbonensis; now *Avignon*, in Provence. See AVIGNON.

AVENOR, an officer belonging to the king's stables, who provides oats for the horses. He acts by warrant from the master of the horse.

AVENS. See CARIOPHYLLUS, BOTANY *Index*.

AVENTINE, JOHN, author of the Annals of Bavaria, was born of mean parentage, in the year 1466, at Abensperg in the country just named. He studied first at Ingoldstadt, and afterwards in the university of Paris. In 1503, he privately taught eloquence and poetry at Vienna; and in 1507 he publicly taught Greek at Cracow in Poland. In 1509, he read lectures on some of Cicero's works at Ingoldstadt: and in 1512, was appointed to be preceptor to Prince Louis and Prince Ernest, sons of Albert the Wise, duke of Bavaria, and travelled with the latter of these two princes. After this he undertook to write the annals of Bavaria; being encouraged by the dukes of that name, who settled a pension upon him, and gave him hopes that they would defray the charges of the book. This work, which gained its author great reputation, was first published in 1554, by Jerome Zieglerus, professor of poetry in the university of Ingoldstadt; and afterwards at Basil in 1580, by Nicholas Cisner. An affront which Aventine received in the year 1529, stuck by him all the rest of his life: he was forcibly taken out of his sister's house at Abensperg, and hurried to jail; the true cause of which violence was never known: but it would probably have been carried to a much greater length, had not the duke of Bavaria interposed, and taken this learned man into his protection. Mr Bayle remarks, that the incurable melancholy which from this time possessed Aventine, was so far from determining him to lead a life of celibacy, as he had done till he was 64, that it induced him perhaps to think of marrying. The violence of his new passion was not, however, so great, but that it suffered him to advise with two of his friends, and consult certain passages of the Bible relative to marriage. The result was, that it was best for him to marry; and having already lost too much time, considering his age, he took the first woman he met with, who happened to be his own maid, ill-tempered, ugly, and extremely poor. He died in 1534, aged 68; leaving one daughter, who was then but two months old. He had a son, who died before.

AVENTINUS MONS, one of the seven hills on which ancient Rome stood. The origin of the name *Aventinus* is uncertain: but this hill was also called *Murcius*, from Murcia the goddess of sloth, who had a little chapel there; and *Collis Dianæ*, from the temple of Diana; likewise *Remonius*, from Remus, who wanted to build the city, and who was buried there. It was taken within the compass of the city by Ancus Martius. To the east it had the city walls; to the south, the Campus Figulinus; to the west, the Tiber; and to the north, Mons Palatinus: in circuit two miles and a quarter.

AVENTURE, in law books, means a mischance causing the death of a person without felony.

AVENUE, in *Gardening*, a walk planted on each side with trees, and leading to a house, garden-gate, wood, &c. and generally terminated by some distant object.

All avenues that lead to a house ought to be at least as wide as the whole front of the house, if wider they are better still; and avenues to woods, and prospects, ought not to be less than 60 feet wide. The trees should not be planted nearer to one another than 35 feet, especially if they are trees of a spreading kind; and the same ought to be the distance, if they are for a regular grove.

The trees most proper for avenues with us, are the English elm, the lime, the horse-chesnut, the common chesnut, the beech, and the abele. The English elm will do in all grounds, except such as are very wet and shallow; and this is preferred to all other trees, because it will bear cutting, heading, or lopping in any manner, better than most others. The rough or smooth Dutch elm is approved by some, because of its quick growth. This is a tree which will bear removing very well; it is also green almost as soon as any plant whatever in spring, and continues so as long as any, and it makes an incomparable hedge, and is preferable to all other trees for lofty espaliers. The lime is valued for its natural growth and fine shade. The horse-chesnut is proper for all places that are not too much exposed to rough winds. The common chesnut will do very well in a good soil; and rises to a considerable height, when planted somewhat close; though, when it stands single, it is rather inclined to spread than to grow tall.

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The beech is a beautiful tree, and naturally grows well with us in its wild state; but it is less to be chosen for avenues than the before-mentioned, because it does not bear transplanting well, but is very subject to miscarry. Lastly, the abele is fit for any soil, and is the quickest grower of any forest-tree. It seldom fails in transplanting; and succeeds very well in wet soils, in which the others are apt to fail. The oak is but little used for avenues, because of its slow growth.

The old method of planting avenues was with regular rows of trees, and this has been always kept to till of late: but we have now a much more magnificent way of planting avenues; this is by setting the trees in clumps, or platoons, making the opening much wider than before, and placing the clumps of trees at about 300 feet distant from one another. In each of these clumps there should be planted either seven or nine trees; but it is to be observed, that this is only to be practised where the avenue is to be of some considerable length, for in short walks this will not appear so sightly as single rows of trees. The avenues made by clumps are fittest of all for parks. The trees in each clump should be planted about 30 feet asunder; and a trench should be thrown up round the whole clump, to prevent the deer from coming to the trees to bark them.

AVENZOAR, Abu Merwan Abdalmalec ebn Zohr, an eminent Arabian physician, flourished about the end of the eleventh or the beginning of the twelfth century. He was of noble descent, and born at Seville, the capital of Andalusia, where he exercised his profession with great reputation. His grandfather and father were both physicians. The large estate he inherited from his ancesters, set him above practising altogether for gain: he therefore took no fees from the poor, or from artificers, though he refused not the presents of princes and great men. His liberality was extended even to his enemies; for which reason he used to say, that they hated him not for any fault of his, but rather out of envy. Dr Freind writes, that he lived to the age of 135; that he began to practise at 40, or (as others say) at 20; and had the advantage of a longer experience than almost any one ever had, for he enjoyed perfect health to his last hour. He left a son, known also by the name of *Ebn Zohr*, who followed his father's profession, was in great favour with Al Manzur emperor of Morocco, and wrote several treatises of physic.

Avenzoar was cotemporary with Averroes, who, according to Leo Africanus, heard the lectures of the former, and learned physic of him; this seems the more probable, because Averroes more than once gives Avenzoar a very high and deserved encomium, calling him *admirable*, *glorious*, *the treasure of all knowledge*, and *the most supreme in physic from the time of Galen to his own*. Avenzoar, notwithstanding, is by the generality of writers reckoned an empiric: but Dr Freind observes, that this character suits him less than any of the rest of the Arabians. "He was bred," continues that author, "in a physical family, his father and grandfather being both practitioners, whom he always remembers with great gratitude and honour. We have his own testimony that he had a regular education; and that he not only learned what properly belongs to a physician, but, out of a great desire of knowledge, every thing besides which relates to pharmacy or surgery." Dr Freind afterwards observes, "that he was averse to quackery, and rejects the idle superstitions of astrologers; and throughout all his works professes himself so much of the dogmatical or rational sect, which was directly opposite to the empirical, that he has a great deal of reasoning about the causes and symptoms of distempers; and as in his theory he chiefly, if not only, follows Galen, so he quotes him upon all occasions, oftener than the rest of the Arabians do. Notwithstanding he is so Galenical, there are several particulars in him which seldom or ever occur in other authors; and there are some cases which he relates from his own experience, which are worth perusing." He wrote a book entitled, *Tayassir fi'lmâdawât w'altadbîr*, i. e. "The method of preparing medicines and diet;" which is much esteemed. This work was translated into Hebrew, in the year of Christ 1280, and thence into Latin by Paravicius, whose version has had several editions. The author added a supplement to it, under the title of *Jâmé*, or *a Collection*. He also wrote a treatise *Fi'ladwiyat wa'laughdiyat*, i. e. "Of Medicines and Food;" wherein he treats of their qualities.

AVERAGE, in *Commerce*, signifies the accidents and misfortunes which happen to ships and their cargoes, from the time of their loading and sailing to their return and unloading; and is divided into three kinds. 1. The simple or particular average, which consists in the extraordinary expences incurred for the ship alone, or for the merchandises alone. Such is the loss of anchors, masts, and rigging, occasioned by the common accidents at sea; the damages which happen to merchants by storm, prize, shipwreck, wet, or rotting; all which must be borne and paid by the thing which suffered the damage. 2. The large and common average, being those expences incurred, and damages sustained, for the common good and security both of the merchandises and vessels, consequently to be borne by the ship and cargo, and to be regulated upon the whole. Of this number are the goods or money given for the ransom of the ship and cargo, things thrown overboard for the safety of the ship, the expences for unloading, for entering into a river or harbour, and the provisions and hire of the sailors when the ship is put under an embargo. 3. The small averages, which are the expences for towing and piloting the ship out of or into harbours, creeks, or rivers, one third of which must be charged to the ship, and two thirds to the cargo.

Average is more particularly used for a certain contribution that merchants make proportionably to their losses, who have had their goods cast into the sea in the time of a tempest. It also signifies a small duty which those merchants, who send goods in another man's ship, pay to the master for his care of them over and above the freight. Hence it is expressed in the bills of lading, paying so much freight for the said goods, with primage and average accustomed.

AVERDUPOIS. See Avoirdupois.

AVERNUS, a lake of Campania in Italy, near Baiæ, famous among the ancients for its poisonous qualities. It is described by Strabo as lying within the Lucrine bay, deep and darksome, surrounded with steep banks that hang threatening over it, and only accessible

accessible by the narrow passage through which you sail in. Black aged groves stretched their boughs over the watery abyss, and with impenetrable foliage excluded almost every ray of wholesome light; mephitic vapours ascending from the hot bowels of the earth, being denied free passage to the upper atmosphere, floated along the surface in poisonous mists. These circumstances produced horrors fit for such gloomy deities; a colony of Cimmerians, as well suited to the rites as the place itself, cut dwellings in the bosom of the surrounding hills, and officiated as priests of Tartarus. Superstition, always delighting in dark ideas, early and eagerly seized upon this spot, and hither she led her trembling votaries to celebrate her dismal orgies; here she evoked the manes of departed heroes—here she offered sacrifices to the gods of hell, and attempted to dive into the secrets of futurity. Poets enlarged upon the popular theme, and painted its awful scenery with the strongest colours of their art. Homer brings Ulysses to Avernus, as to the mouth of the infernal abodes; and in imitation of the Grecian bard, Virgil conducts his hero to the same ground. Whoever sailed thither, first did sacrifice; and endeavoured to propitiate the infernal powers, with the assistance of some priests who attended upon the place, and directed the mystic performance. Within, a fountain of pure water broke out just over the sea, which was fancied to be a vein of the river Styx; near this fountain was the oracle: and the hot waters frequent in those parts were supposed to be branches of the burning Phlegethon. The poisonous effluvia from this lake were said to be so strong, that they proved fatal to birds endeavouring to fly over it. Virgil ascribes the exhalation not to the lake itself, but to the cavern near it, which was called *Avernus* or *Cave of the Sybil*, and through which the poets feigned a descent to hell. Hence the proper name of the lake is *Lacus Averni*, the "lake near the cavern," as it is called by some ancient authors.

The holiness of these shades remained unimpeached for many ages: Hannibal marched his army to offer incense at this altar; but it may be suspected he was led to this act of devotion rather by the hopes of surprising the garrison of Puteoli, than by his piety. After a long reign of undisturbed gloom and celebrity, a sudden glare of light was let in upon Avernus; the horrors were dispelled, and with them vanished the sanctity of the lake: the axe of Agrippa brought its forest to the ground, disturbed its sleepy waters with ships, and gave room for all its malignant effluvia to escape. The virulence of these exhalations, as described by ancient authors, has appeared so very extraordinary, that modern writers, who know the place in a cleared state only, charge these accounts with exaggeration: but Mr Swinburne thinks them entitled to more respect; for even now he observes the air is feverish and dangerous, as the jaundiced faces of the vine-dressers, who have succeeded the Sibyls and Cimmerians in the possession of the temple, most ruefully testify. Boccacio relates, that during his residence at the Neapolitan court, the surface of this lake was suddenly covered with dead fish, black and singed, as if killed by some subaqueous eruption of fire.

At present the lake abounds with tench; the Lucrine with eels. The change of fortune in these lakes is singular: In the splendid days of imperial Rome the Lucrine was the chosen spot for the brilliant parties of pleasure of a voluptuous court: now, a slimy bed of rushes covers the scattered pools of this once beautiful sheet of water; while the once dusky Avernus is clear and serene, offering a most alluring surface and charming scene for similar amusements. Opposite to the temple is a cave usually styled the Sibyl's grotto; but apparently more likely to have been the mouth of a communication between Cuma and Avernus, than the abode of a prophetess; especially as the Sibyl is positively said by historians to have dwelt in a cavern under the Cumean citadel.

AVERRHOA. See BOTANY *Index*.

AVERROES, one of the most subtile philosophers that ever appeared among the Arabians, flourished at the end of the 11th and beginning of the 12th century. He was the son of the high-priest and chief judge of Corduba in Spain: he was educated in the university of Morocco; and studied natural philosophy, medicine, mathematics, law and divinity. After the death of his father, he enjoyed his posts; but notwithstanding his being exceeding rich, his liberality to men of letters in necessity, whether they were his friends or his enemies, made him always in debt. He was afterwards stripped of all his posts, and thrown into prison, for heresy; but the oppressions of the judge who succeeded him, caused him to be restored to his former employments.

He died at Morocco in the year 1206. He was excessively fat, though he ate but once a-day. He spent all his nights in the study of philosophy; and when he was fatigued, amused himself with reading poetry or history. He was never seen to play at any game, or to partake in any diversion. He was extremely fond of Aristotle's works, and wrote commentaries on them; whence he was styled *the commentator*, by way of eminence. He likewise wrote a work on the whole art of physic, and many amorous verses; but when he grew old, he threw these last into the fire. His other poems are lost, except a small piece, in which he says, "That when he was young, he acted against his reason; but that when he was in years, he followed its dictates:" upon which he utters this wish; "Would to God I had been born old, and that in my youth I had been in a state of perfection!" as to religion, his opinions were, that Christianity is absurd; Judaism, the religion of children; Mahometanism, the religion of swine.

AVERROISTS, a sect of Peripatetic philosophers, who appeared in Italy some time before the restoration of learning, and attacked the immortality of the soul. They took their denomination from AVERROES, the celebrated interpreter of Aristotle (see the preceding article), from whom they borrowed their distinguishing doctrine.

The Averroists, who held the soul was mortal, according to reason or philosophy, yet pretended to submit to the Christian theology, which declares it immortal. But the distinction was held suspicious; and this divorce of faith from reason was rejected by the doctors of that time, and condemned by the last council of the Lateran under Leo X.

AVERRUNCI (DEI)); certain gods, whose business it was, according to the Pagan theology, to avert misfortunes.

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fortunes. Apollo and Hercules were of the number of these gods among the Greeks; and Castor and Pollux among the Romans.

AVERSA, a town of Italy in the kingdom of Naples, with a bishop's see. It is situated in a very fine plain, in E. Long. 14. 20. N. Lat. 41. 0.

AVERSION, according to Lord Kames, is opposed to *affection*, and not to *desire*, as it commonly is. We have an affection to one person; we have an aversion to another; the former disposes us to do good to its object, the latter to do ill.

AVERTI, in *Horsemanship*, is applied to a regular step or motion enjoined in the lessons. In this sense they say *pas averte*, sometimes *pas ecouté*, and *pas d'ecole*, which all denote the same. The word is mere French, and signifies *advised*.

AVES, one of the Carribbee islands, 451 miles south of Porto Rico, with a good harbour for careening of ships. It is so called from the great number of birds that frequent it. There is another of the same name lying to the northward of this, in N. Lat. 15. 0.; and a third near the eastern coast of Newfoundland, in N. Lat. 50. 5.

Aves, *Birds*, the name of Linnæus's second class of animals. See ORNITHOLOGY.

AVESBURY, ROBERT, an English historian, of whom little more is known than that he was keeper of the registery of the court of Canterbury in the reign of Edward III. and consequently that he lived in the 14th century. He wrote, *Memorabilia gesta magnifici regis Angliæ domini Edwardi tertii post conquestum, procerumque; tactis primitus quibusdam gestis de tempore patris sui domini Edwardi secundi, quæ in regnis Angliæ, Scotiæ, et Franciæ, ac in Aquitania et Britannia, non humana sed Dei potentia, contigerunt, per Robertum de Avesbury.* This history ends with the battle of Poictiers, about the year 1356. It continued in manuscript till the year 1720, when it was printed by the industrious Thomas Hearne at Oxford, from a manuscript belonging to Sir Thomas Seabright. It is now become very scarce.

AVEZZANO, a town of Italy in the kingdom of Naples, in the Farther Abruzzo. It is built on an almost imperceptible declivity, one mile from the lake of Celano, to which an avenue of poplars leads from the baronial castle. This edifice stands at a little distance from the town, is square, and flanked with towers; it was erected by Virginio Orsini, to which family this and many other great lordships belonged, before they were wrested from them in times of civil war, and transferred to the Colonnas. Avezzano was founded in 860, and contains 2700 inhabitants, and two religious communities within its walls, which are indeed in a ruinous condition. The houses are in general mean; but there are some large buildings and opulent families of the class of gentlemen, not possessed of fees held *in capite*.

AUGE, formerly a territory of Normandy in France, which gave title to a viscount. It extends from Falaise and Argenton as far as the sea, between the rivers Dives, Vie, and Tongues. The arable land is stiff, and produces but little good corn: but they sow sainfoin; which succeeds so well that they have five good crops successively; they likewise sow flax and hemp; and have a vast quantity of apples, with which they make cyder. Horses are bred here in great numbers; and the inhabitants fatten the oxen which come from Poictou and Britanny.

AUGEAS, in fabulous history, was king of Elis, and particularly famed for his stable, which contained 3000 oxen, and had not been cleaned for 30 years. Hercules was desired to clear away the filth from this stable in one day; and Augeas promised, if he performed it, to give him a tenth part of the cattle. This task Hercules is said to have executed by turning the course of the river Alpheus through the stable; when Augeas refusing to stand by his engagement, Hercules slew him with his arrows, and gave his kingdom to Phyleus his son, who had shown an abhorrence of his father's insincerity.

AUGMENT, in *Grammar*, an accident of certain tenses of Greek verbs, being either the prefixing of a syllable, or an increase of the quantity of the initial vowels.

AUGMENTATION, in a general sense, is the act of adding or joining something to another with a design to render it large.

AUGMENTATION is also used for the additament or thing added.

AUGMENTATION was also the name of a court erected 27 Hen. VIII. so called from the augmentation of the revenues of the crown, by the suppression of religious houses; and the office still remains, wherein there are many curious records, though the court has been dissolved long since.

AUGMENTATION, in *Heraldry*, are additional charges to a coat-armour, frequently given as particular marks of honour, and generally borne either in the escutcheon or a conton; as have all the baronets of England, who have borne the arms of the province of Ulster in Ireland.

AUGRE, or AWGRE, an instrument used by carpenters and joiners to bore large round holes; and consisting of a wooden handle, and an iron blade terminated at bottom with a steel bit.

AUGSBURG, a city of Germany, in the kingdom of Bavaria, seated near the confluence of the Ardech and Lech, in one of the most beautiful plains that can be imagined. It is one of the largest and handsomest cities of the empire; but the fortifications are after the old manner, and very irregular; the streets are broad and straight; the houses mostly of timber, plastered and whitened without, or adorned with paintings; the rest are of freestone; the churches and fountains are generally ornamented with fine figures of brass. Many of the churches are stately, and adorned within with curious workmanship and paintings. That part of the city erected by the noble family of the Fuggers, who are lords of the adjacent country, consists of several streets crosswise, containing 106 houses: the poor people that inhabit them are maintained by an annual pension. Its magnificent town-house is little inferior to that of Amsterdam, being a vast square stone building, with a marble portico; at the top of the front, within the pediment, is a large spread eagle, holding a sceptre and globe in its talons, of brass gilt, said to weigh 2200 weight; the great portal is of a very beautiful reddish marble, over which is a balcony of the same colour, supported by two pillars of white marble; over the gate there are two large griffins of

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brass; most of the rooms are wainscotted and ceiled with very fine timber: the great hall is very magnificent, and paved with marble; it is 110 feet long, 58 broad, and 52 high, and its roof is supported by eight columns of red marble: the ceiling of the upper wall is of very curious workmanship of polished ash, consisting of compartments, the squares and pannels of which are enriched with gilded sculptures, and filled with pictures and other ornaments; this is likewise supported by eight pillars, with bases and chapiters of brass: the other rooms are handsomely adorned with very fine paintings.

In the square, near the town-house, is the fountain of Augustus, which is a marble bason, surrounded with iron ballustrades finely wrought: at the four corners are four brass statues, as big as the life, two of which are women and two men; in the middle of the bason is a pedestal, at the foot of which are four large sphinxes squirting water out of their breasts; a little above these are four infants holding four dolphins in their arms, which pour water out of their mouths: and over these infants are festoons and pine-apples all of brass; upon the pedestal, is the statue of Augustus as large as the life. The fountain most remarkable next to this is that of Hercules, which is a hexagon bason with several brass figures, particularly Hercules engaging the hydra. Another curiosity is the secret gate, which was contrived to let in persons safely in time of war: it has so many engines and divisions with gates and keys, and apartments for guards at some distance from each other, where passengers are examined, that it is impossible for the town to be surprised this way; the gates are bolted and unbolted, opened and shut, by unseen operators, insomuch that it looks like enchantment. The water-towers are also very curious, of which there are three seated on a branch of the river Lech, which runs through the city in such a torrent as to drive many mills, which work a number of pumps that raise the water in large leaden pipes to the tops of the towers; one of these sends water to the public fountains, and the rest to near 1000 houses in the city.

The Lutherans have a college here, which is a vast square building, with a fine clock on the top of the front. In this there are seven different classes, a hall for public disputations, and a theatre for dramatic representations. The cathedral is a large, gloomy, Gothic building, with two spire steeples; it is adorned with paintings upon whimsical subjects, and has a great gate all of brass, over which are several scripture passages well represented in basso-relievo. The Jesuits had a splendid college here, with a church full of gilding, painting, and carving; and a fine library. Though half the inhabitants are Lutherans, there are a great many Popish processions. There are no Jews in the town, nor are they suffered to lie there; but they inhabit a village at about a league distance, and pay so much an hour for the liberty of trading in the daytime. The Benedictine abbey is a vast Gothic building, the ceiling of which is said to be the highest in Germany, and overlooks all the rest of the churches; it is adorned with several statues, and has one very grand altar. The church of St Croix is one of the handsomest in Augsburg for architecture, painting, sculpture, gilding, and a fine spire.

The inhabitants look upon Augustus Cæsar as the founder of the town: it is true, that that emperor sent a colony there; but the town was already founded, though he gave it the name of *Augusta Vindelicorum*. Augsburg, indeed, is one of the oldest towns in Germany, and one of the most remarkable of them, as it is there and at Nuremberg that you meet with the oldest marks of German art and industry. In the 14th and 15th centuries, the commerce of this town was the most extensive of any part of south Germany, and contributed much to the civilization of the country, by the works of art and variety of necessaries to the comfort and convenience of life which it was the means of introducing. Many things originated in this town which have had a great influence on the happiness of mankind. Not to mention the many important diets of the empire held here; here, in 952, did a council confirm the order for the celibacy of priests; here, in 1530, was the confession of faith of the Protestants laid before the emperor and other estates of Germany; and here, in 1555, was signed the famous treaty of peace, by which religious liberty was secured to Germany.

Though the Protestants were very powerful at Augsburg, they could not keep their ground: for the Bavarians drove them from thence: but Gustavus Adolphus restored them again in 1632; since which time they have continued there, and share the government with the Catholics. In 1703, the elector of Bavaria took the city after a siege of seven days, and demolished the fortifications: however the battle of Hochstedt restored their liberty, which they enjoyed under the government of their own magistrates, till the French revolution. It was suffered to continue a free city in 1803, but was united to Bavaria in 1807. The chapter is composed of persons of quality, who are to bring proofs of their nobility, and the canons have a right of electing their own bishop.

The police of the place is very good: and though the town has no territory, it has no debts. Augsburg is, however, no longer what it was. It no longer has a Fugger and a Welser in it to lend the emperor millions. In this large and handsome town, formerly one of the greatest trading towns in Germany, there are no merchants at present to be found who have capitals of more than 20,000l. The others, most of whom must have their coaches, go creeping on with capitals of 3000l. or 4000l. and do the business of brokers and commissioners. Some houses, however, carry on a little banking trade; and the way through Tyrol and Graubundten occasions some little exchange between this place and Germany. After these brokers and doers of business by commission, the engravers, statuaries, and painters, are the most reputable of the labouring part of the city. Their productions, like the toys of Nuremberg, go everywhere. There are always some people of genius amongst them; but the small demand for their art affords them so little encouragement, that to prevent starving they are mostly confined to the small religious works which are done elsewhere by Capuchin monks. They furnish all Germany with little pictures for prayer books, and to hang in the citizens houses. There is an academy of arts instituted here under the protection of the magistrates: the principal aim of which is to produce good mechanics, and preserve the manufactures of the city. This

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This town, which is nine miles and a half in circumference, contains, according to Mr Riesbeck, hardly 30,000 inhabitants: but Mr Nicolai makes them about 35,000.

This city has its drinking water from the river Lech, which runs at some distance from it; and the aqueducts which convey the water are much to be admired. It is a central depositary of the Neckar, Tyrolese, Italian, and Greek wines. Another important branch of traffic here is that of bookselling and publishing, especially in Catholic literature. The Catholics have six churches and eight monasteries here, and the Lutherans six churches; but the former considerably exceed the latter in point of numbers. This city was first constituted the capital of the circle of the Lech, but was joined in 1810 to that of the Iller, of which Kempten is now the chief town. The elector of Treves fixed his residence here after the secularization of his territories. A wooden bridge of ingenious structure was built over the Lech at Augsburg in 1808. In the war of 1756, the citizens were divided into equal parties for the two courts. The Catholics considered the emperor as their god, and the Protestants did the same by the king of Prussia. The flame of religion had almost kindled a bloody civil war amongst them.—The bishop takes his name from this town, but resides at Dillingen. He has an income of about 20,000l. per annum. As a proof of the catholicism of this place, the Pope throughout his whole progress met nowhere with such honours as he did here. This he owed to his friends the Jesuits, who had great influence in this place. E. Long. 10. 58. N. Lat. 48. 24.

Augsburg Confession, denotes a celebrated confession of faith drawn up by Luther and Melancthon, on behalf of themselves and other ancient reformers, and presented in 1530 to the emperor Charles V. at the diet of Augusta or Augsburg, in the name of the evangelic body. This confession contains 28 chapters; of which the greatest part is employed in representing, with perspicuity and truth, the religious opinions of the Protestants, and the rest in pointing out the errors and abuses that occasioned their separation from the church of Rome.

AUGUR, an officer among the Romans appointed to foretel future events, by the chattering, flight, and feeding of birds. There was a college or community of them, consisting originally of three members, with respect to the three tribes, the Luceres, Ramnenses, and Tatienses: afterwards the number was increased to nine, four of whom were patricians and five plebeians. They bore an augural staff or wand, as the ensign of their authority; and their dignity was so much respected, that they were never deposed, or any substituted in their place, though they should be convicted of the most enormous crimes. See Augury.

AUGURAL, something relating to the augurs.—The augural instruments are represented on several ancient medals.

Augural Supper, that given by a priest on his first admission into the order, called also by Varro *Adjicialis*.

Augural Books, those wherein the discipline and rules of augury were laid down.

AUGURALE, the place in a camp where the general took auspicia. This answered to the *Auguratorium* in the city.

Augurale is also used in Seneca for the ensign or badge of an augur, as the *lituus*.

AUGURATORIUM, a building on the Palatine mount, where public auguries were taken.

AUGURY, in its proper sense, the art of foretelling future events by observations taken from the chattering, singing, feeding, and flight, of birds; though it is used by some writers in a more general signification, as comprising all the different kinds of divination.

Augury was a very ancient superstition. We know from Hesiod, that husbandry was in part regulated by the coming or going of birds: and most probably it had been in use long before his time, as astronomy was then in its infancy. In process of time, these animals seem to have attained a greater and very wonderful authority, till at last no affair of consequence, either of private or public concern, was undertaken without consulting them. They were looked upon as the interpreters of the gods; and those who were qualified to understand their oracles were held among the chief men in the Greek and Roman states, and became the assessors of kings, and even of Jupiter himself. However absurd such an institution as a college of augurs may appear in our eyes, yet, like all other extravagant institutions, it had in part its origin from nature. When men considered the wonderful migration of birds, how they disappeared at once, and appeared again at stated times, and could give no guess where they went, it was almost natural to suppose that they retired somewhere out of the sphere of this earth, and perhaps approached the ethereal regions, where they might converse with the gods, and thence be enabled to predict events. It was almost natural for a superstitious people to imagine this; at least to believe it, as soon as some impostor was impudent enough to assert it. Add to this, that the disposition in some birds to imitate the human voice, must contribute much to the confirmation of such a doctrine. This institution of augury seems to have been much more ancient than that of aruspicy; for we find many instances of the former in Homer, but not a single one of the latter, though frequent mention is made of sacrifices in that author. From the whole of what has been observed, it seems probable that natural augury gave rise to religious augury, and this to aruspicy, as the mind of man makes a very easy transition from a little truth to a great deal of error.

A passage in Aristophanes gave the hint for these observations. In the comedy of the Birds, he makes one of them say this: "The greatest blessings which can happen to you mortals, are derived from us. First, we show you the seasons, viz. spring, winter, autumn. The crane points out the time for sowing, when she flies with her warning notes into Egypt; she bids the sailor hang up his rudder and take his rest, and every prudent man provide himself with winter garments. Next the kite appearing, proclaims another season, viz. when it is time to shear his sheep. After that the swallow informs you when it is time to put on summer clothes. We are to you, (adds the chorus), Ammon, Dodona, Apollo: for, after consulting us, you undertake every thing; merchandise, purchases,

marriages,

marriages," &c. Now, it seems not improbable, that the same transition was made in the speculations of men which appears in the poet's words; and that they were easily induced to think, that the surprising foresight of birds, as to the time of migration, indicated something of a divine nature in them; which opinion Virgil, as an Epicurean, thinks fit to enter his protest against, when he says,

Haud equidem credo, quia sit divinitas illis
Ingenium.

But to return to Aristophanes. The first part of the chorus, from whence the fore-cited passage is taken, seems, with all its wildness, to contain the fabulous cant, which the augurs made use of in order to account for their impudent impositions on mankind. It sets out with cosmogony; and says, That in the beginning were Chaos and Night, and Erebus and Tartarus: That there was neither water, nor air, nor sky: That Night laid an egg, from whence, after a time, Love arose: That Love, in conjunction with Erebus, produced a third kind; and that they were the first of the immortal race, &c.

AUGUST, (*augustus*), in a general sense, something majestic, venerable, or sacred. The appellation was first conferred by the Roman senate upon Octavius, after his being confirmed by them in the sovereign power. It was conceived as expressing something divine, or elevated above the pitch of mankind, being derived from the verb *augeo*, "I increase," *tanquam supra humanam sortem auctus*. See AUGUSTUS.

AUGUST, in *Chronology*, the eighth month of our year, containing 31 days. August was dedicated to the honour of Augustus Cæsar, because, in the same month, he was created consul, thrice triumphed in Rome, subdued Egypt to the Roman empire, and made an end of civil wars, being before called *Sextilis*, or the sixth month from March.

AUGUSTA, or AUSTA, an island in the Adriatic sea on the coast of Dalmatia, near Ragusa, subject to Venice. E. Long. 17. 50. N. Lat. 42. 35.

AUGUSTA, a town of Georgia in North America. See GEORGIA.

AUGUSTA *Ausciorum*, a town of Aquitania, so named out of compliment to Augustus, being originally called *Climberrum*, which name it afterwards resumed. In the middle age, it took the name of the people, *Ausci;* and is now called *Auch*, the capital of Gascony.

AUGUSTA *Emerita*, a town of Lusitania, on the river Anas, the capital of the province: a colony of the Emeriti, or such soldiers as had served out their legal time, were men of experience, or had received marks of favour. The colony was founded by Augustus: and is now called *Merida*, a city of Spain, in Estremadura, on the river Guadiana. See MERIDA.

AUGUSTA *Prætoria*, a town and colony of Gallia Cisalpina, and capital of the Salassi; seated at the foot of the Alpes Graiæ on the Duria. Now *Aouste* in Piedmont. See AOUSTE.

AUGUSTA *Rauracorum*, a town of Gallia Belgica; now a small village called *August*, at the bend of the Rhine northward; but from the ruins, which are still to be seen, it appears to have been a considerable colony, at the distance of six miles from Basil to the east.

AUGUSTA *Suessonum*, a town of Gallia Belgica on the Axona; so called from Augustus, and with great probability supposed to be the Noviodunum Suessonum of Cæsar. Now *Soissons*, on the river Aisne, in the Isle of France. See SOISSONS.

AUGUSTA *Taurinorum*, a town of the Taurini at the foot of the Alps, where the Duria Minor falls into the Po; now *Turin*, the capital of Piedmont.

AUGUSTA *Treba*, a town of the Æqui, near the spring of the river Anio in Italy; now *Trevi*, in Umbria, on the east of the Campagna di Roma.

AUGUSTA *Trevirorum*, a town of the Treviri, a people inhabiting between the Rhine and the Meuse, but especially about the Moselle; now *Triers*, or *Treves*, in the circle of the Lower Rhine, on the Moselle.

AUGUSTA *Vindelicorum*, a town of the Licates on the Licus; called by Tacitus a noble colony of *Rhætia;* now *Augsburg*, capital of Suabia.

AUGUSTA *Historia* is the history of the Roman emperors from the time of Adrian to Carinus, that is, from the year of our Lord 157 to 285, composed by six Latin writers, Æl. Spartianus, Julius Capitolinus, Æl. Lampridius, Vulcatius Gallicanus, Trebellius Pollio, and Flavius Vopiscus.

AUGUSTALES, in Roman antiquity, an epithet given to the flamens or priests appointed to sacrifice to Augustus after his deification; and also to the ludi or games celebrated in honour of the same prince on the fourth of the ides of October.

AUGUSTALIA, a festival instituted by the Romans in honour of Augustus Cæsar, on his return to Rome, after having settled peace in Sicily, Greece, Syria, Asia, and Parthia; on which occasion they likewise built an altar to him, inscribed *Fortunæ reduci*.

AUGUSTALIS PRÆFECTUS, a title peculiar to a Roman magistrate who governed Egypt, with a power much like that of a proconsul in other provinces.

AUGUSTAN CONFESSION. See *Augsburg Confession*.

AUGUSTIN, or AUSTIN, ST, the first archbishop of Canterbury, was originally a monk in the convent of St Andrew at Rome, and educated under St Gregory, afterwards Pope Gregory I. by whom he was despatched into Britain with 40 other monks of the same order, about the year 596, to convert the English Saxons to Christianity. They landed in the isle of Thanet; and having sent some French interpreters to King Ethelbert with an account of their errand, the king gave them leave to convert as many of his subjects as they could, and assigned their place of residence, at Durovernum, since called *Canterbury;* to which they were confined till the king himself was converted, whose example had a powerful influence in promoting the conversion of his subjects; but though he was extremely pleased at their becoming Christians, he never attempted to compel them. He despatched a priest and a monk to Rome, to acquaint the pope with the success of his mission, and to desire his resolution of certain questions. These men brought back with them a pall, and several books, vestments, utensils, and ornaments for the churches. His holiness, by the same messengers,

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Augustin, Augustine. messengers, gave Augustin directions concerning the settling of episcopal sees in Britain; and ordered him not to pull down the idol-temples, but to convert them into Christian churches; only destroying the idols, and sprinkling the place with holy water, that the natives, by frequenting the temples they had been always accustomed to, might be the less shocked at their entrance into Christianity. Augustin resided principally at Canterbury, which thus became the metropolitan church of England; and having established bishops in several of the cities, he died on the 26th May, 607. The Popish writers ascribe several miracles to him. The observation of the festival of St Augustin was first enjoined in a synod held under Cuthbert archbishop of Canterbury, and afterwards by the pope's bull in the reign of King Edward III.

AUGUSTINE, St, an illustrious father of the church, was born at Thagaste, a city of Numidia, on the 13th of November 354. His father, a burgess of that city, was called *Patricius;* and his mother, *Monica*, who being a woman of great virtue, instructed him in the principles of the Christian religion. In his early youth he was in the rank of the catechumens; and falling dangerously ill, earnestly desired to be baptized; but the violence of the distemper ceasing, his baptism was delayed. His father, who was not yet baptized, made him study at Thagaste, Madaura, and afterwards at Carthage. Augustine having read Cicero's books of philosophy, began to entertain a love for wisdom, and applied himself to the study of the Holy Scriptures; nevertheless, he suffered himself to be seduced by the Manicheans. At the age of 19, he returned to Thagaste, and taught grammar, and also frequented the bar: he afterwards taught rhetoric at Carthage with applause. The insolence of the scholars at Carthage made him take a resolution to go to Rome, though against his mother's will. Here also he had many scholars; but disliking them, he quitted Rome, and settled at Milan, and was chosen public professor of rhetoric in that city. Here he had opportunities of hearing the sermons of St Ambrose, which, together with the study of St Paul's epistles, and the conversion of two of his friends, determined him to retract his errors, and quit the sect of the Manicheans; this was in the 32d year of his age. In the vacation of the year 386, he retired to the house of a friend of his, named *Verecundus*, where he seriously applied himself to the study of the Christian religion, in order to prepare himself for baptism, which he received at Easter in the year 387. Soon after this, his mother came to see him at Milan, and invite him back to Carthage; but at Ostia, whither he went to embark in order to his return, she died. He arrived in Africa about the end of the year 388; and having obtained a garden-plot without the walls of the city of Hippo, he associated himself with 11 other persons of eminent sanctity, who distinguished themselves by wearing leathern girdles, and lived there in a monastic way for the space of three years, exercising themselves in fasting, prayer, study, and meditation, day and night: from hence sprung up the Augustine friars, or eremites of St Augustine, being the first order of mendicants; those of St Jerome, the Carmelites, and others, being but branches of this of St Augustine. About this time, or before, Valerius bishop of Hippo, against his will, ordained him priest: nevertheless, he continued to reside in his little monastery, with his brethren, who, renouncing all property, possessed their goods in common. Valerius, who had appointed St Augustine to preach in his place, allowed him to do it in his presence, contrary to the custom of the churches in Africa. He explained the creed, in a general council of Africa, held in 393. Two years after, Valerius, fearing he might be preferred to be bishop of another church, appointed him his coadjutor or colleague, and caused him to be ordained bishop of Hippo, by Megalus bishop of Calame, then primate of Numidia. St Augustine died the 28th day of August, 430, aged 76 years, having had the misfortune to see his country invaded by the Vandals, and the city where he was bishop besieged for seven months.

Augustine, Augustins. The works of St Augustine make ten volumes: the best edition of them is that of Maurin, printed at Antwerp, in 1700. They are but little read at this time, except by the clergy of the Greek church and in the Spanish universities. The booksellers of London receive frequent commissions for them, and indeed for the most of the fathers, from Russia, and also from Spain.

AUGUSTINE, *St*, a fort of North America, on the east coast of Cape Florida, situated in W. Long. 81. 40. N. Lat. 30. 0. This fort was built by the Spaniards; who were scarce well established there when they were attacked by Sir Francis Drake in 1586, who reduced and pillaged the fort and town adjacent. In 1665, it underwent a similar fate, being attacked by Captain Davis at the head of a considerable company of bucaniers. In 1702 an attempt was made by Colonel More to annex St Augustine to the British dominions. He invested it with only 500 English and 700 Indians; but succours having arrived, he found it necessary to raise the siege, and retire with precipitation. In 1740, another unsuccessful attempt was made on this fort by General Oglethorpe: it was, however, together with the whole country of Florida, ceded to Great Britain by the treaty of Paris in 1763; but was restored to Spain by the treaty of peace 1783. In 1817 the white population of the town consisted of about 1000 persons, of whom 150 were able to carry arms. There were about 150 white regular troops, and 250 black or coloured regulars, and 500 slaves.

AUGUSTINE, a cape of South America. W. Long. 35. 4. S. Lat. 8. 30.

AUGUSTINS, or AUGUSTINIANS, an order of religious; thus called from St Augustine, whose rule they observe. The Augustins, popularly also called Austin friars, were originally hermits, whom Pope Alexander IV. first congregated into one body, under their general Lanfranc, in 1256. Soon after their institution, this order was brought into England, where they had about thirty-two houses at the time of their suppression.

The Augustins are clothed in black, and make one of the four orders of mendicants. From these arose a reform, under the denomination of *bare-foot Augustins*, or *Minorets*, or *Friars minor*.

There are also canons regular of St Augustine, who are clothed in white, excepting their cope, which is black. At Paris they were known under the denomination of *religious of* GENEVIEVE; that abbey was the chief of of the order. There are also nuns and canonesses, who observe the rules of St Augustine.

Augustinians are also those divines who maintain, on the authority of St Augustine, that grace is effectual from its nature, absolutely and morally, and not relatively and gradually. They are divided into rigid and relaxed.

AUGUSTOBONA, a city of the Tricassers in ancient Gaul, from whom it was afterwards called *Tricasses*, and *Trecassæ;* and still farther corrupted to *Thracæ*, or *Treci;* whence the modern name *Troyes*, in Champagne, on the Seine. See Troyes.

AUGUSTODUNUM, the capital of the Ædui, where there was a famous academy or school for the education of youth; now Austun, or *Autun*, in the duchy of Burgundy, on the Arroux. See Autun.

AUGUSTOMAGUS, an ancient town of Gallia Belgica; now *Senlis*, in the Isle of France. E. Long. 2. 30. N. Lat. 49. 10.

AUGUSTORITUM, in *Ancient Geography*, according to some authors, the capital of the Pictones, afterwards called *Pictavi;* now *Poictiers*. But by Antonine's Itinerary from Burdigala to Argantomagus (or Argenton, as it is interpreted by many), it can be no other but the capital of the Lemovices, now *Limoges*, situated between Vesunna of the Petrocorii, or Perigeux, and Argantomagus. E. Long. 1. 22. Lat. 45. 52.

AUGUSTOW, a small but strong town of Poland, in the department of Lomza, seated on the river Narieu. E. Long. 24. 2. N. Lat. 53. 25.

AUGUSTUS, Fort, a small fortress seated on a plain at the head of Loch Ness in Scotland, between the rivers Taarf and Oich; the last is a considerable stream, and has over it a stone bridge of three arches. The fort consists of four bastions: within is the governor's house, and barracks for 400 men; it was taken by the rebels in 1746, who immediately deserted it after demolishing what they could. The name of this fort in Erse is *Kill Chumin*, or *the burial place of the Cumins*. It lies on the road to the isle of Sky, which is about 52 miles off; but on the whole way there is not a place fit for the reception of man or horse.

Augustus, the appellation conferred upon Cæsar Octavianus, the first Roman emperor. See Octavianus, and Rome.

The obscure name *Octavianus*, Mr Gibbon observes, he derived from a mean family, in the little town of Aricia. It was stained with the blood of the proscription; and he was desirous, had it been possible, to erase all memory of his former life. The illustrious surname of *Cæsar* he had assumed, as the adopted son of the dictator; but he had too much good sense either to hope to be confounded, or to wish to be compared, with that extraordinary man. It was proposed in the senate, to dignify their minister with a new appellation; and after a very serious discussion, that of *Augustus* was chosen among several others, as being the most expressive of the character of peace and sanctity, which he uniformly affected. *Augustus* was therefore a personal, *Cæsar* a family, distinction. The former should naturally have expired with the prince on whom it was bestowed: and however the latter was diffused by adoption and female alliance, Nero was the last prince who could allege any hereditary claims to the honour of the Julian line. But at the time of his death, the practice of a century had inseparably connected those appellations with the imperial dignity, and they have been preserved by a long succession of emperors, Romans, Greeks, Franks, and Germans, from the fall of the republic to the present time. A distinction was, however, soon introduced. The sacred title of *Augustus* was always reserved for the monarch; the name of *Cæsar* was more freely communicated to his relations; and from the reign of Hadrian at least, was appropriated to the second person in the state, who was considered as the presumptive heir of the empire.

AVIARY, a place set apart for feeding and propagating birds. It should be so large as to give the birds some freedom of flight; and turfed, to avoid the appearance of foulness on the floor.

AVICENNA, or Avicenes, the prince of Arabian philosophers and physicians, was born at Assena, a village in the neighbourhood of Bokhara. His father was from Balkh in Persia, and had married at Bokhara. The first years of Avicenna were devoted to the study of the Koran and the belles lettres. He soon showed what he was likely to become afterwards; and the progress he made was so rapid, that when he was but ten years old, he was perfectly intelligent in the most hidden senses of the Koran.

Abou-Abdoullah, a native of Napoulous in Syria, at that time professed philosophy at Bokhara with the greatest reputation. Avicenna studied under him the principles of logic; but soon, disgusted with the slow manner of the schools, he set about studying alone, and read all the authors that had written on philosophy, without any other help than that of their commentators. Mathematics had no fewer charms for him; and after reading the first six propositions of Euclid, he got alone to the last, having made himself perfect master of them, and treasured up all of them equally in his memory.

Possessed with an extreme avidity to be acquainted with all sorts of sciences, he likewise devoted himself to the study of medicine. Persuaded that this divine art consists as much in practice as in theory, he sought all opportunities of seeing the sick; and afterwards confessed, that he had learned more from experience than from all the old books he had read. He was now in his 16th year, and already was celebrated for being the light of his age. He resolved at this age to resume his studies of philosophy, which medicine had made him neglect: and he spent a year and a half in this painful labour, without ever sleeping all this time a whole night together. If he felt himself oppressed by sleep, or exhausted by study, a glass of wine refreshed his wasted spirits, and gave him new vigour for study; if in spite of him his eyes for a few minutes shut out the light, it then happened to him to recollect and meditate upon all the things that had occupied his thoughts before sleep. At the age of 21, he conceived the bold design of incorporating, in one work, all the objects of human knowledge; and carried it into execution in an Encyclopedie of 20 volumes, to which he gave the title of the *Utility of Utilities*.

Several great princes had been taken dangerously ill, and Avicenna was the only one that could know their ailments

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Avicenna. ailments and cure them. His reputation increased daily, and all the kings of Asia desired to retain him in their families.

Mahmud, the son of Sabektekin, the first sultan of the dynasty of the Samanides, was then the most powerful prince of the east. Imagining that an implicit obedience should be paid by all manner of persons to the injunctions of his will, he wrote a haughty letter to Mamun sultan of Kharazm, ordering him to send Avicenna to him, who was at his court, with several other learned man. Philosophy, the friend of liberty and independence, looks down with scorn on the shackles of compulsion and restraint. Avicenna, accustomed to the most flattering distinction among the great, could not endure the imperious manner of Mahmud's inviting him to his court, and refused to go there. But the sultan of Karazm, who dreaded his resentment, obliged the philosopher to depart with others whom that prince had demanded to be sent to him.

Avicenna pretended to obey; but instead of repairing to Gazna, he took the route of Giorgian. Mahmud, who had gloried in the thoughts of keeping him at his palace, was greatly irritated at his flight. He despatched portraits done in crayons of this philosopher to all the princes of Asia, with orders to have him conducted to Gazna, if he appeared in their courts. But Avicenna had fortunately escaped the most diligent rearch after him. He arrived in the capital of Giorgian, where under a disguised name he performed many admirable cures.

Cabous then reigned in that country. A nephew, whom he was extremely fond of, being fallen sick, the most able physicians were called in, and none of them were able to know his ailment, or give him any ease. Avicenna was at last consulted. So soon as he had felt the young prince's pulse, he was confident with himself, that his illness proceeded from a violent love, which he dared not to declare. Avicenna commanded the person who had the care of the different apartments in the palace, to name them all in their respective order. A more lively motion in the prince's pulse, at hearing mentioned one of these apartments, betrayed a part of his secret. The keeper then had orders to name all the slaves that inhabited that apartment. At the name of one of those beauties, the young Cabous could not contain himself; an extraordinary beating of his pulse completed the discovery of what he in vain desired to keep concealed. Avicenna, now fully assured that this slave was the cause of the prince's illness, declared, that she alone had the power to cure him.

The sultan's consent was necessary, and he of course was curious to see his nephew's physician. He had scarce looked at him, when he knew in his features those of the crayoned portrait sent him by Mahmud; but Cabous, far from forcing Avicenna to repair to Gazna, retained him for some time with him, and heaped honours and presents on him.

This philosopher passed afterwards into the court of Nedjmeddevle, sultan of the race of the Bouides. Being appointed first physician to that prince, he found means to gain his confidence to so great a degree, that he raised him to the post of grand visir. But he did not long enjoy that illustrious dignity. Too great an attachment to pleasures, especially those of love and the table, made him lose at the same time his post and his master's favour. From that time Avicenna felt all the rigours of adversity, which he had brought upon himself by his ill conduct. He wandered about as a fugitive, and was often obliged to shift the place of his habitation to secure his life from danger. He died at Hamadan, aged 58 years, in the 428th year of the Hegira, and of Christ 1036. Avicenna.

The perfect knowledge he had of physic did not secure him from the ailments that afflict human nature. He was attacked by several maladies in the course of his life, and particularly was very subject to the colic. His excesses in pleasures, and his infirmities, made a poet say who wrote his epitaph, that the profound study of philosophy had not taught him good morals, nor that of medicine the art of preserving his own health.

No one composed with greater facility than Avicenna, writing, when he sat down to it, 50 pages generally in a day, without fatiguing himself. The doctors of Schiras, having made a collection of objections against one of his metaphysical works, sent it to him at Ispahan by Casem. This learned man, not arriving till towards evening, came to Avicenna's house, with whom he sat discoursing till midnight. When Casem had retired, he wrote an answer to the objections of the Schirazians, and finished it before sunrise. He immediately delivered it to Casem, telling him, that he had made all possible despatch in order not to detain him any longer at Ispahan.

Avicenna, after his death, enjoyed so great a reputation, that till the 12th century he was preferred for the study of philosophy and medicine to all his predecessors. His works were the only writings in vogue in schools, even in Europe. The following are the titles. 1. Of the Utility and Advantage of Science, twenty books. 2. Of Innocence and Criminality, two books. 3. Of Health and Remedies, eighteen books. 4. Canons of Physic, fourteen books. 5. On Astronomical Observations, one book. 6. On Mathematical Sciences. 7. Of Theorems, or Mathematical and Theological Demonstrations, one book. 8. On the Arabic Language, and its Properties, ten books. 9. On the Last Judgment. 10. On the Origin of the Soul, and the Resurrection of Bodies. 11. Of the end we should propose to ourselves in Harangues and Philosophical Argumentations. 12. Demonstration of the collateral Lines in the Sphere. 13. Abridgement of Euclid. 14. On Finity and Infinity. 15. On Physics and Metaphysics. 16. On Animals and Vegetables, &c. 17. Encyclopedie, 20 volumes.—Some, however, charge him with having stolen what he published from a celebrated physician who had been his master. This man had acquired so much honour and wealth, that he was solicited by many to take their sons to be his scholars, or even his servants; but being resolved not to discover the secrets of his art, he would receive none of them. Avicenna's mother formed the following stratagem: she offered him her son as a servant, pretending he was naturally deaf and dumb: and the youth, by his mother's instructions, counterfeited those defects so well, that the physician, after making several trials to discover the reality of them, took the boy into his service, and by degrees trusted him

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him so far as to leave his writings open in his room when he went abroad: Avicenna took that opportunity to transcribe them, and carried the copies to his mother; and after the death of his master he published them under his own name. Indeed, if we reflect that he lived but 58 years, that he was a wanderer and a fugitive, and that he was much addicted to his pleasures, we shall have some difficulty to conceive how he could find time to compose so many works. Physic, however, is indebted to him for the discovery of cassia, rhubarb, mirabolans, tamarinds: and from him also, it is said, came to us the art of making sugar.

AVICENIA, Eastern Anacardium. See Botany *Index*.

AVIGATO pear. See Laurus, Botany *Index*.

AVIGLIANO, a small town of Piedmont in Italy. E. Long. 7. 5. N. Lat. 44. 40.

AVIGNON, a city of France, in the department of Vaucluse, the capital of the county of Venaissin, and seated on the banks of the Rhone. It was formerly an archbishop's see; and the residence of several popes at this place for 70 years has rendered it considerable. Near the Rhone there is a large rock, within the circumference of the walls, upon which is a platform, from whence may be had a prospect of the whole city and the places about it. This city is about three miles and two furlongs in circumference, and is in general ill built, irregular, and devoid of beauty. But it is surrounded by handsome battlemented walls and turrets, not unlike those of Rome; and its public edifices are large, solid, and grand as the taste of the fourteenth century could make them. Several popes and anti-popes, who, during their lives, shook the Romish church with violence and mutual altercation, repose quietly near each other in the various monasteries of the place. The church of the Cordeliers contains, in an obscure corner, the almost defaced tomb of Petrarch's Laura and her husband Hugh de Sade; and nearly opposite is the tomb of the brave Gullon, so well known for his invincible courage as well as for his inviolable attachment to his sovereign Henry IV. Many productions of Rene of Anjou are to be seen in the city. It contained 23,211 inhabitants in 1815, but the number was greater before the revolution. Avignon was at first included in the department of the Mouths of the Rhone, but is now the capital of the department of Vaucluse. It was annexed to France by a decree of the national assembly in 1791, but was not formally ceded by the pope till 1797.

The church of Notre Dame is ancient, but not large, and is one of the best adorned in the city. After having ascended about 50 steps, you come to a very ancient portico, which sustains a great tower; as you enter the church on the left hand, you see paintings which equal the finest in Italy. The great altar is very magnificent, and is adorned with a shrine that contains the relicks of we know not how many saints. The treasure of the sacristy is worthy of the curiosity of the traveller. The little palace where the archbishop resided is formed of three bodies of lodgings, accompanied with courts and small pavilions. It overlooks the Rhone, the city, and the fields. These buildings and the mint adorn a large square, which is the common walk of the inhabitants.

In Avignon they reckon seven gates, seven palaces, seven colleges, seven hospitals, seven monasteries, seven nunneries, and seven popes who have lived there in 70 years. The steeples are numerous, and the bells are never at rest; one of silver is rung only on the death of a pope. The church of the Celestines is very magnificent, and full of fine monuments; and the rest are not without their curiosities. The university has four colleges; and the place where the Jews live is a distinct quarter, from whence the Jews, who pay tribute, dare not stir out without yellow hats, and the women must have something yellow about their heads, to distinguish them from the Christians. Their number is very considerable in a very confined place, where the only way of enlarging their abodes is by building their houses higher. Their synagogne is so dark, that they are obliged to light lamps. However, they are forced to hear a monk preach a sermon every week. Across the Rhone, here, extend the ruinous and decayed arches of that bridge against which Madame de Grignan was so near being lost, and of which Madame de Sevigné makes terrified mention. It was demolished in 1699 by one of the inundations common to the Rhone. When entire, it was not less than a quarter of a mile in length; but being so narrow, as not to permit two carriages to pass in any part, it had previously become almost useless; and motives of policy prevent the construction of a new bridge, while Avignon belongs to the papal see. The curious that travel this way go to see the fountain of Vaucluse, where the river Sorgues, which passes through this city, has its source; and whither Petrarch so often retired to indulge his grief and hopeless love. It is situated in a valley five miles distant from the city. The sides of the river are skirted by meadows of the most lively green; above which rise abrupt and lofty rocks, that seem designed to seclude it from human view. The valley becomes gradually narrower towards the extremity, and winding continually describes the figure of a horse-shoe. The view is at length terminated by an enormous mass of rock, forming a barrier across it, of a prodigious height, and absolutely perpendicular. Through its vast recesses run the streams which supply the fountain of Vaucluse, and at its foot appears a bason of water, several hundred feet in circumference, stretched like an expanse, silent and quiet. The sides are very steep, and it is said that in the middle no bottom can be discovered, though attempts have been often made for that purpose; a circumstance probably resulting from the violence with which the springs bubble up, which prevents any weight from descending beyond a certain depth. Though the fountain is clearer in itself than crystal, yet the incumbent rock casts a continual shade, approaching to black, over its surface. The water escaping from this state of inaction by a narrow passage, is immediately precipitated in a cascade down a rocky channel, where it foams over a number of vast detached stones, which intercept and impede its progress. They are covered with a deep green moss of many ages, and have probably tumbled from the mountain that overhangs the torrent. The rocks themselves, which surround and invest this romantic

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mantic spot, are worn by time and the inclemency of the weather into a thousand extraordinary and fantastic forms, to which imagination gives shape and figure. On one of the pointed extremities, and in a situation which appears almost inaccessible, are seen the remains of an ancient castle, projecting over the water. The peasants call it *Il Castello di Petrarca;* and add, with great simplicity, that Laura lived upon the opposite side of the river, under the bed of which was a subterranean passage by which the two lovers visited each other. Nothing is, however, more certain, than that these are the ruins of the chateau belonging to the lords or seigneurs of Avignon; and the bishop of Cavaillon resided in it during the frequent visits which he used to make to Petrarch.—The poet's dwelling was much lower down, and nearer to the bank of the Sorgues, as evidently appears from his minute description of it, and the relation he gives of his quarrel with the Naiads of the stream, who encroached during the winter on his little adjoining territory. No remains of it are now to be discerned. Below the bridge there is an island where the Sorgues joins the Rhone, in which are several pleasure-houses. E. Long. 4. 59. N. Lat. 43. 57.

Avignon Berry, the fruit of a species of lycium; growing plentifully near Avignon and in other parts of France. The berry is somewhat less than a pea; its colour is green, approaching towards a yellow; and it is of an astringent and bitter taste.—It is much used by the dyers, who stain a yellow colour with it: and by the painters, who also make a fine golden yellow of it.

AVILA, a city of Old Castile, in Spain, seated on an eminence on the banks of the river Adaja, and in sight of the mountains of Pico. It is fortified both by nature and art, having a wall 9075 feet in circumference, adorned with 26 lofty towers, and 10 handsome gates. There are 17 principal streets, containing many good houses, but the town is now in a state of decay. It hath nine squares, 2000 houses, nine parishes, as many monasteries, seven nunneries, two colleges, nine hospitals, 18 chapels, and an allowance of 10,000 ducats yearly for the maintenance of orphans and other poor people. It has an university, and a considerable bishopric; besides a noble cathedral, which has eight dignitaries, 20 canons, and the same number of minor canons. It stands in the middle of a fine large plain surrounded with mountains, and covered with fruit-trees and vineyards. Its woollen manufactures have sunk. W. Long. 4. 13. N. Lat. 40. 35.

AVIS, a small town of Alentejo in Portugal, seated on an eminence, with a castle near the river Avis. Hence the military order of the knights of Avis have their name. W. Long. 7. 0. N. Lat. 38. 40.

Avis (*Knights d'Avis*), an order of knighthood in Portugal established about the year 1162. When the city of Evora was taken from the Moors, in the reign of the first king of Portugal, it was garrisoned by several persons who assumed the title of knights of St Mary of Evora, which was soon after changed for that of knights d'Avis, which the king gave them, and whither they removed from Evora. The badge of the order is a green cross flory, and they observe the rule of St Benedict.

AVISO, a term chiefly used in matters of commerce to denote an advertisement, an advice, or piece of intelligence.

AVISON, Charles, organist of Newcastle, and a disciple of Geminiani, was the author of an essay on musical expression, published in the year 1752, in which are some judicious reflections on music in general, but his division of the modern authors into classes is rather fanciful than just. Throughout his book he celebrates Marcello and Geminiani; the latter frequently in prejudice to Mr Handel. In the year 1753 came out remarks on Mr Avison's essay on musical expression, the author whereof first points out sundry errors against the rules of composition in the works of Avison. In the same year Avison republished his essay, with a reply to the author of the remarks; and a letter, containing a number of loose particulars relating to music, collected in a course of various reading, unquestionably written by Dr Jortin. Avison promoted and assisted in the publication of Marcello's music to the psalms adapted to English words. Of his own composition there are extant five collections of concertos for violins, 44 in number; and two sets of sonatas for the harpsichord and two violins, a species of composition little known in England till his time. The music of Avison is light and elegant, but it wants originality; a necessary consequence of his too close attachment to the style of Geminiani, which in a few particulars only he was able to imitate.

AUK, in *Ornithology*. See Alca, Ornithology *Index*.

AUKLAND, Bishop's, a town in the bishopric of Durham in England, situated on the river Were. It is a sanctuary for debtors; and here the bishop has a princely palace and a noble park. W. Long. 0. 75. N. Lat. 54. 44.

AULA, is used for a court baron by Spelman; by some old ecclesiastical writers, for the nave of a church, and sometimes for a court-yard.

Aula Regia or *Regis*, a court established by William the Conqueror in his own hall, composed of the king's great officers of state, who resided in his palace, and were usually attendant on his person. This court was regulated by the article which forms the eleventh chapter of Magna Charta, and established in Westminster-hall, where it hath ever since continued. See *King's Bench*.

AULCESTER, a town of Warwickshire in England. W. Long. 1. 47. N. Lat. 52. 15.

AULETES, in antiquity, denotes a flute-player. One of the Ptolemies, kings of Egypt, father of Cleopatra, bore the surname or denomination of *Auletes*.

AULIC, an epithet given to certain officers of the empire, who compose a court which decides, without appeal, in all processes entered in it. Thus we say, *aulic council, aulic chamber, aulic counsellor*.

The aulic council is composed of a president, who is a catholic; of a vice chancellor, presented by the archbishop of Mentz; and of 18 counsellors, nine of whom are Protestants and nine Catholics. They are divided into a bench of lawyers, and always follow the emperor's court; for which reason they are called *justitium imperatoris*, the emperor's justice, and aulic council. The aulic court ceases at the death of the emperor; whereas the imperial chamber of Spire is perpetual, representing not only the deceased emperor,

 but

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but the whole Germanic body, which is reputed never to die.

Aulic, in the Sorbonne and foreign universities, is an act which a young divine maintains upon being admitted a doctor of divinity. It begins by a harangue of the chancellor, addressed to the young doctor, after which he receives the cap, and presides at the aulic or disputation.

AULIS, in *Ancient Geography*, a town of Bœotia, over against Chalcis of Eubœa, on the Euripus, where that strait is narrowest; and which was sometimes joined with Chalcis together by a mole or causeway, (Diodorus Siculus): a craggy situation, (Homer, Nonnius); and a village of the Tanagræi, (Strabo), distant from Chalcis three miles: A harbour famous for the rendezvous of the Grecian fleet under Agamemnon, previous to the Trojan expedition, (Livy, Virgil, Pliny). Now entirely destroyed.

AULNEGER. See Alnager.

AULON, anciently a town and dock or station for ships in Illyricum, on the Adriatic; now *Valona*, or *Volana*, a port-town in the duchy of Ferrara, on one of the mouths of the Po, on the gulf of Venice. E. Long. 13. N. Lat. 44. 50.

Aulon, or *Aulona*, anciently a town of Elis, in Peloponnesus, on the confines of Messenia. Here stood a temple of Æsculapius; hence the epithet *Aulonius* given that divinity, (Pausanias).

AULOS, a Grecian long measure, the same with stadium.

AULPS, a town of Provence in France, in the diocese of Frejus, with the title of a vigurie. E. Long. 6. 25. N. Lat. 43. 40.

AULUS Gellius. See Gellius.

AUMBRY, a country word denoting a cupboard.

AUME, a Dutch measure for Rhenish wine, containing 40 English gallons.

AUNCEL-weight, an ancient kind of balance, now out of use, being prohibited by several statutes, on account of the many deceits practised by it. It consisted of scales hanging on hooks, fastened at each end of a beam, which a man lifted up on his hand. In many parts of England, auncel-weight signifies meat sold by the hand, without scales.

AUNE, a long measure used in France to measure cloths, stuffs, ribbons, &c. At Rouen, it is equal to one English ell; at Calais, to 1.52; at Lyons, to 1.061; and at Paris, to 0.95.

AUNGERVYLE, Richard, commonly known by the name of *Richard de Bury*, was born in 1281 at St Edmund's Bury in Suffolk, and educated at the university of Oxford: After which he entered into the order of Benedictine monks, and became tutor to Edward prince of Wales, afterwards King Edward III. Upon the accession of his royal pupil to the throne, he was first appointed cofferer, then treasurer of the wardrobe, archdeacon of Northampton, prebendary of Lincoln, Sarum, and Litchfield, keeper of the privy seal, dean of Wells, and last of all was promoted to the bishopric of Durham. He likewise enjoyed the offices of lord high chancellor and treasurer of England; and discharged two important embassies at the court of France. Learned himself, and a patron of the learned, he maintained a correspondence with some of the greatest geniuses of the age, particularly with the celebrated Italian poet Petrarch. He was also of a most humane and benevolent temper, and performed many signal acts of charity. Every week he made eight quarters of wheat into bread, and gave it to the poor. Whenever he travelled between Durham and Newcastle, he distributed eight pounds sterling in alms: between Durham and Stockton five pounds, between Durham and Aukland five marks, and between Durham and Middleham five pounds. He founded a public library at Oxford for the use of the students, which he furnished with the best collection of books then in England; and appointed five keepers, to whom he granted yearly salaries. At the dissolution of religious houses in the reign of Henry VIII. Durham college, where he fixed the library, being dissolved among the rest, some of the books were removed to the public library, some to Baliol college, and some came into the hands of Dr George Owen, a physician of Godstow, who bought that college of King Edward VI. Bishop Aungervyle died at his manor of Aukland, April 24. 1345, and was buried in the south part of the cross aisle of the cathedral church of Durham, to which he had been a benefactor. He wrote, 1. *Philobiblos*, containing directions for the management of his library at Oxford, and a great deal in praise of learning, in bad Latin. 2. *Epistolæ familiarium*; some of which are written to the famous Petrarch. 3. *Orationes ad principes*; mentioned by Bale and Pitts.

AUNIS, formerly a small province in France, but now included in the department of the Lower Charente, and belonging to the arrondisements of Rochefort, La Rochelle, and Varennes. It is watered by the rivers Seure and Sarente, the former of which has its source at Seure in Poictou. The coast of this small district has the advantage of several ports, the most remarkable of which are Rochefort, Rochelle, Brouge, St Martin de Re, Tremblade, Tonnai, and Charente. The soil of this country is dry, yet produces good corn and plenty of wine. The marshes feed a great number of cattle, and the salt marshes yield the best salt in Europe.

AVOCADO, or Avigato, *Pear*. See Laurus, Botany *Index*.

AVOCATORIA, a mandate of the emperor of Germany, addressed to some prince, in order to stop his unlawful proceedings in any cause appealed to him.

AVOIDANCE, in the canon law, is when a benefice becomes void of an incumbent; which happens either in fact, as by the death of the person; or in law, as by cession, deprivation, resignation, &c. In the first of these cases, the patron must take notice of the avoidance at his peril; but in avoidance by law, the ordinary is obliged to give notice to the patron, in order to prevent a lapse.

AVOIRDUPOIS. This is the weight for the larger and coarser commodities, such as groceries, cheese, wool, lead, &c. Bakers, who live not in corporation towns, are to make their bread by avoirdupois weight, those in corporations by troy weight. Apothecaries buy by avoirdupois weight, but sell by troy. The proportion of a pound avoirdupois to a pound troy is as 17 to 14.

AVOSETTA. See Recurvirostra, Ornithology *Index*.

AVOWEE, one who has a right to present to a benefice. He is thus called in contradistinction to those

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those who only have the lands to which the advowson belongs for a term of years, or by virtue of intrusion or disseisin.

AVOWRY, in *Law*, is where a person distrained sues out a replevin; for then the distrainer must vow, and justify his plea, which is called his *avowry*.

AURA, among *Physiologists*, an airy exhalation or vapour. The word is Latin, derived from the Greek, *αυρα*, *gentle wind*.

AURACH, a town of Germany with a good castle, in the kingdom of Wirtemberg. It is the usual residence of the youngest sons of the house of Wirtemberg, and is seated at the foot of a mountain on the rivulet Ermst, nine miles east of Warzach. E. Long. 9. 20. N. Lat. 48. 25.

AURÆ, in *Mythology*, a name given by the Romans to the nymphs of the air. They are mostly to be found in the ancient paintings of ceilings; where they are represented as light and airy, generally with long robes and flying veils of some lively colour or other, and fluttering about in the rare and pleasing element assigned to them. They are characterized as sportive and happy in themselves, and wellwishers to mankind.

AURANCHES, the capital of a territory called *Auranchin*, about 30 miles in length, in Lower Normandy in France, now the department of the Channel. The city is mean; but its situation very fine, being on an eminence near which the river See runs, about a mile and a half from the ocean. The cathedral stands on a hill, which terminates abruptly; the front of the church extending to the extreme verge of it, and overhanging the precipice. It bears the marks of high antiquity; but the towers are decayed in many places. The population of the town in 1815 was 6000. Here, you are told, the English Henry II. received absolution from the Papal nuncio for the murder of St Thomas-a-Becket in 1172, and the stone on which he knelt during the performance of that ceremony is shewn to strangers. Its length is about 30 inches, and the breadth 12. It stands before the north portal, and on it is engraved a chalice in commemoration of the event. The ruins of the castle of Auranches are very extensive; and beneath lies a rich extent of country, abounding in grain, and covered with orchards, from the fruit of which is made the best cyder in Normandy. W. Long. 1. 20. N. Lat. 48. 51.

AURANTIUM, in *Botany*. See CITRUS, BOTANY *Index*.

AURAY, a small seaport town of Lower Britanny in France, situated on the gulf called *Morbihan*, and in the department of the same name. It consists of only one handsome street, and is chiefly known for its trade. W. Long. 2. 25. N. Lat. 47. 48.

AURELIA, in *Natural History*, the same with what is more usually called *chrysalis*, and sometimes *nymph*. See CHRYSALIS, ENTOMOLOGY *Index*.

AURELIANUS, LUCIUS DOMITIUS, emperor of Rome, was one of the greatest generals of antiquity, and commanded the armies of the emperor Claudius with such glory, that after the death of that emperor all the legions agreed to place him on the throne: this happened in the year 270. He carried the war from the east to the west, with as much facility, says a modern writer, as a body of troops marches from Alsace into Flanders. He defeated the Goths, Sarmatians, Marcomanni, the Persians, Egyptians and Vandals; conquered Zenobia queen of the Palmyrenians, and Tetricus general of the Gauls; both of whom were made to grace his triumph, in the year 274. He was killed by one of his generals in Thrace in the year 275, when he was preparing to enter Persia with a great army. See ROME.

AURELIUS VICTOR. See VICTOR.

AURENGABAD, a city in the East Indies, capital of a province of the same name, on the western side of the peninsula. It is furnished with handsome mosques and caravanseras. The buildings are chiefly of freestone, and pretty high, and the streets planted on each side with trees. They have large gardens well stocked with fruit trees and vines. The soil about it is also very fertile, and the sheep fed in its neighbourhood are remarkably large and strong. E. Long. 75. 30. N. Lat. 19. 10.

AURENG-ZEBE, a celebrated Mogul emperor. See HINDOSTAN.

AUREOLA, in its original signification, signifies a jewel, which is proposed as a reward of victory in some public dispute. Hence the Roman schoolmen applied it to denote the reward bestowed on martyrs, virgins, and doctors, on account of their works of supererogation; and painters use it to signify the crown of glory with which they adorn the heads of saints, confessors, &c.

AUREUS, a Roman gold coin, equal in value to 25 denarii. According to Ainsworth, the aureas of the higher empire weighed near five pennyweights; and in the lower empire, little more than half that weight. We learn from Suetonius, that it was customary to give aurei to the victors in the chariot races.

AUREUS MONS, in *Ancient Geography*, a mountain in the north-west of Corsica, whose ridge runs out to the north-east and south-east, forming an elbow.—Another mountain of Mœsia Superior, or Servia (Peutinger), to the south of the Danube, with a cognominal town at its foot on the same river. The emperor Probus planted this mountain with vines (Eutropius).

AURICK, a city of Germany, in East Friesland, in the kingdom of Hanover, containing 2200 inhabitants. It is situated in a plain surrounded with forests full of game. E. Long. 6. 50. N. Lat. 53. 28.

AURICLE, in *Anatomy*, that part of the ear which is prominent from the head, called by many authors *auris externa*.

AURICLES are likewise two muscular bags situated at the basis of the heart, and intended as diverticula for the blood during the diastole.

AURICULA, in *Botany*. See PRIMULA, BOTANY *Index*.

AURIFLAMMA, in the French history, properly denotes a flag or standard belonging to the abbey of St Dennis, suspended over the tomb of that saint, which the religious on occasion of any war in defence of their lands or rights, took down with great ceremony, and gave it to their protector or advocate, to be borne at the head of their forces.

AURIFLAMMA is also sometimes used to denote the chief flag or standard in any army.

AURICA,

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AURIGA, *the Waggoner*, in *Astronomy*, a constellation of the northern hemisphere, consisting of 23 stars, according to Tycho; 40, according to Hevelius; and 68, in the Britannic catalogue.

AURILLAC, a town in France, in Lower Auvergne, now the department of Cantal, seated on a small river called *Jourdane*. It is one of the most considerable towns of the province, and contained 10,332 inhabitants in 1815. The castle is very high, and commands the town. The abbot was lord of Aurillac, and had episcopal jurisdiction; and was also chief justice of the town. This place is remarkable for having produced several great men. E. Long. 2. 33. N. Lat. 44. 55.

AURIPIGMENTUM, Orpiment, in *Natural History*. See Orpiment.

AURISCALPIUM, an instrument to clean the ears, and serving also for other operations in disorders of that part.

AURORA, the morning twilight, or that faint light which appears in the morning when the sun is within 18 degrees of the horizon.

Aurora, the goddess of the morning, according to the Pagan mythology. She was the daughter of Hyperion and Theia, according to Hesiod; but of Titan and Terra, according to others. It was under this name that the ancients deified the light which foreruns the rising of the sun above our hemisphere. The poets represent her as rising out of the ocean, in a chariot, with rosy fingers dropping gentle dew. Virgil describes her ascending in a flame-coloured chariot with four horses.

Aurora, one of the New Hebrides islands in the South sea, in which Mr Forster supposes the *Peak d'Etoile* mentioned by Mr Bougainville to be situated. The island is inhabited; but none of its inhabitants came off to visit Captain Cook. The country is woody, and the vegetation seemed to be excessively luxuriant. It is about 12 leagues long, but not above five miles broad in any part; lying nearly north and south. The middle lies in S. Lat. 15. 6. E. Long. 168. 24.

Aurora Borealis, *Northern Twilight*, or *Streamers*; a kind of meteor appearing in the northern part of the heavens, mostly in the winter time, and in frosty weather. It is now so generally known, that no description is requisite of the appearance which it usually makes in this country. But it is in the arctic regions that it appears in perfection, particularly during the solstice. In the Shetland islands, the *merry dancers*, as they are there called, are the constant attendants of clear evenings, and prove great reliefs amidst the gloom of the long winter nights. They commonly appear at twilight near the horizon, of a dun colour, approaching to yellow; sometimes continuing in that state for several hours without any sensible motion; after which they break out into streams of stronger light, spreading into columns, and altering slowly into ten thousand different shapes, varying their colours from all the tints of yellow to the obscurest russet. They often cover the whole hemisphere, and then make the most brilliant appearance. Their motions at these times are most amazingly quick; and they astonish the spectator with the rapid change of their form. They break out in places where none were seen before, skimming briskly along the heavens; are suddenly extinguished, and leave behind an uniform dusky track. This again is brilliantly illuminated in the same manner, and as suddenly left a dull blank. In certain nights they assume the appearance of vast columns, on one side of the deepest yellow, on the other declining away till it becomes undistinguished from the sky. They have generally a strong tremulous motion from end to end, which continues till the whole vanishes. In a word, we, who only see the extremities of these northern phenomena, have but a faint idea of their splendour and their motions. According to the state of the atmosphere, they differ in colour. They often put on the colour of blood, and make a most dreadful appearance. The rustic sages become prophetic, and terrify the gazing spectators with the dread of war, pestilence, and famine. This superstition was not peculiar to the northern islands; nor are these appearances of recent date. The ancients called them *Chasmata*, and *Trabes*, and *Bolides*, according to their forms or colours.

1
This meteor formerly very rare.

In old times they were extremely rare, and on that account were the more taken notice of. From the days of Plutarch to those of our sage historian Sir Richard Baker, they were supposed to have been portentous of great events, and timid imagination shaped them into aerial conflicts:

> Fierce fiery warriors fight upon the clouds
> In ranks and squadrons and right form of war.

Dr Halley tells us, that when he saw a great aurora borealis in 1716, he had begun to despair of ever seeing one at all: none having appeared, at least in any considerable degree, from the time he was born till then. Notwithstanding this long interval, however, it seems that in some periods the aurora borealis had been seen much more frequently; and perhaps this, as well as other natural phenomena, may have some stated times of returning.

2
History by Dr Halley.

The only thing that resembles a distinct history of this phenomenon, is what we have from the learned Dr Halley, Phil. Trans. N° 347. The first account he gives, is of the appearance of what is called by the author *burning spears*, and was seen at London on January 30th 1560. This account is taken from a book entitled, *A Description of Meteors*, by *W. F.* D. D. and reprinted at London in 1654. The next appearance, on the testimony of Stow, was on October 7th, 1564. In 1574 also, according to Camden, and Stow abovementioned, an aurora borealis was observed two nights successively, viz. on the 14th and 15th of November, with much the same appearances as described by Dr Halley in 1716, and which we now so frequently observe. Again, the same was twice seen in Brabant, in the year 1575; viz. on the 13th of February and 28th of September. Its appearances at both these times were described by Cornelius Gemm, professor of medicine in the university of Louvain, who compares them to spears, fortified cities, and armies fighting in the air. After this, Michael Mæstlin, tutor to the great Kepler, assures us, that at Baknang in the county of Wurtemberg in Germany, these phenomena, which he styles *chasmata*, were seen by himself no less than seven times in 1580. In 1581, they again appeared in an extraordinary manner in April and September, and in a less degree at some other times of the same year. In 1621, September 2d, this phenomenon was observed all over France,

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Aurora Borealis.

France, and described by Gassendus, who gave it the name of *aurora borealis:* yet neither this, nor any similar appearances posterior to 1574, are described by English writers till the year 1707; which, as Dr Halley observes, shows the prodigious neglect of curious matters which at that time prevailed. From 1621 to 1707, indeed, there is no mention made of an aurora borealis being seen by any body; and considering the number of astronomers who during that period were in a manner continually poring on the heavens, we may very reasonably conclude that no such thing did make its appearance till after an interval of 86 years. In 1707, a small one was seen in November; and during that year and the next, the same appearances were repeated five times. The next on record is that mentioned by Dr Halley in March 1715—16, the brilliancy of which attracted universal attention, and by the vulgar was considered as marking the introduction of a foreign race of princes. Since that time those meteors have been so common, that no accounts have been kept of them.

3 Mr Forster's account of similar appearances in the southern hemisphere.

It was for a long time a matter of doubt whether this meteor made its appearance only in the northern hemisphere, or whether it was also to be observed near the south pole. This is now ascertained by Mr Forster; who in his late voyage round the world along with Captain Cook, assures us, that he observed them in the high southern latitudes, though with phenomena somewhat different from those which are seen here. On Feb. 17. 1773, as they were in Lat. 58° south, "A beautiful phenomenon (says he) was observed during the preceding night, which appeared again this and several following nights. It consisted of long columns of a clear white light, shooting up from the horizon to the eastward, almost to the zenith, and gradually spreading on the whole southern part of the sky. These columns were sometimes bent sidewise at their upper extremities; and though in most respects similar to the northern lights (*aurora borealis*) of our hemisphere, yet differed from them in being always of a whitish colour, whereas ours assume various tints, especially those of a fiery and purple hue. The sky was generally clear when they appeared, and the air sharp and cold, the thermometer standing at the freezing-point."

4 Rises very high.

Dr Halley observed that the aurora borealis described by him arose to a prodigious height, it being seen from the west of Ireland to the confines of Russia and Poland on the east; nor did he know how much farther it might have been visible; so that it extended at least 30 degrees in longitude, and from Lat. 50° north it was seen over all the northern part of Europe; and what was very surprising, in all those places where it was visible, the same appearances were exhibited which Dr Halley observed at London. He observes, with seeming regret, that he could by no means determine its height, for want of observations made at different places; otherwise he might as easily have calculated the height of this aurora borealis, as he did of the fiery globe in 1719 *. To other philosophers, however, he gives the following exhortation. "When therefore for the future any such thing shall happen, all those that are curious in astronomical matters are hereby *admonished* and *entreated* to set their clocks to the apparent time at London, for example, by allowing so many minutes as is the difference of meridians; and then to note, at the end of every half hour precisely, the exact situation of what at that time appears remarkable in the sky; and particularly the azimuths of those very tall pyramids so eminent above the rest, and therefore likely to be seen furthest: to the intent that, by comparing these observations taken at the same moment in distant places, the difference of their azimuths may serve to determine how far these pyramids are distant from us." This advice of Dr Halley seems to have been totally neglected by all the philosophical people in this country. In other countries, however, they have been more industrious. Father Boscovich has determined the height of an aurora borealis, observed on the 16th of December 1737 by the marquis of Poleni, to have been 825 miles high; the celebrated Mr Bergman, from a mean of 30 computations, makes the average height of the aurora borealis to be 70 Swedish, or upwards of 460 English miles. Euler supposes it to be several thousands of miles high; and Mairan also assigns them a very elevated region. In the 74th volume of the Philosophical Transactions, Dr Blagden, when speaking of the height of some fiery meteors, tells us, that the "aurora borealis appears to occupy as high, if not a higher region above the surface of the earth, as may be judged from the very distant countries to which it has been visible at the same time." The height of these meteors, however, none of which appear to have exceeded or even arrived at the height of a hundred miles, must appear trifling in comparison of the vast elevations above mentioned. But these enormous heights, varying so exceedingly, show that the calculators have not had proper data to proceed upon; and indeed the immense extent of space occupied by the aurora borealis itself, with its constant motion, must make it infinitely more difficult to determine the height of it than of a fiery globe, which occupies but a small portion of the visible heavens. The most certain method of making a comparison betwixt the aurora borealis and the meteors already mentioned, would be, if a ball of fire should happen to pass through the same part of the heavens where an aurora borealis was; when the comparative height of both could easily be ascertained. One instance of this only has come under our observation, where one of the small meteors, called *falling stars*, was evidently obscured by an aurora borealis; and therefore must have been higher than the lower part of the latter at least. A singularity in this meteor was, that it did not proceed in a straight line through the heavens, as is usual with falling stars, but described a very considerable arch of a circle, rising in the north-west, and proceeding southward a considerable way in the arch of a circle, and disappearing in the north. Its edges were ill defined, and five or six coruscations seemed to issue from it like the rays painted as issuing from stars. The aurora borealis was not in motion, but had degenerated into a crepusculum in the northern part of the hemisphere. Indeed, in some cases, this kind of crepusculum appears so plainly to be connected with the clouds, that we can scarcely avoid supposing it to proceed from them. We cannot, however, argue from this to the height of the aurora borealis wh[illegible] it moves with great velocity, because it then ma[illegible] and very probably does, ascend much higher. Dr B[illegible]agden, indeed,

* See *Atmosphere.*

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Aurora Borealis.

deed, informs us, that instances are recorded, where the northern lights have been seen to join, and form luminous balls, darting about with great velocity, and even leaving a train like the common fire-balls. It would seem, therefore, that the highest regions of the aurora borealis are the same with those in which fire-balls move.

5 Conjectures concerning the cause of this meteor.

With regard to the cause of the aurora borealis many conjectures have been formed. The first which naturally occurred was, that it was occasioned by the ascent of inflammable sulphureous vapours from the earth. To this supposition Dr Halley objects the immense extent of such phenomena, and that they are constantly observed to proceed from north to south, but never from south to north. This made him very reasonably conclude, that there was some connexion between the poles of the earth and the aurora borealis; but being unacquainted with the electric power, he supposed, that this earth was hollow, having within it a magnetical sphere, which corresponded in virtue with all the natural and artificial magnets on the surface; and the magnetic effluvia passing through the earth, from one pole of the central magnet to another, might sometimes become visible in their course, which he thought was from north to south, and thus exhibit the beautiful coruscations of the aurora borealis. Had Dr Halley, however, known that a stroke of electricity would give polarity to a needle that had it not, or reverse the poles of one that had it before, he would undoubtedly have concluded the electric and magnetic effluvia to be the same, and that the aurora borealis was this fluid performing its circulation from one pole of the earth to the other. In fact, this very hypothesis is adopted by S. Beccaria: and by the supposed circulation of the electric fluid he accounts for the phenomena of magnetism and the aurora borealis in a manner perfectly similar to that of Dr Halley, only changing the phrase *magnetic effluvia* for *electric fluid*. The following is the account given us by Dr Priestley of Beccaria's sentiments on this matter.

"Since a sudden stroke of lightning gives polarity to magnets, he conjectures, that a regular and constant circulation of the whole mass of the fluid from north to south may be the original cause of magnetism in general.

"That this ethereal current is insensible to us, is no proof of its non-existence, since we ourselves are involved in it. He had seen birds fly so near a thunder-cloud, as he was sure they would not have done had they been affected by its atmosphere.

"This current he would not suppose to arise from one source, but from several, in the northern hemisphere of the earth; and he thinks that the aurora borealis may be this electric matter performing its circulation in such a state of the atmosphere as renders it visible, or approaching the earth nearer than usual. Accordingly, very vivid appearances of this kind have been observed to occasion a fluctuation in the magnetic needle."

A direct disproof of this circulation, however, is furnished by the observation of Mr Forster already mentioned: with which, though neither Dr Halley nor S. Beccaria could be acquainted, they might have thought of it as a final proof either of the truth or falsehood of their hypothesis.—If the aurora borealis is no other than the electric fluid performing the above-mentioned circulation, it ought to dart from the horizon towards the zenith in the northern hemisphere, and from the zenith to the horizon in the southern one: but Mr Forster plainly tells up, that the columns shot up from the horizon towards the zenith as well in the southern hemisphere as in the northern; so that if the aurora borealis is to be reckoned the flashings of electric matter, its course is plainly directed from both poles toward the equator, and not from one pole to the other.

Concerning the cause of this phenomenon, Mr Canton has the following query: "Is not the aurora borealis the flashing of electrical fire from positive towards negative clouds at a great distance, through the upper part of the atmosphere where the resistance is least?" But to this we must reply in the negative; for in this case it would flash in every direction according to the position of the clouds, as well as from north to south. Besides this query, he conjectures, that when the needle is disturbed by the aurora borealis, that phenomenon proceeds from the electricity of the heated air; and supposes the air to have the property of becoming electric by heat, like the tourmalin. But neither does this hypothesis appear at all probable; because, in such a case, the aurora borealis ought to be most frequent in summer when the air is most heated, whereas it is found to be the reverse. Lastly, with these electrical hypotheses we shall contrast that of Mr Mairan, who imagined this phenomenon to proceed from the atmosphere of the sun, particles of which were thrown off by its centrifugal force acquired by his rotation on his axis; and that these particles falling upon the atmosphere of the earth near its equatorial parts, were from thence propelled by the diurnal motion of the earth towards the polar regions, where they formed the aurora borealis. This hypothesis, besides its being a mere supposition unsupported by one single appearance in nature, is liable to the objection already mentioned; for in this case the light should dart from the equator to the poles, and not from the poles to the equator: or if we should suppose this matter to be gradually accumulated at each of the poles, we must then make other suppositions equally vague and ill founded, concerning its getting back with such surprising rapidity in direct opposition to the power which once brought it thither.

The first person who seems to have endeavoured to find any positive proof of the electrical quality of the aurora borealis, was Dr Hamilton of Dublin. He observes, that though this phenomenon is commonly supposed to be electrical, yet he had not seen any attempt to prove that it is so; but the only proof he himself brings is an experiment of Mr Hawksbee, by which the electric fluid is shown to put on appearances somewhat like the aurora borealis, when it passes through a vacuum. He observed, that when the air was most perfectly exhausted, the streams of electric matter were then quite white; but when a small quantity of air was let in, the light assumed more of a purple colour. The flashing of this light therefore from the dense regions of the atmosphere into such as are more rare, and the transitions through mediums of different density, he reckons the cause of the aurora borealis, and of the different colours it assumes.

Dr Hamilton's proof, then, of the electricity of the

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Aurora Borealis. the aurora borealis, consists entirely in the resemblance the two lights bear to one another; and if to this we add, that during the time of an aurora borealis, the magnetic needle hath been disturbed, electric fire obtained from the atmosphere in plenty, and at some times different kinds of rumbling and hissing sounds heard, we have the sum of all the positive evidence in favour of the electric hypothesis.

Was the aurora borealis the first natural phenomenon the solution of which had been attempted by electricity, no doubt the proofs just now adduced would be very insufficient: but when it is considered, that we have indisputable evidence of the identity of the phenomena of thunder and of electricity; when we also consider that the higher parts of our atmosphere are continually in a strongly electrified state; the analogy becomes so strong that we can scarce doubt of the aurora borealis arising from the same cause. The only difficulty is, to give a good reason why the electricity of the atmosphere should be constantly found to direct its course from the poles towards the equator, and not from the equator to the poles; and this we think may be done in the following manner.

See *Electricity*, passim. 1. It is found that all electric bodies, when considerably heated, become conductors of electricity; thus hot air, hot glass, melted rosin, sealing-wax, &c. are all conductors, till their heat is dissipated, and then they again become electrics.

2. As the converse of every true proposition ought also to be true, it follows from the above one, that if electrics when heated become conductors, then nonelectrics when subjected to violent degrees of cold ought to become electric. In one instance this has been verified by experience; water, which is a conductor when warm or not violently cooled, is found to become electric when cooled to 20° below 0 of Fahrenheit's thermometer. With regard to metallic substances, indeed, no experiments have as yet been made to determine whether their conducting power is affected by cold or not. Very probably we might not be able to produce such a degree of cold as sensibly to lessen their conducting power; but still the analogy will hold; and, as we are by no means able to produce the greatest degree of cold possible, reason will always suggest to us, that if a certain degree of cold changes one conductor into an electric, a sufficient degree of it will also change all others into electrics.

3. If cold is sufficient to change conducting substances into electrics, it must also increase the electric power of such substances as are already electric; that is to say, very cold air, glass, rosin, &c. provided they are dry, will be more electric than when they are warmer. With regard to air, which is most to our present purpose, this is rendered extremely probable, by considering that clear frosty weather is of all others the most favourable for electric experiments. They may be made indeed to equal advantage almost in any state of the atmosphere, provided sufficient pains are used, but in dry hard frosts they will succeed much more easily than at any other time.

These three axioms being allowed, the cause of the aurora borealis is easily deduced from them. The air, all round the globe, at a certain height above its surface, is found to be exceedingly cold, and, as far as experiments have yet determined, exceedingly electrical also. The inferior parts of the atmosphere between the tropics, are violently heated during the day-time by the reflection of the sun's rays from the earth. Such air will therefore be a kind of conductor, and much more readily part with its electricity to the clouds and vapours floating in it, than the colder air towards the north and south poles. Hence the prodigious appearances of electricity in these regions, showing itself in thunder and other tempests of the most terrible kind. Immense quantities of the electric fluid are thus communicated to the earth; and the inferior warm atmosphere having once exhausted itself, must necessarily be recruited from the upper and colder region. This becomes very probable from what the French mathematicians observed when on the top of one of the Andes. They were often involved in clouds, which, sinking down into the warmer air, appeared there to be highly electrified, and discharged themselves in violent tempests of thunder and lightning: while in the mean time, on the top of the mountain, they enjoyed a calm and serene sky. In the temperate and frigid zones, the inferior parts of the atmosphere never being so strongly heated, do not part with their electricity so easily as in the torrid zone, and consequently do not require such recruits from the upper regions: but notwithstanding the difference of heat observed in different parts of the earth near the surface, it is very probable that at considerable heights the degrees of cold are nearly equal all round it. Were there a like equality in the heat of the under part, there could never be any considerable loss of equilibrium in the electricity of the atmosphere: but as the hot air of the torrid zone is perpetually bringing down vast quantities of electric matter from the cold air that lies directly above it; and as the inferior parts of the atmosphere lying towards the north and south poles do not conduct in any great degree; it thence follows, that the upper parts of the atmosphere lying over the torrid zone will continually require a supply from the northern and southern regions. This easily shows the necessity of an electric current in the upper parts of the atmosphere from each pole towards the equator: and thus we are also furnished with a reason why the aurora borealis appears more frequently in winter than in summer; namely, because at that time the electric power of the inferior atmosphere is greater on account of the cold than in summer; and consequently the abundant electricity of the upper regions must go almost wholly off to the equatorial parts, it being impossible for it to get down to the earth: hence also the aurora borealis appears very frequent and bright in the frigid zone, the degree of cold in the upper and under regions of the atmosphere being much more nearly equal in these parts than in any other. In some parts of Siberia particularly, this meteor appears constantly from October to Christmas, and its coruscations are said to be very terrifying. Travellers agree, that here the aurora borealis appears in greatest perfection; and it is to be remarked that Siberia is the coldest country on earth. In confirmation of this, it may also be observed, that from the experiments hitherto made with the electrical kite, the air appears considerably more electrical in winter than in summer, though the clouds are known to be often most violently electrified in the summer time; a proof, that the electricity naturally

turally belonging to the air is in summer much more powerfully drawn off by the clouds than in the winter, owing to the excess of heat in summer, as already observed.

A considerable difficulty, however, still remains from the upright position which the streams of the aurora borealis are generally supposed to have; whereas, according to the hypothesis above mentioned, they ought rather to run directly from north to south. This difficulty occurred to Dr Halley; but he answers it by supposing his magnetic effluvia to pass from one pole to another in arches of great circles, arising to a vast height above the earth, and consequently darting from the places whence they arose almost like the radii of a circle; in which case, being sent off in a direction nearly perpendicular to the surface of the earth, they must necessarily appear erect to those who see them from any part of the surface, as is demonstrated by mathematicians. It is also reasonable to think that they will take this direction rather than any other, on account of their meeting with less resistance in the very high regions of the air than in such as are lower.

But the greatest difficulty still remains: for we have supposed the equilibrium of the atmosphere to be broken in the daytime, and restored only in the night; whereas, considering the immense velocity with which the electric fluid moves, the equilibrium ought to be restored in all parts almost instantaneously; yet the aurora borealis never appears except in the night, although its brightness is such as must sometimes make it visible to us did it really exist in the daytime.

In answer to this it must be observed, that though the passage of electricity through a good conductor is instantaneous, yet through a bad conductor it is observed to take some time in passing. As our atmosphere therefore, unless very violently heated, is but a bad conductor of electricity; though the equilibrium in it is broken, it can by no means be instantaneously restored. Add to this, that as it is the action of the sun which breaks the equilibrium, so the same action, extending over half the globe, prevents almost any attempt to restore it till night, when flashes arise from various parts of the atmosphere, gradually extending themselves with a variety of undulations towards the equator.

It now remains to explain only one particularity of the aurora borealis, namely, that its streams do not always move with rapidity; sometimes appearing quite stationary for a considerable time, and sometimes being carried in different directions with a slow motion. To this indeed we can give no other reply, than that weak electric lights have been sometimes observed to put on the same appearance at the surface of the earth: and much more may we suppose them capable of doing so at great heights above it, where the conductors are both fewer in number and much more imperfect. When M. de Romas was making experiments with an electric kite in Italy, a cylinder of blue light about four or five inches diameter was observed surrounding the string. This was in the day time; but had it been night, he imagined it must have been four or five feet in diameter; and as the string was 780 feet long, it would probably have seemed pyramidal, pointing upwards like one of the streams of the aurora borealis. A still more remarkable appearance, Dr Priestley tells us, was observed by Mr Hartman. He had been making electrical experiments for four or five hours together in a very small room; and upon going out of it, and returning with a light in his hand, walking pretty quick, he perceived a small flame following him at about three feet distance. Being alarmed at this appearance, he stopped to examine it, upon which it vanished. This last instance is very remarkable, and singular in its kind; from both, however, we are sufficiently warranted to conclude, that small portions of our atmosphere may by various causes be so much electrified as to shine, and likewise be moved from one place to another without parting with the electricity they have received, for a considerable time.

The corona, or circle, which is often formed near the zenith by the aurora borealis, is easily accounted for in the same manner. As this corona is commonly stationary for some time, we imagine it would be a very proper mark whereby to determine the distance of the meteor itself. If an aurora borealis, for instance, was observed by two persons, one at London, and the other at Edinburgh; by noting the stars among which the corona was observed at each place, its true altitude from the surface of the earth could easily be determined by trigonometry.

Under the article ATMOSPHERE it was suggested, that no good proof had been as yet brought for the extreme rarity of the air usually supposed to take place at no very great heights above the earth. The brightness of the meteor there mentioned at 70 miles perpendicular from the surface, as also its figure, seemed to prove the air considerably dense at that distance from the earth. Though the height of the aurora borealis has never been determined, we can scarce imagine it to be greater than that of this meteor, or indeed so great: but although its streams resemble the passage of electric light through a vacuum, it cannot be from thence inferred, that the air is at all in a state similar to the vacuum of an air-pump in those places where the aurora borealis is produced; seeing we have instances of similar appearances being produced in very dense air. The plate of an electrophorus is often so highly electrified, as to throw out flashes from different parts as soon as it is lifted up, and by proper management it may be always made to emit long and broad flashes which shall scarcely be felt by the finger, instead of small, dense, and pungent sparks; so that, though long flashes may be produced in rarefied air, it by no means follows, that the same may not also be produced in denser air. As little can we infer any thing from the colour; for we observe the electric spark sometimes white, sometimes blue, and sometimes purple, in the very same state of the atmosphere, and from the same substance.

The aurora borealis is said to be attended with a peculiar hissing noise in some very cold climates; Gmelin speaks of it in the most pointed terms, as frequent and very loud in the north-eastern parts of Siberia; and other travellers have related similar facts. Gmelin's account is very remarkable. "These northern lights (says he) begin with single bright pillars, rising in the north, and almost at the same time in the north-east, which gradually increasing, comprehend a large space of the heavens, rush about from place to place with incredible velocity, and finally almost cover the whole sky

Aurora Borealis.

sky up to the zenith. The streams are then seen meeting together in the zenith, and produce an appearance as if a vast tent was expanded in the heavens, glittering with gold, rubies, and sapphire. A more beautiful spectacle cannot be painted; but whoever should see such a northern light for the first time, could not behold it without terror. For however fine the illumination may be, it is attended, as I have learned from the relation of many persons, with such a hissing, cracking, and rushing noise throughout the air, as if the largest fire-works were playing off. To describe what they then hear, they make use of the expression, *Spolochi chodjat*, that is 'the raging host is passing.' The hunters who pursue the white and blue foxes on the confines of the Icy sea, are often overtaken in their course by these northern lights. The dogs are then so much frightened, that they will not move, but lie obstinately on the ground till the noise has passed. Commonly clear and calm weather follows this kind of northern lights. I have heard this account, not from one person only, but confirmed by the uniform testimony of many, who have spent part of several years in these very northern regions, and inhabited different countries from the Yenesei to the Lena; so that no doubt of its truth can remain. This seems indeed to be the real birthplace of the *aurora borealis*."

The hissing or rushing noise above described, Dr Blagden is inclined to attribute to small streams of electric matter running off to the earth from the masses or accumulations of electricity by which the northern lights are supposed to be produced.

6
Aurora borealis succeeded by south-west winds.

We shall conclude this article with an account of a paper presented to the Royal Society by Mr Winn, in 1772, wherein he says that the appearance of an aurora borealis is a certain sign of a hard gale of wind from the south or south-west. This he never found to fail in 23 instances; and even thinks, that from the splendour of the meteor, some judgment may be formed concerning the ensuing tempest. If the aurora is very bright, the gale will come on within twenty-four hours, but will be of no long duration; if the light is faint and dull, the gale will be less violent and longer in coming on, but it will also last longer. His observations were made in the English channel, where such winds are very dangerous; and by attending to the auroræ, he says he often got easily out of it, when others narrowly escaped being wrecked. This is an exceeding useful observation for sailors: but it cannot be expected that the winds succeeding these meteors should in all places blow from the south-west; though no doubt a careful observation of what winds succeed the aurora borealis, and other meteors, in different parts of the world, might contribute in some measure to lessen the dangers of navigation.

7
Conjecture concerning the reason.

That the aurora borealis ought to be succeeded by winds, may be easily deduced from the hypothesis last mentioned. If this phenomenon is occasioned by the vast quantity of electric matter conveyed to the equatorial parts of the earth, it is certain that the earth cannot receive any great quantity of this matter at one place without emitting it at another. The electricity, therefore, which is constantly received at the equator, must be emitted near the poles, in order to perform its course, otherwise there could not be a constant supply of it for the common operations of nature. It is observed, that electrified bodies are always surrounded by a blast of air, which is sent forth from them in all directions; hence if the electric matter find a more ready passage through one part of the earth than another, a wind will be found to blow from that quarter. If therefore one of these places happen to be in the Atlantic ocean near the coast of France, or in the bay of Biscay, the electric matter which has been received at the equator during an aurora borealis will be discharged there for some time after, and consequently a wind will blow from that quarter, which will be from the south-west to those ships which are in the English channel. It cannot be imagined, however, that all the matter can be discharged from one place; and therefore, according to the different situations of those electrical vents, winds may blow in different directions; and thus the same aurora borealis may produce a south-west wind in the English channel, and a north west one in Scotland.

Aurora Borealis ‖ Ausi.

AURUM. See GOLD, CHEMISTRY, and MINERALOGY *Index*.

This metal was introduced into medicine by the Arabians, who esteemed it one of the greatest cordials and comforters of the nerves. From them Europe received it without any diminution of its character; in foreign pharmacopœias it is still retained, and even mixed with the ingredients from which simple waters are to be distilled. But no one, it is presumed, at this time, expects any singular virtues from it, since it certainly is not alterable in the human body. Mr Geoffroy, though unwilling to reject it from the cordial preparations, honestly acknowledges that he has no other reason for retaining it than complaisance to the Arabian schools. The chemists have endeavoured, by many elaborate processes, to extract what they call a sulphur or anima of gold; but no method is as yet known of separating the component parts of this metal; all the tinctures of it, and aurum potabile, which have hitherto appeared, are real solutions of it in aqua regia, diluted with spirit of wine or other liquors, and prove injurious to the body rather than beneficial. A place, however, is now given in some of the foreign pharmacopœias to the aurum fulminans; and it has of late been recommended as a remedy in some convulsive diseases, particularly in the chorea sancti viti.

AURUM Fulminans. See CHEMISTRY *Index*.

AURUM Mosaicum. See CHEMISTRY *Index*.

AURUNCI, in *Ancient Geography*, a people of Latium, towards Campania; the same with the Ausones, at least so intermixed as not to be easily distinguishable, though Pliny separates them.

AUSA, a town of Tarraconensis, in the middle age called *Ausona*; now *Vich de Osuna*, a town of Catalonia in Spain. E. Long. 2. 0. N. Lat. 41. 50.

AUSCH. See AUCH.

AUSI, an ancient and very savage people of Libya. Herodotus tells us that they were unacquainted with marriage, and had all their women in common. The children were brought up by their mothers till they were able to walk: after which they were introduced to an assembly of the men, who met every three months; and the man to whom any child first spoke, acknowledged himself its father. They celebrated annually a feast in honour of Minerva, in which the girls divided into two companies, fought with sticks

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and stones, and those who died of their wounds were concluded not to have been virgins.

AUSIMUM, or AUXIMUM, an ancient Roman colony in the Picenum; now *Osimo* or *Osmo*, in the marquisate of Ancona in Italy. E. Long. 15. N. Lat. 43. 20.

AUSITÆ, or ÆSITÆ, a tribe of ancient Arabs, supposed by Bochart to have inhabited the land of Uz mentioned in Scripture.

AUSONA, in *Ancient Geography*, a town of the Ausones, a people who anciently occupied all the Lower Italy, from the Promontorium Circæum down to the straits of Sicily (Livy), but were afterwards reduced to a much narrower compass; namely, between the Montes Circæi and Massici: nor did they occupy the whole of this, but other people were intermixed. Concerning Ausona or its remains there is nothing particular recorded.

AUSONIA, the ancient name of Italy, from its most ancient inhabitants the Ausones, (Virgil, Servius).

AUSONEUM MARE, in *Ancient Geography*, a part of the Ionian sea, extending southward from the promontory Japygium to Sicily, which it washes on the east, as it does the Bruttii and Magna Græcia on the south and east. It is separated from the Tuscan sea by the strait of Messina.

AUSONIUS (in Latin, *Decius*, or rather *Decimus*, Magnus Ausonius), one of the best poets of the fourth century, was the son of an eminent physician, and born at Bourdeaux. Great care was taken of his education, the whole family interesting themselves in it, either because his genius was very promising, or that the scheme of his nativity, which had been cast by his grandfather on the mother's side, made them imagine that he would rise to great honour. He made an uncommon progress in classical learning, and at the age of 30 was chosen to teach grammar at Bourdeaux. He was promoted some time after to be professor of rhetoric; in which office he acquired so great a reputation, that he was sent for to court to be preceptor to Gratian the emperor Valentinian's son. The rewards and honours conferred on him for the faithful discharge of his office prove the truth of Juvenal's maxim, that when Fortune pleases, she can raise a man from a rhetorician to the dignity of a consul. He was actually appointed consul by the emperor Gratian, in the year 379, after having filled other considerable posts; for besides the dignity of quæstor, to which he had been nominated by Valentinian, he was made prefect of the prætorium in Italy and Gaul after that prince's death. His speech returning thanks to Gratian on his promotion to the consulship is highly commended. The time of his death is uncertain; he was still living in 392, and lived to a great age. The emperor Theodosius had a great esteem for Ausonius, and pressed him to publish his poem. There is a great inequality in his works; and in his manner and his style there is a harshness which was perhaps rather the defect of the times he lived in than of his genius. Had he lived in Augustus's reign, his verses, according to good judges, would have equalled the most finished of that age. He is generally supposed to have been a Christian: some ingenious authors indeed think otherwise, but, according to Mr Bayle, without just reason. The best edition of his poems is that of Amsterdam in 1671.

AUSPEX, a name originally given those who were afterwards denominated *augurs*. In which sense the word is supposed to be formed from *avis*, "bird," and *inspicere*, "to inspect;" *auspices*, q. d. *avispices*.

AUSPICIUM, AUSPICY, the same with augury.

AUSTER, one of the four cardinal winds, as Servius calls them, blowing from the south, (Pliny, Ovid, Manilius).

AUSTERE, rough, astringent. Thus an austere taste is such a one as constringes the mouth and tongue; as that of unripe fruit, harsh wines, &c.

AUSTERITY, among moral writers, implies severity and rigour. Thus we say, *austerity of manners*, *austerities of the monastic life*, &c.

AUSTIN, ST. See *St AUGUSTIN*.

AUSTRAL, AUSTRALIS, the same with southern. The word is derived from *auster*, "south wind." Thus the six austral signs of the zodiac, are those on the south side of the equinoctial.

AUSTRALASIA, a new division, lately introduced by geographers, forming the fifth great division of the globe. It comprehends New Holland, New Guinea, and a vast multitude of other islands scattered over the Pacific ocean. See SUPPLEMENT.

AUSTRALIS PISCIS, the SOUTHERN FISH, is a constellation of the southern hemisphere, not visible in our latitude; whose stars in Ptolemy's catalogue are 18, and in the Britannic catalogue 24.

AUSTRIA, one of the principal provinces of the empire of Germany towards the east; from which situation it takes its name, *Oost-rych* in the German language signifying the *East Country*. It is bounded on the north by Moravia; on the east by Hungary; on the south by Stiria; and on the west by Bavaria. It is divided into *Upper* and *Lower*, which are separated by the river Ens. Vienna the capital is in Lower Austria, which contains several other very considerable towns. The country is fertile, but rather mountainous; it has a great many mines, and produces vast quantities of salt and sulphur.

In the ninth and tenth centuries, Austria was the frontier of the empire against the barbarians. In 928, the emperor Henry the Fowler, perceiving that it was of great importance to settle some person in Austria who might oppose these incursions, invested Leopold, surnamed the *Illustrious*, with that country. Otho I. erected Austria into a marquisate in favour of his brother-in-law Leopold, whose descendant Henry II. was created duke of Austria by the emperor Frederic Barbarossa. His posterity becoming extinct in 1240, the states of the country, in order to defend themselves from the incursions of the Bavarians and Hungarians, resolved to put themselves under the protection of Henry marquis of Misnia; but Othogar II. king of Bohemia, being likewise invited by a party in the duchy, took possession of it, alleging not only the invitation of the states, but also the right of his wife, heiress of Frederic the last duke. The emperor Rodolphus I. pretending a right to this duchy, refused to give Othogar the investiture of it; and afterwards killing him in a battle, procured the right of it to his own family. From this Rodolphus the present house of Austria is descended, which

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Austria. which for several centuries past has rendered itself so famous and so powerful, having given 14 emperors to Germany, and six kings to Spain.

In 1477, Austria was erected into an archduchy by the emperor Frederic the Pacific for his son Maximilian, with these privileges: That these shall be judged to have obtained the investiture of the states, if they do not receive it after having demanded it three times; that if they receive it from the emperor, or the imperial ambassadors, they are to be on horseback, clad in a royal mantle, having in their hand a staff of command, and upon their head a ducal crown of two points, and surrounded with a cross like that of the imperial crown. The archduke is born privy-counsellor to the emperor, and his states cannot be put to the ban of the empire. All attempts against his person are punished as crimes of lese-majesty, in the same manner as those against the king of the Romans, or electors. No one dared to challenge him to single combat. It is in his choice to assist at the assemblies, or to be absent; and he has the privilege of being exempt from contributions and public taxes, excepting 12 soldiers which he is obliged to maintain against the Turks for one month. He has rank immediately after the electors; and exercises justice in his states without appeal, by virtue of a privilege granted by Charles V. His subjects cannot even be summoned out of his province upon account of lawsuits, to give witness, or to receive the investiture of fiefs. Any of the lands of the empire may be alienated in his favour, even those that are feudal; and he has a right to create counts, barons, gentlemen, *poets*, and notaries. In the succession to his states, the right of birth takes place; and, failing males, the females succeed according to the lineal right, and, if no heir be found, they may dispose of their lands as they please.

Upper Austria, properly so called, has throughout the appearance of a happy country. Here are no signs of the striking contrast betwixt poverty and riches which offends so much in Hungary. All the inhabitants, those of the capital only excepted, enjoy that happy mediocrity which is the consequence of a gentle and wise administration. The farmer has property; and the rights of the nobility, who enjoy a kind of lower judicial power, are well defined. The south and south-west parts of the country are bounded by a ridge of hills, the inhabitants of which enjoy a share of prosperity unknown to those of the interior parts of France. There are many villages and market towns, the inhabitants of which have bought themselves off from vassalage, are now their own governors, and belong some of them to the estates of the country. The cloisters, the prelates of which belong to the estates of the country, are the richest in Germany, after the immediate prelacies and abbacies of the empire. One of the greatest convents of Benedictines is worth upwards of four millions of French livres, half of which goes to the exchequer of the country.

Lower Austria exports great quantities of wine to Moravia, Bohemia, Upper Austria, Bavaria, Saltzburg, and part of Stiria and Carinthia. This wine is sour, but has a great deal of strength, and may be carried all over the world without danger; when it is ten or twenty years old it is very good. The valleys near the Danube are fertile, but agriculture is generally in a rude state. The southern parts of Austria are covered with hills, which rise gradually from the banks of the Danube to the borders of Stiria, and are covered with woods. They lose themselves in the mass of mountains which run to the south of Germany, and stretch through all Stiria, Carniola, Carinthia, and Tyrol, to the Swiss Alps; and are probably, after Savoy and Switzerland, the highest part of the earth. The inhabitants of this extensive ridge of mountains are all very much alike; they are a strong, large, and, the GOITRES excepted, a very handsome people. Upper and Lower Austria together contain 45,760 square miles, and their population in 1818 amounted to 4,457,692. The revenue which these provinces yield is estimated at nearly four millions sterling.

The characteristic of the inhabitants of all this country is striking bigotry, united with striking sensuality. You need only see what is going forwards here to be convinced that the religion taught by the monks is as ruinous to the morals as it is repugnant to Christianity. The Cicisbeos accompany the married women from their bed to church, and lead them to the very confessional. The bigotry of the public in the interior parts of Austria, which, from the mixture of gallantry with it, is still to be found even amongst people of rank, degenerates amongst the common people into the grossest and most abominable buffoonery. The Windes, who are mixed with the Germans in these countries, distinguish themselves by a superstitious custom that does little honour to the human understanding, and would be incredible if we had not the most unequivocal proofs of the fact before our eyes. Many years ago, they set out in company with some Hungarian enthusiasts to Cologne on the Rhine, which is about 120 German miles distant, to cut off the beard of a crucifix there. Every seven years this operation is repeated, as in this space of time the beard grows again to its former length. The rich persons of the association send the poorer ones as their deputies, and the magistrates of Cologne receive them as ambassadors from a foreign prince. They are entertained at the expence of the state, and a counsellor shows them the most remarkable things in the town. This farce brings in large sums of money at stated times, and may therefore deserve political encouragement; but still, however, it is the most miserable and meanest way of gain that can be imagined. These Windes have alone the right to shave our Saviour, and the beard grows only for them. They firmly believe, that if they did not do this service to the crucifix, the earth would be shut to them for the next seven years, and there would be no harvests. For this reason they are obliged to carry the hair home with them, as the proof of having fulfilled their commission, the returns of which are distributed among the different communities, and preserved as holy relics. The imperial court has for a long time endeavoured in vain to prevent this emigration, which deprives agriculture of so many useful hands. When the Windes could not go openly they would go clandestinely. At length the court thought of the expedient of forbidding the regency of Cologne to let them enter the town. When this happened, the numerous embassy was-

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was obliged to beg its way back again without the wonderful beard; which without doubt the Capuchins, to whom the crucifix belonged, used to put together from their own. The trade which the monks carry on with holy salves, oils, &c. is still very considerable; a prohibition which the court published, rather lessened it, but did not entirely suppress it.

For an account of the whole Austrian monarchy, see Austria, Supplement.

AUSTROMANCY, Austromantia, properly denotes soothsaying, or a vain method of predicting futurity, from observations of the winds.

AUTERFOITS Acquit.
Auterfoits Attaint.
Auterfoits Acquit.
} See the article *Plea to Indictment.*

AUTHENTIC, something of acknowledged and received authority. In law, it signifies something clothed in all its formalities, and attested by persons to whom credit has been regularly given. Thus we say, *authentic papers*, *authentic instruments*.

AUTHOR, properly signifies one who created or produced any thing. Thus God, by way of eminence is called the *Author of nature*, the *Author of the universe*.

Author, in matters of literature, a person who has composed some book or writing.

AUTHORITY, in a general sense, signifies a right to command, and make one's self obeyed. In which sense we say, *the royal authority, the episcopal authority, the authority of a father*, &c. It denotes also the testimony of an author, some apophthegm or sentence of an eminent person quoted in a discourse by way of proof.

Authority is represented, in painting, like a grave matron sitting in a chair of state, richly clothed in a garment embroidered with gold, holding in her right hand a sword, and in her left a sceptre. By her side is a double trophy of books and arms.

AUTOCHTHONES, an appellation assumed by some nations, importing that they sprung, or were produced, from the same soil which they still inhabited. In this sense, *Autochthones* amounts to the same with *Aborigines*. The Athenians valued themselves on their being Autochthones, *self-born*, or γηγενεις, *earth-born*; it being the prevailing opinion among the ancients, that, in the beginning, the earth, by some prolific power, produced men, as it still does plants. The proper Autochthones were those primitive men who had no other parent beside the earth. But the name was also assumed by the descendants of these men, provided they never changed their ancient state, nor suffered other nations to mix with them. In this sense it was that the Greeks, and especially the Athenians, pretended to be Autochthones; and as a badge thereof, wore a golden grasshopper woven in their hair, an insect supposed to have the same origin.

AUTOCRATOR, a person vested with an absolute independent power, by which he is rendered unaccountable to any other for his actions. The power of the Athenian generals, or commanders, was usually limited; so that, at the expiration of their office, they were liable to render an account of their administration. But, on some extraordinary occasions, they were exempted from this restraint, and sent with a full and uncontroulable authority: in which sense they were styled Αυτοκρατορες. The same people also applied the name to some of their ambassadors, who were vested with a full power of determining matters according to their own discretion. These were denominated Πρεσβεις Αυτοκρατορες, and resembled our plenipotentiaries.

AUTO DA FE, act of faith. See *Act of Faith*.

AUTODIDACTUS, a person self-taught, or who has had no master or assistant of his studies besides himself.

AUTOGRAPH, denotes a person's hand-writing, or the original manuscript of any book, &c.

AUTOLITHOTOMUS, he who cuts himself for the stone. Of this we have a very extraordinary instance given by Reiselius, in the Ephemerides of the Academy *Naturæ Curiosorum*, dec. 1. an. 3. obs. 192.

AUTOMATE, called also *Hiera*, one of the Cyclades, an island to the north of Crete (Pliny), said to have emerged out of the sea, between the islands Thera and Therasia, in the fifth year of the emperor Claudius; in extent 30 stadia, (Orosius).

AUTOMATON, (from αυτος, *ipse*, and μαιομαι, *excitor*), a self-moving machine, or one so constructed, by means of weights, levers, pulleys, &c. as to move for a considerable time, as though endowed with animal life. According to this description, clocks, watches, and all machines of that kind, are automata.

Under the article Androides we observed that the highest perfection to which automata could be carried was to imitate exactly the motions and actions of living creatures, especially of mankind, which are more difficultly imitated than those of other animals. Very surprising imitations, however, have been made of other creatures. So long ago as 400 years before Christ, Archytas of Tarentum is said to have made a wooden pigeon that could fly; nor will this appear at all incredible, when we consider the flute-player made by M. Vaucanson, and the chess-player by M. Kempel. Dr Hook is also said to have made the model of a flying chariot, capable of supporting itself in the air. But M. Vaucanson above mentioned hath distinguished himself still more eminently. That gentleman, encouraged by the favourable reception of his flute-player, made a duck, which was capable of eating, drinking, and imitating exactly the voice of a natural one. Nay, what is still more surprising, the food it swallowed was evacuated in a digested state; not that it was really in a state of natural excrement, but only considerably altered from what it was when swallowed; and this digestion was performed on the principles of solution, not of trituration. The wings, viscera, and bones, of this artificial duck, were also formed so as very strongly to resemble those of a living animal. Even in the actions of eating and drinking, this resemblance was preserved; the artificial duck swallowed with avidity and vastly quick motions of the head and throat; and likewise muddled the water with its bill, exactly like a natural one.

M. le Droz of La Chaux de Fonds, in the county of Neufchattel, hath also executed some very curious pieces of mechanism, which well deserve to be ranked with those already mentioned. One was a clock, which was presented to his Spanish majesty; and had among other curiosities, a sheep, which imitated the bleating of a natural one; and a dog watching a basket of fruit. When any one attempted to purloin the fruit, the dog gnashed

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gnashed his teeth and barked; and if it was actually taken away, he never ceased barking till it was restored. Besides this, he made a variety of human figures, which exhibited motions truly surprising; but all inferior to Mr Kempel's chess-player, which may justly be looked upon as the greatest masterpiece in mechanics that ever appeared. See ANDROIDES.

AUTONOMIA, a power of living or being governed by our own laws and magistrates. The liberty of the cities which lived under the faith and protection of the Romans, consisted in their autonomia, i. e. they were allowed to make their own laws, and elect their own magistrates, by whom justice was to be administered, and not by Roman presidents or judges, as was done in other places which were not indulged the autonomia.

AUTOPYROS, from αυτος, and πυρος, *wheat;* in the ancient diet, an epithet given to a species of bread, wherein the whole substance of the wheat was retained without retrenching any part of the bran. Galen describes it otherwise, viz. as bread where only the coarser bran was taken out.—And thus it was a medium between the finest bread, called *similageneus*, and the coarsest called *furfuraceus*. This was also called *autopyrites* and *syncomistus*.

AUTRE-EGLISE, a village of Brabant, in the Netherlands; to which the left wing of the French army extended, when the confederates obtained the victory at Ramillies, in 1706. E. Long. 4. 50. N. Lat. 50. 40.

AUTRICUM, the capital of the Carnutes, a people of Gallia Celtica; afterwards called *Carnotena*, *Carnotenus*, and *Civitas Carnotenum*: Now *Chartres*, in the Orleanois, on the Eure. E. Long. 1. 32. N. Lat. 48. 47.

AUTUMN, the third season of the year, when the harvest and fruits are gathered in. Autumn is represented in painting, by a man at perfect age, clothed like the vernal, and likewise girded with a starry girdle; holding in one hand a pair of scales equally poised, with a globe in each; in the other hand a bunch of divers fruits and grapes. His age denotes the perfection of this season; and the balance, that sign of the zodiac which the sun enters when our autumn begins.

Autumn begins on the day when the sun's meridian distance from the zenith, being on the decrease, is a mean between the greatest and the least; which in these countries is supposed to happen when the sun enters Libra. Its end coincides with the beginning of winter. Several nations have computed the years by autumns; the English Saxons, by winters. Tacitus tells us, that the ancient Germans were acquainted with all the other seasons of the year, but had no notion of autumn. Lidyat observes of the beginning of the several seasons of the year, that

Dat Clemens hyemem, dat Petrus ver cathedratus,
Æstuat Urbanus, autumnat *Bartholomæus*.

Autumn has always been reputed an unhealthy season. Tertullian calls it *tentator valetudinum;* and the satirist speaks of it in the same light. *Autumnus Libitinæ questus acerbæ*.

AUTUMNAL POINT, is that part of the equinox from which the sun begins to descend towards the south pole.

AUTUMNAL Signs, in *Astronomy*, are the signs Libra, Scorpio, Sagittarius, through which the sun passes during the autumn.

AUTUMNAL Equinox, that time when the sun enters the autumnal point.

AUTUN, an ancient city of France, in the department of Saone and Loire, formerly the duchy of Burgundy, the capital of the Autonois, with a bishop's see. The length of this city is about three quarters of a mile, and its breadth nearly equal. The river Arroux washes its ancient walls, whose ruins are so firm, and the stones so closely united, that they seem almost to be cut out of the solid rock. In this city are the ruins of three ancient temples, one of which was dedicated to Janus, and another to Diana. Here are likewise a theatre and a pyramid, which last is probably a tomb; it stands in a place called the *field of urns*, because several urns had been found there. Here are also two antique gates of great beauty. The city contained about 8000 inhabitants in 1815. E. Long. 4. 15. N. Lat. 46. 58.

AUTURA, or AUDURA, a river of Gallia Celtica, only mentioned in the Lives of the Saints. Now the *Eure*, which falls into the Seine, on the left-hand or south side.

AUVERGNE, a late province of France, about 100 miles in length and 75 in breadth. It is bounded on the north by the Bourbonnois; on the east by Torez and Velay; on the west, by Limosin, Quercy, and La Marche: and on the south, by Rovergne and the Cevennes. It is divided into upper and lower: the latter, otherwise called *Limagne*, is one of the finest countries in the world. The mountains of Higher Auvergne render it less fruitful; but they afford good pasture, which feeds great numbers of cattle, which are the riches of that country. Auvergne supplies Lyons and Paris with fat cattle, makes a large quantity of cheese, and has manufactures of several kinds. The capital of the whole province is Clermont. It is now divided into the departments of Cantal and Puy de Dome.

AUVERNAS, a very deep-coloured heady wine, made of black raisins so called, which come from Orleans. It is not fit to drink before it is above a year old; but if kept two or three years, it becomes excellent.

AUXERRE, an ancient town of France in the department of Yonne, and capital of the Auxerrois, and lately a bishop's see. The episcopal palace was one of the finest in France, and the churches were also very beautiful. This town contained 11,300 inhabitants in 1815, and is well situated for trade with Paris, on the river Yonne. E. Long. 3. 35. N. Lat. 47. 54.

AUXESIS, in *Mythology*, a goddess worshipped by the inhabitants of Egina, and mentioned by Herodotus and Pausanias.

AUXESIS, in *Rhetoric*, a figure whereby any thing is magnified too much.

AUXILIARY, whatever is aiding or helping to another.

AUXILIARY Verbs, in *Grammar*, are such as help to form or conjugate others; that is, are prefixed to them, to form or denote the modes or tenses thereof; as *to have* and *to be*, in the English; *etre* and *avoir*, in the French; *ho* and *sono* in the Italian, &c. In the English language,

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language, the auxiliary verb *am* supplies the want of passive verbs.

AUXO, in *Mythology*, the name of one of two Graces worshipped by the Athenians. See HEGEMONE.

AUXONNE, a small fortified town in France, in the department of Cote d'Or; seated on the river Saone, over which there is a bridge of 23 arches, to facilitate the running off of the waters after the overflowing of the river. It contained 2340 inhabitants in 1815. E. Long. 5. 22. N. Lat. 47. 11.

AUXY; the French give the name of *auxy wool* to that which is spun in the neighbourhood of Abbeville, by those workmen who are called *houpiers*. It is a very fine and beautiful wool, which is commonly used to make the finest stockings.

AWARD, in *Law*, the judgment of an arbitrator, or of one who is not appointed by the law a judge, but chosen by the parties themselves for terminating their difference. See ARBITER and ARBITRATION.

AWL, among shoemakers, an instrument wherewith holes are bored through the leather, to facilitate the stitching or sewing the same. The blade of the awl is usually a little flat and bended, and the point ground to an acute angle.

AWLAN, a small town of Germany, in the circle of Suabia, seated on the river Kochen. E. Long. 11. 15. N. Lat. 48. 52.

AWME, or AUME, a Dutch liquid measure containing eight steckens, or 20 verges or verteels, equal to the tierce in England, or to one sixth of a ton of France.

AWN. See ARISTA, BOTANY *Index*.

AWNING, in the sea-language, is the hanging a sail, tarpawling, or the like, over any part of the ship, to keep off the sun, rain, or wind.

AX, a carpenter's instrument, serving to hew wood. The ax differs from the joiner's hatchet, in that it is made larger and heavier, as serving to hew large stuff; and its edge tapering into the middle of its blade. It is furnished with a long handle or helve, as being to be used with both hands.

Battle-Ax. See CELT.

AXAMENTA, in antiquity, a denomination given to the verses or songs of the *salii*, which they sung in honour of all men. The word is formed, according to some, from *axare*, q. d. *nominare*. Others will have the *carmina saliaria* to have been denominated *axamenta*, on account of their having been written *in axibus*, or on wooden tables.

The *axamenta* were not composed, as some have asserted, but only sung by the *salii*. The author of them was Numa Pompilius; and as the style might not be altered, they grew in time so obscure, that the *salii* themselves did not understand them. Varro says they were 700 years old. Quint. Inst. Or. lib. i. c. 11.

AXAMENTA, or *Assamenta*, in ancient music, hymns or songs performed wholly with human voices.

AXAYACATL, the name of a species of fly, common in Mexico, about the lake; the eggs of which being deposited in immense quantities, upon the rushes and corn-flags, form large masses, which are taken up by fishermen and carried to market for sale. This caviare, called *ahuauhtli*, which has much the same taste with the caviare of fish, used to be eaten by the Mexicans, and is now a common dish among the Spaniards. The Mexicans eat not only the eggs, but the flies themselves, made up together into a mass, and prepared with saltpetre.

AXATI, a town of ancient Bætica, on the Bætis; now *Lora*, a small city of Andalusia, in Spain, seated on the Guadalquiver. W. Long. 5. 20. N. Lat. 37. 20.

AXBRIDGE, a town of Somersetshire in England, consisting of one long narrow street, and containing 853 inhabitants in 1811. W. Long. 2. 20. N. Lat. 51. 30.

AXEL, a small fortified town in Dutch Flanders. E. Long. 40. 0. N. Lat. 51. 17.

AXHOLM, an island in the north-west part of Lincolnshire in England. It is formed by the rivers Trent, Idel, and Dan; and is about ten miles long and five broad. The lower part is marshy, but produces an odoriferous shrub called *gall;* the middle is rich and fruitful, yielding flax in great abundance, as also alabaster which is used for making lime. The principal town is called *Axey*, and is now very thinly inhabited.

AXIACE, an ancient town of Sarmatia Europæa; now *Oczakow*, the capital of Budziac Tartary. E. Long. 32. 30. N. Lat. 46. 0.

AXILLA, in *Anatomy*, the arm-pit or the cavity under the upper part of the arm.

AXILLA, in *Botany*, is the space comprehended between the stems of plants and their leaves. Hence we say those flowers grow in the axillæ of the leaves; i. e. at the base of the leaves, or just within the angle of their pedicles.

AXILLARY, something belonging to or lying near the axilla. Thus, *axillary artery* is that part of the subclavian branches of the ascending trunk of the aorta which passeth under the arm-pits; *axillary glands* are situated under the arm-pits, enveloped in fat, and lie close by the axillary vessels; and *axillary vein* is one of the subclavians which passes under the arm pit, dividing itself into several branches, which are spread over the arm.

AXIM, a small territory on the Gold coast in Africa. The climate here is so excessively moist, that it is proverbially said to rain 11 months and 29 days of the year. This excessive moisture renders it very unhealthy; but it produces great quantities of rice, water melons, lemons, oranges, &c. Here are also produced vast numbers of black cattle, goats, sheep, tame pigeons, &c. The whole country is filled with beautiful and populous villages, and the intermediate lands well cultivated; besides which the natives are very wealthy, from the constant traffic carried on with them by the Europeans for their gold. The capital, which is also called *Axim*, by some *Achambone*, stands under the cannon of the Dutch fort St Antonio. Behind, it is secured by a thick wood that covers the whole declivity of a neighbouring hill. Between the town and the sea runs an even and spacious shore of beautiful white sand. All the houses are separated by groves of cocoa and other fruit trees, planted in parallel lines, each of an equal width, and forming an elegant vista. The little river Axim crosses the town; and the coast is defended by a number of small pointed rocks which project from the shore, and render all access to it dangerous. The capital is situated in W. Long. 24. 0. N. Lat. 5. 0. This canton is a kind of republic, the government being

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being divided between the Caboceroes or chief men and Manaceroes or young men. It must be observed, however, that in their courts there is not even a pretence of justice: whoever makes the most valuable presents to the judges is sure to gain the cause, the judges themselves alleging the gratitude due for the bribes received as a reason: and if both parties happen to make presents of nearly equal value, they absolutely refuse to give the cause a hearing.

AXINOMANCY, Axinomantia, from ἀξίνη, *securis*, and μαντεία, *divinatio;* an ancient species of divination, or a method of foretelling future events by means of an ax or hatchet.—This art was in considerable repute among the ancients; and was performed, according to some, by laying an agate-stone on a red-hot hatchet; and also by fixing a hatchet on a round stake so as to be exactly poised; then the names of those that were suspected were repeated, and he at whose name the hatchet moved was pronounced guilty.

AXIOM, Axioma (from ἀξιόω, *I am worthy*); a self-evident truth, or a proposition whose truth every person perceives at first sight. Thus, that the whole is greater than a part; that a thing cannot be and not be at the same time; and that from nothing, nothing can arise; are axioms.

Axiom is also an established principle in some art or science. Thus, it is an axiom in physics, that nature does nothing in vain; that effects are proportional to their causes, &c. So it is an axiom in geometry, that things equal to the same thing are also equal to one another; that if to equal things you add equals, the sums will be equal, &c. It is an axiom in optics, that the angle of incidence is equal to the angle of reflection, &c.

AXIPOLIS, a town of the Triballi, in Mœsia Inferior; now *Axiopoli*, in Bulgaria. E. Long. 34. 0. N. Lat. 45. 40.

AXIS, in *Geometry*, the straight line in a plain figure, about which it revolves, to produce or generate a solid. Thus, if a semicircle be moved round its diameter at rest, it will generate a sphere, the axis of which is that diameter.

Axis, in *Astronomy*, is an imaginary right line supposed to pass through the centre of the earth and the heavenly bodies, about which they perform their diurnal revolutions.

Axis, in *Conic Sections*, a right line dividing the section into two equal parts, and cutting all its ordinates at right angles.

Axis, in *Mechanics*. The axis of a balance is that line about which it moves, or rather turns about. *Axis of oscillation*, is a right line parallel to the horizon, passing through the centre about which a pendulum vibrates.

Axis in Peritrochio, one of the six mechanical powers, consisting of a peritrochium or wheel concentric with the base of a cylinder, and moveable together with it about its axis.

Axis, in *Optics*, is that particular ray of light coming from any object which falls perpendicularly on the eye.

Axis, in *Architecture*. *Spiral axis*, is the axis of a twisted column drawn spirally in order to trace the circumvolutions without. *Axis of the Ionic capital*, is a line passing perpendicularly through the middle of the eye of a volute.

Axis of a Vessel, is an imaginary right line passing through the middle of it perpendicularly to its base, and equally distant from its sides.

Axis, in *Botany*, is a taper column placed in the centre of some flowers or catkins, about which the other parts are disposed.

Axis, in *Anatomy*, the name of the second vertebra of the neck; it hath a tooth which goes into the first vertebra, and this tooth is by some called the *axis*.

AXMINSTER, a town of Devonshire, situated on the river Ax, in the great road between London and Exeter, in W. Long. 3. 15. N. Lat. 50. 40. It was a place of some note in the time of the Saxons, and contained 2387 inhabitants in 1811. Here is a considerable manufactory of broad and narrow cloths, carpets, cotton tapes, druggets, and leather articles.

AXOLOTLF. See Lacerta.

AXUMA, formerly a large city, and capital of the whole kingdom of Abyssinia in Africa, but now reduced to a miserable village scarcely containing 100 inhabitants. E. Long. 36. 4. N. Lat. 14. 13.

AXUNGIA, in a general sense, denotes old lard, or the driest and hardest of any fat in the bodies of animals: but more properly it signifies only hog's lard.

Axungia Vitri, Sandiver, or *Salt of Glass*, a kind of salt which separates from the glass while it is in fusion. It is of an acrimonious and biting taste. The farriers use it for cleansing the eyes of horses. It is also made use of for cleansing the teeth; and it is sometimes applied to running ulcers, the herpes, or the itch, by way of desiccative.

AXYRIS. See Botany *Index*.

AY, a town of France, in the department of Marne, near the river Marne, remarkable for its excellent wines. E. Long. 3. 15. N. Lat. 49. 4.

AYAMONTE, a sea-port town of Andalusia in Spain, with a strong castle built on a rock; seated on the mouth of the river Guadiana. It has a commodious harbour, fruitful vineyards, and excellent wine. W. Long. 8. 5. N. Lat. 37. 9.

AYENIA. See Botany *Index*.

AYLESBURY. See Ailesbury. This place gave title of earl to the noble family of Bruce, now to a branch of the Brudenals by succession.

AYLMER, John, bishop of London, in the reign of Queen Elizabeth, was born in the year 1521, at Aylmer-hall in the parish of Tilney, in the county of Norfolk. Whilst a boy, he was distinguished for his quick parts by the marquis of Dorset, afterwards duke of Suffolk; who sent him to Cambridge, made him his chaplain and tutor to his children. One of these children was the unfortunate Lady Jane Gray, who soon became perfectly acquainted with the Latin and Greek languages. His first preferment was to the archdeaconry of Stow, in the diocese of Lincoln, which gave him a seat in the convocation held in the first year of Queen Mary, where he resolutely opposed the return to Popery, to which the generality of the clergy were inclined. He was soon after obliged to fly his country, and take shelter among the Protestants in Switzerland. On the accession of Queen Elizabeth, he returned to England. In 1562, he obtained the arch-

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Aylmer, Ayr. deaconry of Lincoln; and was a member of the famous synod of that year, which reformed and settled the doctrine and discipline of the church of England. In the year 1576, he was consecrated bishop of London. He died in the year 1594, aged 73; and was buried in St Paul's. He was a learned man, a zealous father of the church, and a bitter enemy to the Puritans. He published a piece entitled, *An harbrowe for faithful and true subjects against the late blowne blaste concerning the government of women*, &c. This was written whilst he was abroad in answer to Knox, who published a book in Geneva under this title, *The first blast against the monstrous regiment and empire of women.* He is by Strype supposed to have published Lady Jane Gray's letter to Harding. He also assisted Fox in translating his History of Martyrs into Latin.

AYR, a royal borough, of great antiquity, and considerable extent, the county town of Ayrshire, and the seat of a justiciary court. It was erected into a royal borough by William the Lion, about the year 1180; and the privileges granted by that charter are still enjoyed by the town. It is pleasantly situated on a point of land, between the influx of the rivers Doon and Ayr into the Atlantic ocean. The principal street is a fine ornamented, broad, spacious way, with a row of elegant houses on each side. Its shape is somewhat of the form of a crescent, having the tolbooth and town-hall in the centre, with a fine spire, 135 feet high. In ancient times we find Ayr to have been a town of considerable trade. The merchants imported a great quantity of wine from France, and exported corn and other produce of the country. The rising trade of Glasgow proved very injurious to the trade of this town; but of late it has much revived. The sea shore is flat and shallow, and the entrance of the river Ayr, which forms the harbour, is subject to the inconvenience of a bar of sand, which is often thrown quite across the river, especially with a strong north-west wind. The water never rises above twelve feet; but from some improvements and extensive works now carrying on on the sides of the river, it is hoped the channel will be considerably deepened. There are erected two reflecting light-houses to conduct vessels safely into the harbour. There is great plenty of salmon in the two rivers, the fishings of which rent at upwards of 200l. Ship-building is carried on to a considerable extent, and about 60 vessels belong to the port, whose burden is nearly 6000 tons, and which are navigated by 500 seamen. The exports consist chiefly of cotton and woollen goods, pig-iron, coals; and the imports of grain, spirits, slates, &c. The trade is chiefly with Ireland. There is an extensive manufacture of leather and soap. Ayr was in ancient times, however, not only distinguished for trade, but also for military strength. Here the heroic exploits of Sir William Wallace began, and here Edward I. fixed one of his most powerful garrisons. Oliver Cromwell, too, judging it a proper place to build a fortress, took possession of the old church, and converted it and the neighbouring ground into a regular citadel. On one of the mounts, within the walls of this fortress, stood the old castle of Ayr, mentioned in ancient histories, and the old church, the tower of which still remains, noted for the meeting of the Scottish parliament, when Robert Bruce's title to the throne was unanimously confirmed. Ayr is a very gay and fashionable place. It has well-attended races, and is sometimes the seat of the Caledonian hunt. In 1801, the population amounted to 5560, and in 1811 to 6291. There is a strong chalybeate spring, which is famous in scrophulous and scorbutic complaints. Tradition reports an engagement to have taken place in the valley of Dalrymple, between two kings, Fergus and Coilus, in which both leaders lost their lives; the names of places in the neighbourhood seem derived from this circumstance, and a cairn of stones in the midst of the valley is said to point out the place of the engagement. History has only recorded two distinguished characters in literature, natives of Ayr: 1st, Joannes Scotus, surnamed *Erigena*, celebrated for his acumen of judgment, his readiness of wit, and fluency of elocution: and 2d, the Chevalier Ramsay, author of Cyrus's Travels, and other works. To these we may add the late Robert Burns, whose genius, at least, will bear a comparison with any of the former.

Ayr, Ayrshire. AYR, *Newton of.* While the borough of Ayr extends along the south side of the river Ayr, this small parish is situated on the north side of the same river. It is a burgh of considerable domain, having in that domain baronial jurisdiction; governed by a magistracy elected by freemen, but not having parliamentary representation. It is of very ancient erection, owing its privileges to Robert Bruce, who upon being attacked with leprosy, came to reside in this place, and was induced to establish a lazar-house, and to confer considerable favours on the town, and on the small village of Priestwick, about two or three miles distant. In the Newton of Ayr are a number of very good houses. It has a tolerable good harbour, chiefly employed in the coal trade. Lying on the banks of Ayr, and the sea coast, the soil is mostly flat and sandy. Its extent is about three miles long, and one and a half broad. In 1811, the population was 2809.

AYR, a river in the parish of Muirkirk, in Ayrshire; which after a course of about eighteen miles nearly due west falls into the sea at Ayr, where its æstuary forms a fine harbour. It is for a considerable course only a small rivulet; but joined by the Greenock and Garpel, tributary streams, it becomes a large body of water. It frequently shifts its bed, and does considerable damage by its encroachments. Its banks are steep and very romantic, and the number of seats which ornament them present a fine picturesque scenery. Sorn-castle, Auchincruive, and Auchinleck, may be mentioned as the chief beauties of the scene. The village of Catrine is situated on its banks. It forms the boundary between the districts of Ayrshire, denominated Kyle and Carrick.

AYRSHIRE, a county of Scotland, which is bounded on the north by the county of Renfrew; on the east by the shires of Lanark and Dumfries; on the south by Galloway; and on the west by the Irish channel, and the frith of Clyde. Its extent in length is about 80 miles, and about 30 in breadth. It is divided into three great districts or stewarties, which bear the names of Kyle, Cunningham, and Carrick. These divisions are not altogether artificial; the river Doon forming the separation between Carrick and Kyle (or Ayrshire Proper), and the river Irvine (at the mouth of which is a borough of the same name) is the limit between Kyle and Cunningham. These

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These districts are very different from each other in appearance. Carrick, and the interior parts of Kyle, are mountainous, and more fitted for pasture; while the coast of Kyle, and the greater part of Cunningham, exhibit a fine level country, interspersed with numerous villages and towns. The sea coast is mostly sandy, with sunk rocks, possessing several good harbours. The island of Ailsa is in this county. From the ridge, of which the mountains of Carrick are a part, rise almost all the rivers of the south of Scotland. The Tweed, the Esk, the Nith, the Annan, the Urr, &c. flow to the east and south, while the Stinchar, the Girvan, the Doon, the Ayr, and the Lugar, pouring into the Irish channel, intersect the county of Ayr with their copious streams. Besides these, the Irvine and other smaller rivulets, water the more northerly parts of the county. Ayrshire has two royal boroughs, viz. Ayr and Irvine; and several populous towns and villages, of which Kilmarnock, Beith, Saltcoats, Kilwinning, Largs, Girvan, and Ballantrae, are the chief. Fitted as Ayrshire is in every respect for the carrying on of trade, and the extension of agricultural improvements, it is only of late years that much has been done in that way. Possessing valuable seams of excellent coal, and enriched with the returns from its exportation, little attention was paid to the culture of the ground. The establishment of the Douglas and Heron Bank, though ruinous to the proprietors, contributed greatly to promote the improvement of Ayrshire. The abundance of wealth which it fallaciously seemed to pour into the country, and the ready command of money it gave, set all the proprietors towards improving and planting their estates, furnished means for raising and burning lime for manure, and above all, with the money from the bank, canals and roads were opened through every part of the county. Upon the failure of that extravagant and ill-conducted speculation, the proprietors of many estates saw their property brought to the hammer, and the greater part of their lands purchased by new proprietors. The Ayrshire breed of cattle is much esteemed; and a particular district is celebrated for cheese. In 1808 the real rent of the county was 314,673l.; the valued rent, according to an old estimate by which certain taxes are imposed, is 191,605l. There are in the county considerable woollen manufactures. In the parish of Beith there are 70 mills for spinning thread; and the various branches of the cotton manufactures are carried on in many parts to a great extent. At Muirkirk there are extensive iron-works. Ayrshire, besides the inexhaustible seams of coal with which it abounds, possesses several other valuable minerals; as freestone, limestone, iron-stone, several rich ores of lead and copper. A few curious specimens are also to be found in the hills of Carrick, of agates, porphyries, and of calcareous petrifactions. In the parishes of Stair and New Cumnock, galena and plumbago have been found; and in several parts of the county is found that species of whetstone known by the name of *Ayrstone*. There is plenty of marl in most of the lochs; the chief of which is Loch Doon, from which the river of that name takes its rise. There is annually a great quantity of sea-weed thrown ashore, from which many tons of kelp are made. All the rivers of Ayrshire abound with salmon, and the coasts are admirably adapted for the white fishing.

The following is a statement of the population of this county at two different periods.

	Parishes.	Population in 1755.	Population in 1790—98.
	Ardrossan	1297	1518
	Auchinleck	887	775
	Ayr	2964	4647
	Ballantrae	1049	770
5	Barr	858	750
	Beith	2064	2872
	Cumbraes	259	509
	Colmonell	1814	1100
	Coylton	527	667
10	Craigie	551	700
	Cumnock, New	1497	1200
	Cumnock, Old	1336	1632
	Dailly	839	1607
	Dalmellington	739	681
15	Dalry	1498	2000
	Dalrymple	439	380
	Dreghorn	887	830
	Dundonald	983	1317
	Dunlop	796	779
20	Fenwick	1113	1281
	Galston	1013	1577
	Girvan	1193	1725
	Irvine	4025	4500
	Kilbirny	651	700
25	Kilbride, West	885	698
	Kilmarnock	4403	6776
	Kilmaurs	1094	1147
	Kilwinning	2541	2360
	Kirkmichael	710	956
30	Kirkoswald	1168	1335
	Largs	1164	1025
	Loudoun	1494	2308
	Mauchline	1169	1800
	Maybole	2058	3750
35	Monktown	582	717
	Muirkirk	745	1100
	Newton on Ayr	581	1689
	Ochiltree	1210	1150
	Riccartoun	745	1300
40	St Quivox	499	1450
	Sorn	1494	2779
	Stair	369	518
	Stevenstoun	1412	2425
	Stewartoun	2819	3000
45	Straitoun	1123	934
	Symington	359	610
	Tarbolton	1365	1200
		Total, 59,268	75,544

Population in 1811, 103,954. See AYRSHIRE, SUPPLEMENT.

AYRY, or AERY, *of Hawks*, a nest or company of hawks; so called from the old French word *aire*, which signified the same.

AYSCUE, SIR GEORGE, a gallant English admiral, descended from a good family in Lincolnshire. He obtained the honour of knighthood from King Charles I. which, however, did not withhold him from

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adhering to the parliament in the civil war: he was by them constituted admiral of the Irish seas, where he is said to have done great service to the Protestant interest, and to have contributed much to the reduction of the whole island. In 1651 he reduced Barbadoes and Virginia, then held for the king, to the obedience of the parliament: and soon after the Restoration behaved with great honour in the war with the Dutch. In the famous engagement in the beginning of June 1666, when Sir George was admiral of the white squadron, his ship the Royal Prince ran upon the Gallop-sand; where, being surrounded with enemies, his men obliged him to strike. He went no more to sea after this, but spent the rest of his days in retirement.

AYMOUTH. See EYMOUTH.

AYTONIA. See BOTANY *Index*.

AZAB, in the Turkish armies, a distinct body of soldiery, who are great rivals of the Janizaries.

AZAI, a town of Touraine in France, seated on the river Indre. E. Long. 10. 35. N. Lat. 47. 18.

AZALEA, AMERICAN UPRIGHT HONEYSUCKLE. See BOTANY *Index*.

AZAMOR, a small sea-port town of the kingdom of Morocco in Africa. It is situated on the river Morbeya, in the province of Duguella, at some considerable distance from its mouth. This town, though formerly very considerable, is not proper for maritime commerce, because the entrance of the river is dangerous. It was unsuccessfully besieged by the Portuguese in 1508; it was taken, however, in 1513, by the duke of Braganza, but abandoned about the end of the 16th century. W. Long. 7. 0. N. Lat. 32. 50.

AZARAKITES, a sect of Mahometan Arabs. See ARABIA, N° 143, *et seq.*

AZARIAH, or UZZIAH, a king of Judah, succeeded his father Amaziah, 810 years before Christ. He assembled an army of above 300,000 men, with which he conquered the Philistines, and demolished the walls of Gath, Jabniel, and Ashdod; built up the walls of Jerusalem; furnished the city with conduits; and planted gardens and vineyards: but at last, being elated with his prosperity, and resolving to usurp the office of high-priest, he was struck with a leprosy, which obliged him to remain shut up in his palace for the rest of his days. He died about 759 years before the Christian era, and was succeeded by Jotham his son.—There are several other persons of this name mentioned in the sacred Scriptures.

AZAZEL. The word relates to the history of the scape-goat, under the Jewish religion. Some call the goat itself by this name, as St Jerome and Theodoret. Dr Spenser says, the scape-goat was to be sent to Azazel; by which is meant the devil. Mr Le Clerc translates it *præcipitium*, making it to be that steep and inaccessible place to which the goat was sent, and where it was supposed to perish.

AZEKA, in *Ancient Geography*, a city of the Amorites, in the lot of Judah; situated between Eleutheropolis and Ælia (Jerome); where the five kings of the Amorites and their army were destroyed by hailstones from heaven, (Joshua).

AZEM, ASEM, ASSAM, or ACHAM, a country of Asia to the north of Ava, but which is very little known to Europeans. It is said to be very fertile, and to contain mines of gold, silver, iron, and lead, all which belong to the king, who, in consequence of enjoying the produce, requires no taxes from his people. They have also great quantities of gum lac, and coarse silk. It is also thought that the inhabitants of Azem were long ago the inventors of cannon and gun-powder; and that from them the invention passed to the inhabitants of Pegu, and from thence to the Chinese.

AZIMUTH, in *Astronomy*, an arch of the horizon, intercepted between the meridian of the place and the azimuth, or vertical circle passing through the centre of the object, which is equal to the angle of the zenith, formed by the meridian and vertical circle: or it is found by this proportion, As the radius to the tangent of the latitude of the place, so is the tangent of the sun's or star's altitude, for instance, to the cosine of the azimuth from the south, at the time of the equinox.

Magnetical AZIMUTH, an arch of the horizon intercepted between the azimuth, or vertical circle, passing through the centre of any heavenly body and the magnetical meridian. This is found by observing the object with an azimuth-compass.

AZIMUTH-Compass, an instrument for finding either the magnetical azimuth or amplitude of a heavenly object.

The learned Dr Knight invented some time since a very accurate and useful sea-compass, which is at present used in the navy. This instrument, with another invented by the ingenious Mr Smeaton, answers the purposes of an azimuth amplitude compass. See COMPASS.

AZIMUTH Circles, called also *azimuths*, or *vertical circles*, are great circles of the sphere intersecting each other in the zenith and nadir, and cutting the horizon at right angles. These azimuths are represented by the rhumbs on common sea-charts, and on the globe they are represented by the quadrant of altitude, when screwed in the zenith. On these azimuths is reckoned the height of the stars and of the sun when not in the meridian.

AZMER, or AJMEER, a town of the East Indies, capital of a province of the same name, with a very strong castle. It is about 62 leagues west from Agra. The principal trade of this province is in saltpetre. It was in this city that Sir Thomas Rowe had the honour of being introduced to the great Mogul in 1716.

AZOGA SHIPS, are those Spanish ships commonly called the *quicksilver ships*, from their carrying quicksilver to the Spanish West Indies, in order to extract the silver out of the mines of Mexico and Peru. These ships, strictly speaking, are not to carry any goods unless for the king of Spain's account.

AZONI, in ancient mythology, a name applied by the Greeks to such of the gods as were deities at large, not appropriated to the worship of any particular town or country, but acknowledged in general by all countries, and worshipped by every nation. These the Latins called *dii communes*. Of this sort were the Sun, Mars, Luna, &c.

AZORES, islands in the Atlantic ocean, lying between 25 and 33 degrees of west longitude, and between 36 and 40 degrees of north latitude. They belong to the Portuguese, and are also called the

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Western Isles, on account of their situation. They were discovered by the Flemings in the 15th century. They are seven in number. See AZORES, SUPPLEMENT.

AZOTH, in *Ancient Chemistry*, the first matter of metals, or the mercury of a metal; more particularly that which they call the *mercury of philosophers*, which they pretended to draw from all sorts of metallic bodies.

AZOTUS, AZOTH, or ASHDOD, one of the five cities of the Philistines, and a celebrated sea-port on the Mediterranean, situated about 14 or 15 miles south of Ekron, between that and Ascalon. It was in this city that the idol Dagon fell down before the ark: and so strong a place it was, if we may believe Herodotus, that it sustained a siege of 29 years by Psammeticus king of Egypt. It was, however, taken by the Maccabees in a much shorter time; who burnt both the city and temple, and with them about 1000 men. The town is now called by the Arabs *Aasaneyun*. It is but thinly inhabited, though the situation is very pleasant: with regard to the houses, those that were built in the time of Christianity, and which are now inhabited by Mahometans, still preserve some claim to admiration; but the modern buildings, though generally of stone, have nothing in them which can attract the notice of a traveller. The streets are pretty broad, the inhabitants mostly Mahometans, with a few Christians of the Greek communion, who have a church under the jurisdiction of the archbishop of Gaza. The town is about a mile and a half in circumference; and has in it a mosque, a public bath, a market-place, and two inns. The number of the inhabitants is between two and three thousand. The most remarkable things in this place are an old structure with fine marble pillars, which the inhabitants say was the house that Sampson pulled down; and to the south-east, just out of the town, the water in which the eunuch Candace was baptized by the apostle Philip: besides these two, there are several ancient buildings, with capitals and pillars standing.

AZURE, in a general sense, the blue colour of the sky. See SKY and BLUE.

AZURE, among painters. This word, which at present signifies in general a fine blue colour, was formerly applied to *lapis lazuli*, called *azure stone*, and to the blue prepared from it. But since a blue has been extracted from cobalt, custom has applied to it the name of *azure*, although it differs considerably from the former, and is incapable of being used for the same purposes, and particularly for painting in oil. The former at present is called *lapis lazuli*, or only *lapis*; and the blue prepared from it for painting in oil, is called *ultramarine*.—The name *azure* is generally applied to the blue glass made from the earth of cobalt and vitrifiable matters. This glass, which is called *smalt* when in masses, is called *azure* only when it is reduced to a fine powder. Several kinds of azure are distinguished, according to its degrees of beauty, by the names of *fine azure*, *powdered azure*, and *azure of four fires*. In general, the more intense the colour, and the finer the powder, the more beautiful and dear it is. Azure is employed to colour starch; hence it has also been called *starch blue*. It is used for painting with colours, and for a blue enamel.

AZURE, in *Heraldry*, the blue colour in the arms of any person below the rank of a baron. In the escutcheon of a nobleman, it is called *sapphire*; and in that of a sovereign prince, *Jupiter*. In engraving, this colour is expressed by lines or strokes drawn horizontally.—This colour may signify Justice, Perseverance, and Vigilance; but according to G. Leigh, when compounded with

Or	it signifies	Cheerfulness.
Arg.		Vigilance.
Gul.		Readiness.
Ver.		Enterprise.
Pur.		Goodness.
Sab.		Mournfulness.

The French heralds, *M. Upton*, and his followers, rank this colour before gules.

AZYGOS, in *Anatomy*, a vein rising within the thorax, on the right side, having no fellow on the left; whence it is called *azygos*, or *vena sine pari*.

AZYMITES, in church history, Christians who administer the eucharist with unleavened bread. The word is formed from the Greek α priv. and ζυμη, *ferment*.—This appellation is given to the Latin by the Greek church, because the members of the former use fermented bread in the celebration of the eucharist. They also call the Armenians and Maronites by the same name, and for the same reason.

AZYMOUS, something unfermented, or made without leaven; as unleavened bread. Sea biscuit is of this kind; and therefore, according to Galen, less wholesome than bread that has been fermented.

B.

B, THE second letter of the English and most other alphabets. It is the first consonant, and first mute, and its pronunciation is supposed to resemble the bleating of a sheep; upon which account Pierius tells us in his hieroglyphics, that the Egyptians represented the sound of this letter by the figure of that animal.

B is also one of those letters which the eastern grammarians call *labial*, because the principal organs employed in its pronunciation are the lips. It is pronounced

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ced by pressing the whole length of them together, and forcing them open with a strong breath. It has a near affinity with the other labials P and V, and is often used for P both by the Armenians and other orientals, as in *Betrus* for *Petrus*, *apsens* for *absens*, &c. and by the Romans for V, as in *amabit* for *amavit*, *berna* for *verna*, &c. whence arose that jest of Aurelian on the emperor Bonosus, *Non ut vivat natus est, sed ut bibat.*

Plutarch observes, that the Macedonians changed φ into B, and pronounced *Bilip*, *Berenice*, &c. for *Philip*, *Pherenice*, &c.; and those of Delphos used B instead of Π, βαθειν for παθειν, βικρον for πικρον, &c.—The Latins said *suppono*, *oppono*, for *subpono*, *obpono*; and pronounced *optinuit*, though they wrote *obtinuit*, as Quintilian has observed.—They also used B for F or PH: thus, in an ancient inscription mentioned by Gruter, OBRENDARIO is used for OFRENDARIO.

As a numeral, B was used by the Greeks and Hebrews to denote 2; but among the Romans for 300, and with a dash over it (thus $\bar{B}$) for 3000.

B is also used as an abbreviation. Thus B. A. stands for bachelor of arts; B. L. for bachelor of laws; and B. D. for bachelor of divinity. B. F. in the preface to the decrees or senatus consulta of the old Romans, signified *bonum factum*. In music, B stands for the tone above A; as B♭, or ♭B, does for B flat, or the semitone major above A. B also stands for bass; and B. C. for *basso continuo*, or thorough-bass.

BAAL, the same as BEL, or BELUS; an idol of the Chaldeans, and Phœnicians or Canaanites. The former worshipped Mars under this name, according to Josephus *; who, speaking of Thurus the successor of Ninus, says, "To this Mars the Assyrians erected the first statue, and worshipped him as a god, calling him *Baal*." It is probable the Phœnicians worshipped the sun under the name of Baal; for Josiah, willing to make some amends for the wickedness of Manasseh, in worshipping Baal, and all the host of heaven, *put to death the idolatrous priests that burnt incense unto Baal, to the sun, and to the moon, and to the planets, and to all the host of heaven. He likewise took away the horses that the kings of Judah had given to the sun, and burnt the chariots of the sun with fire* †.

* *Antiquit.* lib. viii. cap. 7.

† 2 Kings xxiii. 5. 11.

The temples consecrated to this god, are called in the Scripture *Chamanim*, which signifies *places enclosed with walls* in which was kept a perpetual fire. Maundrell, in his journey from Aleppo to Jerusalem, observed some traces of these enclosures in Syria. In most of them were no statues; in a few there were some, but of no uniform figure.

The word *baal* (in the Punic language), signifies *lord* or *master*; and doubtless meant the supreme Deity, the Lord and Master of the universe. It is often joined with the name of some false god, as *Baal-berith*, *Baal-peor*, *Baal-zephon*, and the like. This deity passed from the Phœnicians to the Carthaginians, who were a colony of the Phœnicians; as appears from the Carthaginian names, Hannibal, Asdrubal, &c. according to the custom of the east, where kings and great men added to their own names those of their gods.

This false deity is frequently mentioned in Scripture in the plural number (*Baalim*); which may signify, either that the name *Baal* was given to several different gods; or that there were many statues, bearing different appellations, consecrated to this idol. Arnobius tells us, that Baal was of an uncertain sex; and that his votaries, when they called upon him, invoked him thus: *Hear us, whether thou art a god or a goddess.*

Some learned men think, that the Baal of the Phœnicians is the Saturn of the Greeks; which is probable enough from the conformity there is between the human sacrifices offered to Saturn and those which the Scripture tells us were offered to Baal. Others are of opinion, that Baal was the Phœnician or Tyrian Hercules, a god of great antiquity in Phœnicia.

BAAL-BERITH, the god of the Shechemites. Bochart conjectures, that Berith is the same as *Beroe*, the daughter of Venus and Adonis, who was given in marriage to Bacchus; and that she gave her name to the city of Berith in Phœnicia, and became afterwards the goddess of it. Baal-berith, signifies *Lord of the covenant*, and may be taken for the god who presides over alliances and oaths, in like manner as the Greeks had their Ζευς ορκιος, and the Romans their *Deus Fidius*, or *Jupiter Pistius*. The idolatrous Israelites, we are told, *made Baal-berith their god*, Judg. viii. 33.

BAAL-PEOR, *Baal-phegor*, or *Beel-phegor*, an idol of the Moabites and Midianites. We are told, that *Israel joined himself to Baal-peor*; and that Solomon erected an altar to this idol upon the mount of Olives. Baal-peor has been supposed to be no other than a Priapus, and that the worship of him consisted in the most obscene practices. Others have thought, that as Baal is a general name signifying *Lord*, Peor may be the name of some great prince deified after his death. Mede imagines that *Peor* being the name of a mountain in the country of Moab, on which the temple of Baal was built, Baal-peor may be only another name of that deity, taken from the situation of his temple; in like manner as Jupiter is styled *Olympius*, because he was worshipped in a temple built on Mount Olympus. Selden, who is of this latter opinion, conjectures likewise that Baal-peor is the same with Pluto; which he grounds upon these words of the Psalmist *, *They joined themselves unto Baal-peor, and ate the offerings of the dead;* though by the *sacrifices* or *offerings of the dead*, in this passage, may be meant no more than sacrifices or offerings made to idols, or false gods, who are very properly called *the dead*, in contradistinction to the true God, who is styled in Scripture the *living God*.

* Ps. cvi.

BAAL-ZEBUB, *Beel-zebub*, or *Belzebub*; the idol, or god, of the Ekronites. In Scripture he is called the *Prince of Devils*. His name is rendered the *Lord of flies*, or the *God fly*; which some think was a mock appellation bestowed on him by the Jews. He had a famous temple and oracle at Ekron. Ahaziah king of Israel, having fallen from the terrace of his house into a lower room, and being dangerously hurt, sent to consult this deity, to know if he should be cured of his wounds. The worship of this false god must have prevailed in our Saviour's time, since the Jews accused him of driving out devils in the name of *Belzebub* their prince. Scaliger derives the name of this deity from *Baalim-zebahim*, which signifies the *Lord of sacrifices*.

BABBLING, among hunters, is when the hounds are too busy after they have found a good scent.

BABEL, a city and tower undertaken to be built by

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by the whole human race soon after the flood, and remarkable for the miraculous frustration of the attempt by the confusion of languages. As to the situation of ancient Babel, most authors are of opinion that it was exactly in the place where the celebrated city of Babylon afterwards stood. That it was in the same country, appears indisputably from Scripture; but that it was exactly in the same place is what cannot be proved, nor is it a matter of any consequence.

Authors have been much divided about the motive by which the whole race of mankind were induced to join as one man in such an undertaking. Some have imagined that it was out of fear of a second deluge; others, that they knew beforehand that they were to be dispersed through all the different countries of the world, and built this tower in order to defeat the design of the Deity, because having a tower of such vast height as they proposed, those who were at a distance could easily find their way back again. Had either of these been their design, however, it is probable they would have chosen an eminence rather than a plain for the situation of their tower, or indeed that they would have chosen some high mountain, such as Ararat, for their mark, rather than any tower at all: for though it is said that they designed the top of their tower to reach to heaven, we can scarcely suppose them to have been so absurd, as to imagine this possible in the sense we understand it; and must therefore rather take it in the limited sense in which it is often used by Moses and his countrymen, where they speak of cities walled up to heaven. Others there are who imagine that the top of this tower was not to reach up to heaven, but to be consecrated to the heavens, i. e. to the worship of the sun, moon, and stars; of the fire, air, &c. and other natural powers, as deities; and therefore that the true Deity interposed in order to prevent a total and irrecoverable defection. Certain it is, that the species of idolatry which takes for the objects of its worship those natural agents, as it is the most ancient, so it is by far the most rational, and the most difficult to be disproved. It is much more difficult, for instance, to prove that the sun, which by his enlivening beams gives vigour to the whole creation, is not a deity, than that a log of wood is not one: and hence if such a system of religion became universally established among mankind, it would be impossible ever afterwards to eradicate it. Indeed, that the scheme of Babel, whatever it was, could have been put into execution by man, seems evident from the interposition of the Deity on the occasion; for we cannot suppose that he would have worked a miracle on purpose to defeat that which would have defeated itself if he had let it alone: and he expressly says, That now nothing could be restrained from them; which intimates very plainly, that, had this scheme gone on, the plan which God had laid for the government of the world would have been totally frustrated: and agreeable to this hypothesis Dr Tennison supposes that the tower was of a pyramidal form, in imitation of the spires of flame; and that it was erected in honour of the sun, as being the most probable cause of drying up the flood.

As to the materials made use of in the building of this tower, the Scripture informs us that they were bricks and slime or bitumen. According to an eastern tradition, three years were taken up in making the bricks, each of which was 13 cubits long, 10 broad, and five thick. Oriental writers say, that the city was 313 fathoms in length, and 151 in breadth; that the walls were 5533 fathoms high, and 33 in breadth; and that the tower itself was no less than 10,000 fathoms, or 12 miles high. Even St Jerome affirms from the testimony of eye-witnesses, who, as he says, had examined the remains of the tower, that it was four miles high; but Ado makes the height to have been no less than 5000 miles. The only account of its dimensions which can be at all depended upon (supposing it to have been the same which afterwards stood in the midst of the city of Babylon, and round which Nebuchadnezzar built the temple of Belus), is that given under the article BABYLON.

BABEL MANDEL, the GATE OF MOURNING; a famous strait in the Indian ocean, between the coast of Arabia Felix in Asia, and that of Adel and Zeila in Africa, at the entrance into the Red sea. By some it is also called the *straits of Moka*. It is narrow, and difficult to sail through, on account of the sand banks. At the mouth of the strait is a small island called also *Babel Mandel*, which is little else than a barren rock. E. Long. 44. 30. N. Lat. 12. 40.

BABENHAUSEN, a town of Bavaria, 16 miles SE. from Ulm. E. Long. 9. 16. N. Lat. 48. 39.

BABINA, COMMONWEALTH OF, a society ludicrously so called, which was founded in Poland in the reign of Sigismund Augustus, in the 16th century. It took its rise from a set of gentlemen, inhabitants of Lublin, who had agreed to meet at a place called *Babina*, merely for the purposes of mirth and jollity. In time their number increased, and they formed themselves into a regular government, under the presidency of a king, senate, and chief magistrate. The magistrates were elected from something which appeared ridiculous in the character or conduct of any of the members. For instance, if any person was meddling or officious, he was immediately created an archbishop; a blundering or disputatious member was promoted to the speaker's chair; a boaster of his own courage, and vain-glorious *Thraso*, was honoured with the commission of generalissimo, which was presented him with great ceremony by the subordinate heroes. Those who declined the office for which they were declared qualified were persecuted with hissings, and abandoned by the society. Thus every vice and every foible was attacked with ridicule; and Babina became in a short time the terror, the admiration, and the reformer of the Polish nation: genius flourished, wit was cultivated, and the abuses which had crept into government and society were corrected by the judicious application of good-humoured satire. Never did any institution of this nature become so general or so useful; but at length it degenerated into a set of buffoons, and banterers of every thing sacred or profane. For several years it was patronized by the kings of Poland, and Sigismund himself became a member; the starosta of Babina telling him jocularly, that "his majesty had certain qualities which entitled him to the first dignity in the commonwealth." Not the least remnant of the society now remains, though it was honoured with extraordinary privileges by kings and emperors.

BABINGTON, GERVASE, bishop of Worcester, was

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was born, according to Fuller, in Nottinghamshire; but in what year is uncertain. He was sent to Trinity College, Cambridge, of which he was made fellow; and, in 1578, was incorporated master of arts at Oxford. He appears, however, to have made Cambridge the place of his residence, where he became an eminent preacher; and, being now doctor in divinity, was made domestic chaplain to Henry earl of Pembroke. In this station he is supposed to have assisted the countess in her translation of the Psalms. In 1588 he was installed prebend of Hereford, and in 1591 consecrated bishop of Landaff. In 1594 he was translated to the see of Exeter, and thence to Worcester in 1597. About this time, or soon after, he was made queen's counsel for the marches of Wales. He was a considerable benefactor to the library belonging to the cathedral of Worcester, where he was buried in May 1610 without a monument. The several historians who have mentioned this prelate agree in giving him the character of a learned and pious man. His writings, like those of most of his cotemporaries, abound with puns and quaint expressions. His works were printed both in folio and quarto in 1615, and again in folio in 1637, under this title: *The works of the right reverend father in God Gervase Babington, late bishop of Worcester, containing comfortable notes upon the five books of Moses, viz. Genesis, &c. As also an exposition upon the Creed, the Ten Commandments, the Lord's Prayer; with a conference betwixt man's frailtie and faith, and three sermons, &c.*

BABOON, in *Zoology*. See SIMIA, MAMMALIA *Index*.

BABYLON, the capital of the ancient kingdom of Babylonia or Chaldea, and supposed to have stood in E. Long. 44. 0. N. Lat. 32. 0. Semiramis is said by some, and Belus by others, to have founded this city. But, by whomsoever it was founded, Nebuchadnezzar was the person who put the last hand to it, and made it one of the wonders of the world. The most famous works in and about it were the walls of the city, the temple of Belus, Nebuchadnezzar's palace, the hanging gardens, the banks of the river, the artificial lake, and canals.

1 City described.

The city was surrounded with walls, in thickness 87 feet, in height 350 feet, and in compass 480 furlongs or 60 of our miles. Thus Herodotus, who was himself at Babylon; and though some disagree with him in these dimensions, yet most writers give us the same, or nearly the same, as he does. Diodorus Siculus diminishes the circumference of these walls very considerably, and takes somewhat from the height of them, as in Herodotus; though he seems to add to their breadth, by saying, that six chariots might drive abreast thereon: while the former writes, that one chariot only might turn upon them; but then he places buildings on each side of the top of these walls, which, according to him, were but one story high; which may pretty well reconcile them together in this respect. It is observed, that those who give the height of these walls but at 50 cubits, speak of them only as they were after the time of Darius Hystaspis, who caused them to be beaten down to that level. These walls formed an exact square, each side of which was 120 furlongs, or 15 miles, in length; and were all built of large bricks cemented together with bitumen, which in a short time grows harder than the very brick and stone which it cements. The city was encompassed, without the walls, with a vast ditch filled with water, and lined with bricks on both sides; and as the earth that was dug out of it served to make the bricks, we may judge of the depth and largeness of the ditch from the height and thickness of the walls. In the whole compass of the wall there were 100 gates, that is, 25 on each of the four sides, all made of solid brass. Between every two of these gates, at proper distances, were three towers, and four more at the four corners of this great square, and three between each of these corners and the next gate on either side, and each of these towers was ten feet higher than the walls. But this is to be understood only of those parts of the walls where towers were needful for defence. For some parts of them being upon a morass, and inaccessible by an enemy, there the labour and cost was spared, which, though it must have spoiled the symmetry of the whole, must be allowed to have savoured of good economy; though that is what one would not have expected from a prince who had been so determined, as Nebuchadnezzar must have been, to make the city complete both for strength and beauty. The whole number, then, of these towers amounted to no more than 250; whereas a much greater number would have been necessary to have made the uniformity complete all round. From each of the 25 gates on each side of the square, there was a straight street, extending to the corresponding gate in the opposite wall; whence the whole number of the streets must have been but 50; but then they were each about 15 miles long, 25 of them crossing the other 25 exactly at right angles. Besides these whole streets, we must reckon four half streets, which were but rows of houses facing the four inner sides of the walls. These four half streets were properly the four sides of the city within the walls, and were each of them 200 feet broad, the whole streets being about 150 of the same. By this intersection of the 50 streets, the city was divided into 676 squares, each of four furlongs and a half on each side, or two miles and a quarter in compass. Round these squares, on every side towards the streets, stood the houses, all of three or four stories in height, and beautified with all manner of ornaments: and the space within each of these squares was all void, and taken up by yards, or gardens, and the like, either for pleasure or convenience.

A branch of the Euphrates divided the city into two, running through the midst of it, from north to south; over which, in the very middle of the city, was a bridge, a furlong in length, or rather more; and indeed much more, if we hearken to others, who say it was no less than five stades or furlongs in length, though but 30 feet broad, a difference we shall never be able to decide. This bridge, however, is said to have been built with wonderful art, to supply a defect in the bottom of the river, which was all sandy. At each end of this bridge were two palaces: the old palace on the east side, the new one on the west side of the river; the former of which took up four of the squares abovementioned, and the latter nine. The temple of Belus, which stood next to the old palace, took up another of the same squares.

The whole city stood in a large flat or plain, in a very fat and deep soil: that part or half of it on the east

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Babylon. east side of the river was the old city, and the other on the west was added by Nebuchadnezzar, both being included within the vast square bounded by the walls aforesaid. The form of the whole was seemingly borrowed from Nineveh, which was also 480 furlongs; but though it was equal in dimensions to this city, it was less with respect to its form, which was a parallelogram, whereas that of Babylon was an exact square. It is supposed, that Nebuchadnezzar, who had destroyed that old seat of the Assyrian empire, proposed that this new one should rather exceed it; and that it was in order to fill it with inhabitants, that he transported such numbers of the captives from other countries hither; though that is what may be disputed, seeing he therein only followed the constant practice of the kings of Assyria, who thought this the most certain means of ensuring their conquests either to themselves or their posterity.

2 Was never fully peopled.

But it plainly appears, that it was never wholly inhabited; so that, even in the meridian of its glory, it may be compared with the flower of the field, which flourishes to-day, and to-morrow is no more. It never had time to grow up to what Nebuchadnezzar visibly intended to have made it; for, Cyrus removing the seat of the empire soon after to Shushan, Babylon fell by degrees to utter decay: yet it must be owned, that no country was better able to support so vast and populous a city, had it been completed up to its first design. But so far was it from being finished according to its original design, that, when Alexander came to Babylon, Q. Curtius tells us, "No more than 90 furlongs of it were then built:" which can be no otherwise understood than of so much in length; and, if we allow the breadth to be as much as the length (which is the utmost that can be allowed), it will follow, that no more than 8100 square furlongs were then built upon: but the whole space within the walls contained 14,400 square furlongs; and therefore there must have been 6300 square furlongs remaining unbuilt, which, Curtius tells us, were ploughed and sown. And, besides this, the houses were not contiguous, but all built with a void space on each side, between house and house.

3 Temple of Belus.

The next great work of Nebuchadnezzar was the temple of Belus. The wonderful tower, however, that stood in the middle of it, was not his work, but was built many ages before; that, and the famous tower of Babel, being, as is commonly supposed, one and the same structure. This tower is said to have been composed of eight pyramidal ones raised above one another, and by Herodotus said to have been a furlong in height; but as there is an ambiguity in his expression, it has been disputed whether each of the towers was a furlong in height, or the whole of them taken together. On the latter supposition, which is the most probable, this tower must have exceeded the highest of the Egyptian pyramids by 179 feet, though it fell short of its breadth at the basis by 33. The way to go up was by stairs on the outside round it; whence it seems most likely, that the whole ascent was, by the benching in, drawn in a sloping line from the bottom to the top eight times round it; and that this made the appearance of eight towers, one above the other. Till the times of Nebuchadnezzar, it is thought this tower was all the temple of Belus; but as he did by the other ancient buildings of the city, so he did by this, making great additions thereto, by vast edifices erected round it, in a square of two furlongs on every side, and just a mile in circumference, which exceeded the square at the temple of Jerusalem by 1800 feet. On the outside of these buildings was a wall which enclosed the whole; and, in consideration of the regularity wherewith this city was to all appearance marked out, it is supposed, that this wall was equal to the square of the city wherein it stood, and so is concluded to have been two miles and a half in circumference. In this wall were several gates leading into the temple, and all of solid brass; which it is thought may have been made out of the brazen sea, and brazen pillars, and other vessels and ornaments of the kind, which Nebuchadnezzar had transported from Jerusalem; for in this temple he is said to have dedicated his spoils from that of Jerusalem.

4 Idols of gold, &c.

In this temple were several images or idols of massy gold, and one of them, as we have seen, 40 feet in height; the same, as supposed, with that which Nebuchadnezzar consecrated in the plains of Dura. For though this last is said to have been 60 cubits, or 90 feet high, these dimensions appear so incredible, that it has been attempted to reconcile them into one, by supposing, that in the 90 feet the height of the pedestal is included, and that the 40 feet are for the height of the statue without the pedestal; and being said to have weighed 1000 talents of Babylon, it is thence computed, that it was worth three millions and a half of our money. In a word, the whole weight of the statues and decorations, in Diodorus Siculus, amounting to 5000 and odd talents in gold, the whole is estimated at above 21,000,000l. of our money; and a sum about equal to the same, in treasure, utensils, and ornaments, not mentioned, is allowed for.

Next to this temple, on the east side of the river, stood the old palace of the kings of Babylon, being four miles in circumference. Exactly opposite to it, on the other side of the river, was the new palace built by Nebuchadnezzar, eight miles in circumference, and consequently four times as big as the old one.

5 Hanging gardens.

But nothing was more wonderful at Babylon than the hanging-gardens, which Nebuchadnezzar made in complaisance to his wife Amyte; who, being a Mede, and retaining a strong inclination for the mountains and forests of her own country, was desirous of having something like them at Babylon. They are said to have contained a square of four plethra, or 400 feet, on each side; and to have consisted of terraces one above another, carried up to the height of the wall of the city, the ascent from terrace to terrace being by steps ten feet wide. The whole pile consisted of substantial arches upon arches, and was strengthened by a wall surrounding it on every side, 22 feet thick; and the floors on each of them were laid in this order: First, on the tops of the arches was laid a bed or pavement of stones 16 feet long, and four feet broad; over this was a layer of reed mixed with a great quantity of bitumen; and over this two courses of brick, closely cemented together with plaster; and over all these were thick sheets of lead, and on these the earth or mould of the garden. This floorage was designed to retain the moisture of the mould; which was so deep, as to give root to the greatest trees which were planted upon

Babylon. on every terrace, together with great variety of other vegetables pleasing to the eye. Upon the uppermost of these terraces was a reservoir, supplied by a certain engine with water from the river, from whence the gardens on the other terraces were supplied.

6 Banks of the river, canals, &c. The other works attributed to Nebuchadnezzar by Berosus and Abydenus, were the banks of the river, the artificial canals, and the great artificial lake said to have been sunk by Semiramis. The canals were cut out on the east side of the Euphrates, to convey the water of the river, when it overflowed its banks, into the Tigris, before they reached Babylon. The lake was on the west side of Babylon; and, according to the lowest computation, 40 miles square, 160 in compass, and in depth 35 feet, as we read in Herodotus, or 75, as Megasthenes will have it; the former, perhaps, measured from the surface of the sides, and the latter from the tops of the banks that were cast up upon them. This lake was dug to receive the waters of the river, while the banks were building on each side of it. But both the lake, and the canal which led to it, were preserved after that work was completed, being found of great use, not only to prevent all overflowings, but to keep water all the year, as in a common reservoir, to be let out, on proper occasions, by sluices, for the improvement of the land.

The banks were built of brick and bitumen, on both sides of the river, to keep it within its channel; and extended on each side throughout the whole length of the city, and even farther, according to some, who reckon they extended 160 furlongs, or twenty miles; whence it is concluded they must have begun two miles and a half above the city, and have been continued an equal distance below it, the length of the city being no more than 15 miles. Within the city they were built from the bottom of the river, and of the same thickness with the walls of the city itself. Opposite to each street, on either side of the river, was a brazen gate in the said wall, with stairs leading down from it to the river; these gates were open by day, and shut by night.

Berosus, Megasthenes, and Abydenus, attribute all these works to Nebuchadnezzar; but Herodotus tells us, the bridge, the banks, and the lake, were the work of a queen after him, called *Nitocris*, who may have finished what Nebuchadnezzar left imperfect, and thence have had the honour this historian gives her of the whole.

The tower or temple stood till the time of Xerxes. But that prince, on his return from the Grecian expedition, having first plundered it of its immense wealth, demolished the whole, and laid it in ruins. Alexander, on his return to Babylon from his Indian expedition, proposed to rebuild it, and accordingly set 10,000 men to work to clear away the rubbish. But his death happening soon after, a stop was put to all further proceedings in that design. After the death of that conqueror, the city of Babylon began to decline apace; which was chiefly owing to the neighbourhood of Seleucia built by Seleucus Nicator, as is said, out of spite to the Babylonians, and peopled with 500,000 persons drawn from Babylon, which by that means continued declining till the very people of the country were at a loss to tell where it had stood.

Such is the description we have by ancient historians of the grandeur of this city; which, if these accounts are not exaggerated, must have exceeded every piece of human grandeur that hath yet appeared. Many of the moderns, however, are of opinion that these magnificent descriptions are very far from being true; although it is certain that few other arguments can be brought against the reality of them, than that we do not see things of a similar kind executed in our own days. The following are the arguments used on this subject by Goguet.

7 Goguet's arguments against the truth of the foregoing relation. "Authors have greatly extolled the public works and edifices which once rendered Babylon one of the wonders of the world. We may reduce all these objects to five principal heads: 1. The height of its walls; 2. The temple of Belus; 3. The hanging gardens; 4. The bridge built over the river Euphrates, and the quays which lined the river; 5. The lake and canals dug by the hand of man to distribute the waters of the Euphrates.

"All these works, so marvellous in the judgment of antiquity, appear to me to have been extremely exaggerated by the authors who have spoke of them. How can we conceive, in effect, that the walls of Babylon could have been 318 feet high, and 81 in thickness, in a compass of near ten leagues?

"I shall say the same of that square building, known under the name of *the temple of Belus*. It was composed of eight towers placed one above another, diminishing always as they went up. Herodotus does not tell us what was the height of this monument. Diodorus says, that it surpassed all belief. Strabo fixes it to one stadium, a measure which answers nearly to 600 of our feet: For in the time of this geographer, the stadia were much more considerable than in the first ages. The entire mass of this building ought to have been answerable to its excessive height; and this is also the idea that the ancients designed to give us of it. We may judge by the following fact. Xerxes had entirely demolished this temple. Alexander undertook to rebuild it. He designed to begin by clearing the place and removing the ruins. Ten thousand workmen who were employed two months in this work, were not, say they, able to finish it.

"The riches enclosed in the temple of Belus were proportioned to its immensity. Without speaking of the tables and censers, the cups and other sacred vases, of massy gold, there was a statue 40 feet high, which alone weighed 1000 Babylonish talents. In short, according to the inventory that the ancients have given us of the riches contained in this temple, the total sum would amount to two hundred and twenty millions and a half of French livres. Exaggerations like these destroy themselves.

"As to the hanging gardens, according to all appearance they never existed. The silence of Herodotus on a work so singular and so remarkable, determines one to place in the rank of fables all that the other writers have delivered upon this pretended wonder. Herodotus had carefully visited Babylon. He enters into such details as prove that he has omitted none of the rarities of that city. Can we presume that he would have passed over in silence such a work as the hanging gardens? All the authors who have spoken of it are of much later date than this great historian. None of them except Berosus speaks on his own testimony.

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mony. It is always on the report of others. Diodorus had extracted from Ctesias what he says of these famous gardens. There is also great appearance that Strabo had drawn from the same source. In a word, the manner in which Quintus Curtius expresses himself, sufficiently shows how much the existence of these gardens appeared to him suspicious. He judged they owed the greatest part of it to the imagination of the Greeks.

"Let us now speak of the bridge of Babylon, which the ancients have placed in the number of the most marvellous works of the east. It was near 100 fathoms in length, and almost four in breadth. We cannot deny but that a great deal of art and labour was necessary to lay the foundations, which it could not be easy to settle in the bed of an extremely deep and rapid river, which also rolls along a prodigious quantity of mud, and whose bottom is entirely sandy. They had therefore taken many precautions to secure the piers of the bridge of Babylon. They were built of stones joined and fastened together with cramps of iron, and their joints filled with melted lead. The front of the piers, turned towards the current of the Euphrates, was defended by buttresses extremely advanced, which diminished the weight and force of the water, by cutting it at a great distance. Such was the bridge of Babylon.

"While we do justice to the skill of the Babylonians in constructing these works, we cannot help remarking the bad taste which at all times reigned in the works of the eastern nations. The bridge of Babylon furnishes a striking instance of it. This edifice was absolutely without grace, or any air of majesty. The breadth of it was in no sort of proportion to its length. The distance between the piers was also very ill contrived. They were distant from each other only 11 feet and a half. Finally, this bridge was not arched. We may judge of its effect on the view.

"As for the quays which lined the Euphrates, we may believe that they were grand and magnificent; but I shall not easily believe that they surpassed those which we have daily under our eyes. In this respect, I believe Paris may dispute it for magnificence, and for the extent of the work, with all the cities of the universe."

The ruins of this famous city have lately been described in detail by Mr Rich, British resident at Bagdad. They are situated near a village called Hellah, and consist of immense piles of bricks, partly decomposed into earth, and partly entire, and scattered over a great space on both sides of the Euphrates. See Babylon, Supplement.

Babylon, a town of Egypt near the eastmost branch of the river Nile, now supposed to be *Grand Cairo*, or this city to stand near its ruins. E. Long. 31. 12. N. Lat. 30. 5.

BABYLONIA, or Chaldea, a kingdom of Asia, and the most ancient in the world, being founded by Nimrod the grandson of Ham, who also, according to the margin of our Bibles, founded Nineveh the capital of the kingdom of Assyria. Indeed, these two kingdoms seem to have always continued in such a state of friendship, that we can scarce help thinking they must have been the same, or perhaps Babylonia was for some time a province of Assyria. Nothing certain is known concerning either of them, except what may be gathered from Scripture. From thence we learn, that in the days of Abraham there was a king of *Shinar*, called *Amraphel*, who, under the king of Elam or Persia, made war upon the Canaanites. From this time we have nothing that can be depended upon till the days of Nabonasser, the first king of Babylon mentioned in Ptolemy's canon. It is plain, indeed, both from Scripture and profane history, that Babylonia subsisted as a distinct kingdom from Assyria even when the latter was in all its glory. The most probable account of the matter is this: The empire of Assyria was founded by Pul, on the ruins of that of Damascus or Syria, in the days of Menahem king of Judah. This king left two sons, Tiglath-Pileser, and Nabonasser. To the former he bequeathed the empire of Assyria, and to the latter that of Babylon. Tiglath-Pileser resided at Nineveh, the original seat of the Assyrian empire; while Nabonasser, who was the younger brother, held his residence at Babylon. As the two kingdoms were governed by princes of the same family, we may well suppose a perfect harmony to have reigned between them, the younger branch at Babylon acknowledging a kind of subjection to the elder at Nineveh. That the Babylonian empire was of Assyrian origin, we are assured by the prophet Isaiah, in the following words: "Behold the land of the Chaldeans: this people was not till the Assyrian founded it for them that dwelt in the wilderness: they set up the towers thereof; they built the palace thereof." As to the kingdom of Assyria, the Scripture mentions only five kings, viz. Pul, Tiglath-Pileser, Shalmanaser, Sennacherib, and Esar-haddon; whose history, as related by the sacred writers, it is needless to mention particularly here. From the days of Nabonasser to Nabopolasser, that is, from the year before Christ 747 to 626, the kings of Babylon made no figure, and were therefore probably in a state of dependence on the kings of Assyria; but at that time, in the reign of *Chyniladan*, the Sardanapalus of the Greeks, Nineveh was taken and destroyed by the Medes and Babylonians, and the seat of the empire transferred to Babylon. This Nabopolasser was the father of the famous Nebuchadnezzar, for whose history we must refer to the sacred writers; and from his time to that of the *Belshazzar* of Daniel, and *Nabonadius* of other authors, the history of Babylon is little better than a mere blank. Of the reduction of Babylon by Cyrus, which happened at this time, we have the following account.

War had been begun betwixt the Medes, Persians, and Babylonians, in the reign of Neriglissar the father of Nabonadius, which had been carried on with very bad success on the side of the Babylonians. Cyrus, who commanded the Median and Persian army, having subdued the several nations inhabiting the great continent from the Ægean sea to the Euphrates, bent his march towards Babylon. Nabonadius, hearing of his march, immediately advanced against him with an army. In the engagement which ensued, the Babylonians were defeated; and the king, retreating to his metropolis, was blocked up and closely besieged by Cyrus. The reduction of this city was no easy enterprise. The walls were of a prodigious height, the number of men to defend them very great, and the place stored with all sorts of provisions for 20 years. Cyrus, despairing of being able to take such a city by storm, caused a line

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Babylonia. of circumvallation to be drawn quite round it, with a large and deep ditch; reckoning that if all communication with the country were cut off, the besieged would be obliged to surrender through famine. That his troops might not be too much fatigued, he divided his army into twelve bodies, appointing each body its month to guard the trenches; but the besieged, looking upon themselves to be out of all danger by reason of their high walls and magazines, insulted him from the ramparts, and looked upon all the trouble he gave himself as so much unprofitable labour.

After Cyrus had spent two whole years before Babylon, without making any progress in the siege, he at last thought of the following stratagem, which put him in possession of it. He was informed, that a great annual solemnity was to be held at Babylon; and that the inhabitants on that occasion were accustomed to spend the whole night in drinking and debauchery. This he therefore thought a proper time for surprising them; and accordingly sent a strong detachment to the head of the canal leading to the great lake, with orders, at a certain time, to break down the great bank which was between the lake and the canal, and to turn the whole current into the lake. At the same time he appointed one body of troops at the place where the river entered the city, and another where it came out; ordering them to march in by the bed of the river as soon as they should find it fordable. Towards the evening he opened the head of the trenches on both sides the river above the city, that the water might discharge itself into them; by which means, and the breaking down of the great dam, the river was soon drained. Then the two above-mentioned bodies of troops, according to their orders, entered the channel; the one commanded by Gobryas and the other by Gadates: and finding the gates all left open by reason of the disorders of that riotous night, they penetrated into the very heart of the city without opposition; and meeting, according to agreement, at the palace, they surprised the guards, and cut them in pieces. Those who were in the palace opening the gates to know the cause of this confusion, the Persians rushed in, took the palace, and killed the king, who came out to meet them sword in hand. Thus an end was put to the Babylonian empire; and Cyrus took possession of Babylon for one called in Scripture *Darius the Mede*, most probably *Cyaxares II.* uncle to Cyrus. From this time Babylonia never was erected into a distinct kingdom, but hath always followed the fortune of those great conquerors who at different times have appeared in Asia. It is now frequently the object of contention between the Turks and Persians. See Assyria.

Concerning the nature of the country, manners, customs, &c. of the ancient Babylonians, the following account is collected by M. Sabbathier.

"As all the nations under the dominion of Cyrus, beside the ordinary tributes, were obliged to maintain him and his army, the monarch and his troops were supported by all Asia. The country of Babylon alone was obliged to maintain him four months of the year; its fertility, therefore, yielded a third of the produce of Asia. The government of this country, which the Persians termed *satrapy*, was richer and more extensive than any of the rest. It maintained for the king, beside the war-horses, a stud of 800 stallions, and 16,000 mares. So great a number of Indian dogs were likewise bred in this province for the king, that four of its cities kept those animals; and in return, they were exempted from all taxes and tributes. Babylonia.

"It rained very seldom in this country, according to Herodotus. The earth was watered by the river, which was here diffused by human industry, as the Nile over Egypt by nature; for all the country of Babylon was divided by canals, the greatest of which was navigable, and flowed from south to north, from the Euphrates to the Tigris. In short, it was one of the finest countries for corn in the world; but for producing trees, the fig-tree, the vine, and the olive, it was not famous. It was so luxuriant in grain, that it commonly yielded a hundred times more than what was sown; and in good years it yielded three hundred times more than it received. The leaves of its wheat and barley were four inches broad. 'Though I know,' says Herodotus, 'that the millet and the sesame of that country grow to the size of trees, I will not describe them particularly; lest those who have not been in Babylonia should think my account fabulous.'

"They had no oil but what they made from Indian corn. The country abounded with palm-trees, which grew spontaneously; and most of them bore fruit, of which the inhabitants made bread, wine, and honey. They cultivated these trees and their fig-trees in the same manner. Some of them, as of other trees, the Greeks called *male* ones. They tied the fruit of the male to the trees which bore dates; that the mosquito, leaving the male, might cause the date to ripen, by penetrating it; for without that assistance it came not to maturity. Mosquitos bred in the male palms as in the wild fig-trees.

"But we must not here omit to give an account of the peculiar and surprising construction of their boats of skins, in which they sailed along the river to Babylon. These boats were invented by the Armenians, whose country lay north from Babylonia. They made them with poles of willow, which they bent, and covered with skins; the bare side of the skins they put outwards; and they made them so tight, that they resembled boards. The boats had neither prow nor stern, but were of a round form like a buckler. They put straw on the bottom. Two men, each with an oar, rowed them down the river, laden with different wares, but chiefly with palm wine. Of these boats some were very large, and some very small. The largest carried the weight of 500 talents. There was room for an ass in one of their small boats; they put many into a large one. When they had unloaded, after their arrival at Babylon, they sold the poles of their boats and the straw; and loading their asses with the skins, returned to Armenia: for they could not sail up the river, its current was so rapid. For this reason they made their boats of skins, instead of wood; and on their return to Armenia with their asses, they applied the skins to their former use.

"As to their dress, they wore a linen shirt, which came down to their feet. Over it they wore a woollen robe; their outer garment was a white vest. Their shoes resembled those of the Thebans. They let their hair grow. On their heads they wore a turban. They rubbed their bodies all over with fragrant liquors. Each

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Each man had a ring on his finger, and an elegant cane in his hand, with an apple at the top, or a rose, a lily, or an eagle or some other figure; for they were not suffered to use canes without devices.

"With regard to their policy, Herodotus thinks that their best law was one which the Heneti, an Illyrian people, likewise observed in every town and village. When the girls were marriageable, they were ordered to meet in a certain place, where the young men likewise assembled. They were then sold by the public crier: but he first sold the most beautiful one. When he had sold her at an immense price, he put up others to sale, according to their degrees of beauty. The rich Babylonians were emulous to carry off the finest women, who were sold to the highest bidders. But as the young men who were poor could not aspire to have fine women, they were content to take the ugliest with the money which was given them: for when the crier had sold the handsomest, he ordered the ugliest of all the women to be brought; and asked, if any one was willing to take her with a small sum of money. Thus she became the wife of him who was most easily satisfied: and thus the finest women were sold; and from the money which they brought, small fortunes were given to the ugliest, and to those who had any bodily infirmity. A father could not marry his daughter as he pleased; nor was he who bought her allowed to take her home, without giving security that he would marry her. But, after the sale, if the parties were not agreeable to each other, the law enjoined that the purchase-money should be restored. The inhabitants of any of their towns were permitted to marry wives at these auctions. Such were the early customs of the Babylonians.

"But they afterwards made a law, which prohibited the inhabitants of different towns to intermarry, and by which husbands were punished for treating their wives ill. When they had become poor by the ruin of their metropolis, fathers used to prostitute their daughters for gain. There was a sensible custom among the Babylonians, worthy to be related. They brought their sick into the forum, to consult those who passed on their diseases; for they had no physicians. They asked those who approached the sick, if they ever had the same distemper? If they knew any one who had it? and how he was cured? Hence, in this country, every one who saw a sick person was obliged to go to him and inquire into his distemper.

"They embalmed their dead with honey; and their mourning was like that of the Egyptians.

"There were three Babylonian tribes, who lived only upon fish, and who prepared them in the following manner: they dried them in the sun, and then beat them in a mortar to a kind of flour, which after they had sifted through linen, they baked it in rolls.

"The Babylonians at first worshipped only the sun and the moon; but they soon multiplied their divinities. They deified Baal, Bel, or Belus, one of their kings, and Merodach-Baladan. They also worshipped Venus, under the name of *Mylitta*. She and Belus were the principal deities of the Babylonians. They counted their day from sunrise to sunrise. They solemnized five days of the year with great magnificence, and almost the same ceremonies with which the Romans celebrated their Saturnalia.

"The Babylonians were very much addicted to judicial astrology. Their priests, who openly professed that art, were obliged to commit to writing all the events of the lives of their illustrious men; and on a fancied connection between those events and the motions of the heavenly bodies, the principles of their art were founded. They pretended that some of their books, in which their historical transactions and revolutions were accurately compared with the courses of the stars, were thousands of years old. This assertion of their judicial astrologers we may reasonably dispute; but that their astronomers had made a long series of observations, is incontestably true. It is certain that some of those observations were extant in the days of Aristotle, and that they were older than the empire of the Babylonians." See *History of* ASTRONOMY.

BABYLONIAN, BABYLONIUS, is used in some ancient writers for an astrologer, or any thing relating to astrology. Hence *Babylonia cura*, the art of casting nativities; and *numeri Babylonii*, the computation of astrologers.

BABYLONICA TEXTA, a rich sort of weavings, or hangings, denominated from the city Babylon, where the practice of interweaving divers colours in their hangings first obtained. Hence also Babylonic garments, Babylonic skins, Babylonic carpets, housings, &c. *Babylonica solana*, coverings laid over couches, &c. painted with gold, purple, and other colours.

BABYLONICS, BABYLONICA, in *Natural History*, a fragment of the ancient history of the world, ending at 267 years before Christ; and composed by Berosus, or Berossus, a priest of Babylon, about the time of Alexander. The Babylonics are sometimes also cited in ancient writers by the title of *Chaldaics*. They were very consonant with Scripture, as Josephus and the ancient Christian chronologers assure; whence the author is usually supposed to have consulted the Jewish writers. Berosus speaks of an universal deluge, an ark, &c. He reckons ten generations between the first man and the deluge; and marks the duration of the several generations by *sari*, or periods of 223 lunar months; which reduced to years, differ not much from the chronology of Moses.—The Babylonics consisted of three books, including the history of the ancient Babylonians, Medes, &c. But only a few imperfect extracts are now remaining of the work; preserved chiefly by Josephus and Syncellus, where all the passages of citations of ancient authors out of Berosus are collected with great exactness. Annius of Viterbo, to supply the loss, forged a complete Berosus out of his own head. The world has not thanked him for the imposture.

BABYROUSSA, in *Zoology*, a synonime of a species of sus. See SUS, MAMMALIA *Index*.

BAC, in *Navigation*, is used for a praam, or ferryboat.

BAC, in *Brewing*, a large flat kind of tub, or vessel, wherein the wort is put to stand and cool before boiling. The ingredients of beer pass through three kinds of vessels. They are masked in one, worked in another, and cooled in a third called *bacs* or *coolers*.

BAC, in *Distillery*, vessels into which the liquor to be

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be fermented is pumped from the cooler, in order to be worked with yeast.

Bac-Maker, is one who makes liquor-bacs, under-bacs, coolers, mash-tuns, working-tuns, &c. for the brewers. The workmanship is partly carpentry, in a particular manner, for it must be tight enough to hold liquor; and partly cooperage, viz. the mash-tun, or vat, which is hooped. There are not many of this trade; and it requires chiefly strength, with a little art. A small stock of stuff, besides tools, will set a man up tolerably well; but with 200l. or 300l. he will make a good figure in business.

BACA, or Baza, a town of Spain in the kingdom of Granada. W. Long. 3. 6. N. Lat. 37. 18. It is situated in a valley called *Hoya de Baza*. It is encompassed with old walls, and has a castle half ruined. It contains about 4000 houses, but has nothing remarkable except the church dedicated to the Virgin Mary. The land about it is well cultivated for half a league round, and is fertile in wheat, wine, honey, hemp, and flax, being watered by the little river Guadalantin.

BACACUM, a town of the Nervii in Gallia Belgica; now *Bavay*, in Hainault. E. Long. 3. 30. N. Lat. 50. 25.

BACAIM, a handsome sea-port town of the kingdom of Visapour, on the Malabar coast, in Asia. It is subject to the Portuguese; and stands in E. Long. 73. 10. N. Lat. 19. 0.

BACASERAY, a town in the peninsula of Crim Tartary, formerly considered as the capital of the country, the khan having had his residence there. E. Long. 35. 10. N. Lat. 45. 30.

BACANTIBI, in ecclesiastical antiquity, wandering clerks, who strolled from church to church.—The word seems formed by corruption from *vacantivi*.

BACCA, Berry, in *Botany*, is used to signify such fruits as consist of a pericarpium full of juice and seeds, without any valves.

BACCALARIA, in middle-age writers, denotes a kind of country-farms, consisting of several manses.

Baccalaria dominicaria, or *indominicata*, was more particularly used for a farm belonging to the lord, and kept in his own hands.

BACCARACH, a town of the Prussian states in the duchy of the Lower Rhine, containing 1250 inhabitants. It is famous for excellent wine; and is situated on the Rhine, in E. Long. 7. 5. N. Lat. 49. 57.

BACCHÆ, in antiquity, the priestesses of Bacchus, who celebrated the *orgia* or mysteries of that god.—The word was also used for the ivy crowns or garlands worn by the priests of Bacchus, in offering sacrifices to him.

BACCHANALIA, feasts celebrated in honour of Bacchus by the ancients. The two most remarkable were called the *greater* and *lesser*. The latter called *Lenæa*, from a word signifying a *wine press*, were held in the open fields about autumn; the greater, called *Dionysia*, from one of the names of Bacchus, were celebrated in the city, about the spring-time. Both these feasts were accompanied with games, spectacles, and theatrical representations; and it was at this time the poets contended for the prize of poetry. Those who were initiated into the celebration of these feasts, represented, some Silenus, others Pan, others Satyrs, and in this manner appeared in public, night and day, counterfeiting drunkenness, dancing obscenely, and committing all kinds of licentiousness and debauchery. See Bacchus.

BACCHARIS, Ploughman's Spikenard. See Botany *Index*.

BACCHI, in *Mechanics*, a kind of ancient machines, in form of goats, used by Jupiter, in his wars against the giants. Rudbeck describes two kinds of bacchi, one made like the battering-ram, wherewith Jupiter demolished the enemy's fortifications; the other contrived to cast fire out of, from whence the Greeks are conjectured to have framed their idea of the *chimera*.

BACCHIC, something relating to the ceremonies of Bacchus. The celebrated *intaglio*, called Michael Angelo's ring, is a representation of a Bacchic feast.

Bacchic song, is sometimes used for a *chanson à boire*, or composition to inspire jollity. But in a more proper sense it is restrained to a dithyrambic ode or hymn.

BACCHINI, Benedict, a Benedictine monk, and one of the most learned men in his time, was born at Borgo San Domino in 1651; and wrote a great number of books in Latin and Italian, the most considerable of which is a Literary Journal. He died at Bologna in 1721, aged 70.

BACCHIUS, a follower of Aristoxenus, supposed by Fabricius to have been tutor to the emperor Marcus Antoninus, and consequently to have lived about A. C. 140. He wrote in Greek a very short introduction to music, in dialogue, which, with a Latin translation thereof, Meibomius has published. It seems it was first published in the original by Mersennus, in his Commentary on the first six chapters of Genesis; and that afterwards he published a translation of it in French, which Meibomius in the preface to his edition of the ancient musical authors, censures as being grossly erroneous.

Bacchius, in ancient poetry, a kind of foot composed of a short syllable and two long ones; as the word [ăvārī]. It takes its name from the god Bacchus, because it frequently entered into the hymns composed in his honour. The Romans called it likewise *œnotrius*, *tripodius*, *saltans*.

BACCHUS, in *Heathen Mythology*, the god of wine, with whose fabulous adventures every school-boy is acquainted. This personage is seldom named in modern times but as a sensual encourager of feast and jollity; but he was regarded in a more respectable light by the ancients, who worshipped him in different countries under the following appellations: in Egypt, he was called *Osiris*; in Mysia, *Fanaces*; in India *Dionysius*; *Liber*, throughout the Roman dominions; *Adoneus*, in Arabia; and *Pentheus*, by the Lucanians. Mythologists furnish reasons for all these different names given to the same god, which may be seen in the second volume of Banier's Mythology.

It is natural to suppose that the Greeks and Romans, as usual, bestowed upon the one Bacchus which they worshipped, the several actions and attributes of the many divinities known by that name, and by other equivalent denominations, in different countries. However,

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Bacchus, Bacchylides.

ever, antiquity chiefly distinguished two gods under the title of *Bacchus;* that of Egypt, the son of Ammon, and the same as Osiris; and that of Thebes in Bœotia, the son of Jupiter and Semele.

The Egyptian Bacchus was brought up at Nysa, a city of Arabia Felix, whence he acquired the name of *Dionysius*, or the god of Nysa; and this was the conqueror of India. Though this Bacchus of the Egyptians was one of the elder gods of Egypt, yet the son of Semele was the youngest of the Grecian deities. Diodorus Siculus tells us, that Orpheus first deified the son of Semele by the name of Bacchus, and appointed his ceremonies in Greece, in order to render the family of Cadmus, the grandfather of the Grecian Bacchus, illustrious.

The great Bacchus, according to Sir Isaac Newton, flourished but one generation before the Argonautic expedition. This Bacchus, says Hermippus, was potent at sea, conquered eastward as far as India, returned in triumph, brought his army over the Hellespont, conquered Thrace, and left music, dancing, and poetry there. And, according to Diodorus Siculus, it was the son of Semele who invented farces and theatres, and who first established a music school, exempting from all military functions such musicians as discovered great abilities in their art; on which account, says the same author, musicians formed into companies have since frequently enjoyed great privileges.

Dr Burney* observes, that the dithyrambics which gave birth to dramatic representations, are as ancient as the worship of Bacchus in Greece; and there is little doubt but that the ceremonies of his mysteries gave rise to the pomp and illusions of the theatre. Many of the most splendid exhibitions upon the stage for the entertainment of the people of Athens and Rome, being performed upon the festivals of Bacchus, gave occasion to the calling all those that were employed in them, whether for singing, dancing, or reciting, *servants of Bacchus*.

* *History of Music*, p. 298. *et seq.*

Pausanias, in his Attics, speaks of a place at Athens consecrated to *Bacchus the singer;* thus named, he says, for the same reason as Apollo is called the *chief* and *conductor* of the muses. Whence it should seem that Bacchus was regarded by the Athenians not only as the god of wine, but of song; and it must be owned, that his followers, in their cups, have been much inclined to singing ever since. Indeed we are certain, that in none of the orgies, processions, triumphs, and festivals, instituted by the ancients to the honour and memory of this prince of *bons vivans*, music was forgotten, as may be still gathered from ancient sculpture, where we find not only that musicians, male and female, regaled him with the lyre, the flute, and with song; but that he was accompanied by fawns and satyrs playing upon timbrels, cymbals, bagpipes, and horns; these Suidas calls his minstrels; and Strabo gives them the appellations of *Bacchi*, *Sileni*, *Satyri*, *Bacchæ*, *Lenæ*, *Thyæ*, *Mamillones*, *Naiades*, *Nymphæ*, and *Tityri*. These representations have furnished subjects for the finest remains of ancient sculpture; and the most voluptuous passages of ancient poetry are descriptions of the orgies and festivals of Bacchus. See Orgia.

BACCHYLIDES, a famous Greek poet, was the nephew of Simonides, and the cotemporary and rival of Pindar. Both sung the victories of Hiero at the public games. Besides odes to athletic victors, he was author of Love Verses; Prosodies; Dithyrambics; Hymns; Pæans; Hyporchemes; Parthenia, or songs to be sung by a chorus of virgins at festivals. The chronology of Eusebius places the birth of Bacchylides in the 82d Olympiad, about 450 B. C.

Bacchylides || Bachelor.

BACCIO, or Baccius, Andrew, a celebrated physician of the 16th century, born at St Elpideo. He practised physic at Rome with great reputation, and was first physician to Pope Sixtus V. The most scarce and valuable of his works are, 1. *De Thermis*. 2. *De Naturali Vinorum Historia*. 3. *De Venenis et Antidotis*. 4. *De Gemmis ac Lapidibus Pretiosis*.

Baccio, *Fra. Bartolomeo*, called *Bartelemi di S. Marco*, a celebrated painter of history and portrait, was born at Savignano near Florence in 1469, and was a disciple of Cosumo Roselli; but his principal knowledge in the art of painting was derived from Leonardo da Vinci. He understood the true principles of design better than most masters of his time, and was also a considerable painter in perspective; which induced Raphael to have recourse to him after he had quitted the school of Perugino; and under his direction likewise Raphael studied the art of managing and uniting colours, as well as the rules of perspective. Some years after the departure of Raphael from Florence, Baccio visited Rome; and by the observations he made on the antiques, and the works of Raphael which were then the admiration of the whole world, he was extremely improved, and manifested his acquired abilities by a picture of S. Sebastian, which he finished at his return to Florence. It was so well designed, so naturally and beautifully coloured, and had so strong an expression of pain and agony, that it was removed from the place where it was publicly seen (in the chapel of a convent), as it had been observed to have made too strong an impression on the imaginations of many women who beheld it. He was very laborious, and made nature his perpetual study; he designed the naked correctly; his figures had a great deal of grace, and his colouring was admirable. He is accounted to have been the first inventor of that machine called a *layman* by the artists, and which to this day is in general use. Upon that he placed his draperies, to observe with greater exactness their natural and their more elegant folds. A capital picture of the ascension by Baccio, is in the Florentine collection. He died in 1517.

BACHELOR, or Batchelor, a common term for a man not married, or who is yet in a state of celibacy.—The Roman censors frequently imposed fines on old bachelors. Dion Halicarnasseus mentions an old constitution, by which all persons of full age were obliged to marry. But the most celebrated law of this kind, was that made under Augustus, called the *Lex Julia de Maritandis Ordinibus;* by which bachelors were made incapable of legacies or inheritances by will, unless from their near relations. This brought many to marry, according to Plutarch's observation, not so much for the sake of raising heirs to their own estates, as to make themselves capable of inheriting those of other men.—The rabbins maintain, that, by the laws of Moses, every body, except some few particulars, is obliged in conscience to marry at 20 years of age: this makes

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makes one of their 613 precepts. Hence those maxims so frequent among their casuists, that he who does not take the necessary measures to leave heirs behind him, is not a man, but ought to be reputed a homicide.—Lycurgus was not more favourable; by his laws, bachelors are branded with infamy, excluded from all offices civil and military, and even from the shows and public sports. At certain feasts they were forced to appear, to be exposed to the public derision, and led round the market place. At one of their feasts, the women led them in this condition to the altars, where they obliged them to make *amende honourable* to nature, accompanied with a number of blows and lashes with a rod at discretion. To complete the affront, they forced them to sing certain songs composed in their own derision. The Christian religion is more indulgent to the bachelor state: the ancient church recommended it as in some circumstances preferable to, and more perfect than, the matrimonial. In the canon law, we find injunctions on bachelors, when arrived at puberty, either to marry or to turn monks and profess chastity in earnest.—In England, there was a tax on bachelors, after 25 years of age, 12l. 10s. for a duke, a common person 1s. by 7 Will. III. 1695. In Britain, at present, they are taxed by an extra-duty on their servants. Every man of the age of 21 years and upwards, never having been married, who shall keep one male servant or more, shall pay 1l. 5s. for each above or in addition to the ordinary duties leviable for SERVANTS. Every man of the age of 21 years and upwards, never having been married, keeping one female servant, shall pay 2s. 6d. in addition to the former 2s 6d.; 5s. in addition for each, if he has two female servants; and 10s. in addition for each for three or more female servants.

BACHELOR, was anciently a denomination given to those who had attained to knighthood, but had not a number of vassals sufficient to have their banner carried before them in the field of battle; or if they were not of the order of bannerets, were not of age to display their own banner, but obliged to march to battle under another's banner. It was also a title given to young cavaliers, who having made their first campaign, received the military girdle accordingly. And it served to denominate him who had overcome another in a tournament the first time he ever engaged.—The word *bachelor*, in a military sense, is derived by Cujas from *buccelarius*, a kind of cavalry, anciently in great esteem. Du Cange deduces it from *baccalaria*, a kind of fees or farms, consisting of several pieces of ground, each whereof contained 12 acres, or as much as two oxen would plough; the possessors of which baccalaria were called *bachelors*. Caseneuve and Altaserra derive bachelor from *baculus*, or *bacillus*, "a staff," because the young cavaliers exercised themselves in fighting with staves. Martinius derives it from *baccalaureus*, i. e. *bacca laurea donatus*, in allusion to the ancient custom of crowning poets with laurel, *baccis lauri*, as was the case with Petrarch at Rome in 1341. Alciat and Vives are of the same opinion: nor is this etymology improbable.

Knights-BACHELORS, the most ancient, but the lowest orders of knights in England; known by the name of *knights* only. They are styled *knights-bachelors*, either (according to some) as denoting their degree, *quasi bas chevaliers*; or, according to others, because this title does not descend to their posterity.

The custom of the ancient Germans was to give their young men a shield and a lance in the great council: this was equivalent to the *toga virilis* of the Romans. Before this, they were not permitted to bear arms, but were accounted as part of the father's household; after it, as part of the public. Hence some derive the usage of knighting, which has prevailed all over the western world, since its reduction by colonies from those northern heroes. Knights are called in Latin *equites aurati; aurati*, from the gilt spurs they wore; and *equites*, because they always served on horseback; for it is observable, that almost all nations call their knights by some appellation derived from a horse. They are also called in our law *milites*, because they formed a part, or indeed the whole, of the royal army, in virtue of their feudal tenures; one condition of which was, that every one who held a knight's fee (which in Henry II.'s time amounted to 20l. per annum) was obliged to be knighted, and attend the king in his wars, or pay a fine for his non-compliance. The exertion of this prerogative, as an expedient to raise money in the reign of Charles I. gave great offence, though warranted by law and the recent example of Queen Elizabeth. At the Restoration, it was, together with all other military branches of the feudal law, abolished; and it now only exists as an honorary title; though, on account of its indiscriminate attainment, not very generally regarded. It is conferred indiscriminately upon gownsmen, burghers, and physicians, by the king's lightly touching the person, who is then kneeling, on the right shoulder with a drawn sword, and saying *Rise, Sir*. See the articles KNIGHT and NOBILITY.

BACHELORS, in a university sense, are persons that have attained to the baccalaureate, or who have taken the first degree in the liberal arts and sciences.

The degree of bachelor was first introduced in the 13th century by Pope Gregory IX. but it remains still unknown in Italy. At Oxford, before a person is entitled to the degree of *bachelor of arts*, he must have studied there four years; three years more to become master of arts; and seven more to commence bachelor of divinity.—At Cambridge, to commence bachelor of arts, he must have been admitted near four years; and above three years more before he commence master; and seven more still to become bachelor of divinity. He may commence bachelor of law after having studied it six years.—At Paris, to pass bachelor in theology, a person must have studied two years in philosophy and three years in theology, and held two acts of examination in the Sorbonne.—Bachelors in the canon law are admitted after two years study in the same, and sustaining an act according to the forms. A bachelor of physic must have studied two years in medicine, after having been four years master of arts in the university, and have stood an examination; after which he is invested with the fur, in order to be licensed.—In the university of Paris, before the foundation of divinity-professorships, those who had studied divinity six years were admitted to go through their course, whence they were called *baccalarii cursores*; and as there were two courses, the first employed in explaining the Bible during

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during three successive years, the second for explaining the master of the sentences for one year, those who were in their Bible-course were called *baccalarii Biblici*, and those arrived at the sentences *baccalarii sententiarii*. And, lastly, those who had gone through both were denominated *baccalarii formati*, or *formed bachelors*.

At present, *formed bachelor* denotes a person who has taken the degree regularly after the due course of study and exercises required by the statutes; by way of opposition to a *current bachelor*, who is admitted in the way of grace, or by diploma.

We also find mention of bachelors of the church, *baccalarii ecclesiæ*. The bishop with his canons and *baccalarii*, *cum consilio et consensu omnium canonicorum suorum et baccalariorum*.

BACHELORS, in the livery companies of London, are those not yet admitted to the livery. These companies generally consist of a master, two wardens, the livery, and the bachelors, who are yet but in expectation of dignity in the company, and have their function only in attendance on the master and wardens. They are also called *yeomen*.

BACHELOR is also a name given in the six companies of merchants at Paris to the elders, and such as, having served the offices, have a right to be called by the masters and wardens to be present with them, and assist them in some of the functions, particularly in what relates to the *chef-d'œuvres* or masterpieces of such as are candidates for being admitted masters.

BACHIAN, one of the Molucca islands, belonging to the Dutch; situated under the equator, in E. Long. 125°. It is the largest of all the small Molucca islands, being 54 miles long, and 20 broad. It produces gold dust and sago, besides the usual tropical fruits. The inhabitants are Malay Mahometans, and are governed by a chief who was once very powerful.

BACHU, a city of Shirvan in Persia, and the best haven in the Caspian sea. It is defended by a double wall, as also by a ditch and redoubts, made by the Russians when they were masters of the place. It had a sumptuous castle, but it is reduced to a ruinous state by the Russians. Formerly many merchants resided here, and carried on a considerable traffic in raw silk; but that commerce is now given up. All the country round is much impregnated with sulphur, which renders the water very unpleasant. The neighbourhood of this city supplies the countries adjacent with naphtha, brimstone, and rock-salt; and is the only place thereabouts which produces saffron. Round Bachu are several very steep craggy mountains, on which are strong watch-towers. E. Long. 49. 5. N. Lat. 40. 0.

BACK, BACK-*Bone*, or SPINE. See ANATOMY *Index*.

BACK, in the manege, and among farriers. A horse's back should be straight, not hollow, which is called *saddle-backed*: horses of this kind are generally light, and carry their heads high, but want in strength and service. A horse with a weak back is apt to stumble. In the French riding-schools, to mount a horse *à dos*, is to mount him bare-backed, without a saddle.

BACK-*Gammon*, an ingenious game played with dice, upon a table, by two persons.

Manner of playing the game. The table is divided into two parts, upon which there are 24 black and white spaces, called *points*. Each adversary has 15 men, black and white, to distinguish them; and they are disposed of in the following manner: Supposing the game to be played in the right-hand table, two are placed upon the ace-point in the adversary's table, five upon the six point in the opposite table, three upon the cinque point in the hithermost table, and five on the six point in the right-hand table. The grand object in this game is for each player to bring the men round into his right-hand table, by throwing with a pair of dice those throws that contribute towards it, and at the same time prevent the adversary doing the like. The first best throw upon the dice is esteemed aces, because it stops the six point in the outer table, and secures the cinque in the thrower's table; whereby the adversary's two men upon the thrower's ace point cannot get out with either quatre, cinque, or six. This throw is an advantage often given to the antagonist by the superior player.

When he carries his men home in order to lose no point, he is to carry the most distant man to his adversary's bar point, that being the first stage he is to place it on; the next stage is six points farther, viz. in the place where the adversary's five men are first placed out of his tables. He must go on in this method till all his men are brought home, except two, when by losing a point, he may often save the gammon, by throwing two fours or two fives.

When a hit is only played for, he should endeavour to gain either his own or adversary's cinque point; and if that fails by his being hit by the adversary, and he finds him forwarder than himself, in that case he must throw more men into the adversary's tables; which is done in this manner: He must put a man upon his cinque or bar point; and if the adversary neglects to hit it, he may then gain a forward game instead of a back game; but if the adversary hits him, he should play for a back game; and then the greater number of men which are taken up makes his game the better, because by these means he will preserve his game at home: and then he should endeavour to gain both his adversary's ace and trois points, or his ace and deuce points, and take care to keep three men upon the adversary's ace point, that in case he hits him from thence, that point may remain still secure to himself.

A back game should not be played for at the beginning of a set, because it would be a great disadvantage, the player running the risk of a gammon to win a single hit.

Rules for playing at setting out all the throws on the dice, when the player is to play for a gammon or for a single hit (A). 1. Two aces are to be played on the cinque

(A) The rules marked thus † are for a gammon only; those marked thus * are for a hit only.

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cinque point and bar point, for a gammon or for a hit. 2. Two sixes, to be played on the adversary's bar point and on the thrower's bar point, for a gammon or for a hit. 3. † Two trois, to be played on the cinque point, and the other two on the trois point in his own tables, for a gammon only. 4. † Two deuces, to be played on the quatre point in his own tables, and two to be brought over from the five men placed in the adversary's tables for a gammon only. 5. † Two fours, to be brought over from the five men placed in the adversary's table, and to be put upon the cinque point in his own tables for a gammon only. 6. Two fives, to be brought over from the five men placed in the adversary's tables, and to be put on the trois point in his own tables, for a gammon or for a hit. 7. Size ace, he must take his bar point for a gammon or for a hit. 8. Size deuce, a man to be brought from the five men placed in the adversary's tables, and to be placed in the cinque point in his own tables, for a gammon or for a hit. 9. Six and three, a man to be brought from the adversary's ace point, as far as he will go, for a gammon or for a hit. 10. Six and four, a man to be brought from the adversary's ace point, as far as he will go, for a gammon or for a hit. 11. Six and five, a man to be carried from the adversary's ace point, as far as he can go, for a gammon or for a hit. 12. Cinque and quatre, a man to be carried from the adversary's ace point, as far as he can go, for a gammon or for a hit. 13. Cinque trois, to make the trois point in his table, for a gammon or for a hit. 14. Cinque deuce, to play two men from the five placed in the adversary's tables, for a gammon or for a hit. 15. † Cinque ace, to bring one man from the five placed in the adversary's tables for the cinque, and to play one man down on the cinque point in his own tables for the ace, for a gammon only. 16. Quatre trois, two men to be brought from the five placed in the adversary's tables, for a gammon or for a hit. 17. Quatre deuce, to make the quatre point in his own tables, for a gammon or for a hit. 18. † Quatre ace, to play a man from the five placed in the adversary's tables for the quatre; and for the ace, to play a man down upon the cinque point in his own tables, for a gammon only. 19. † Trois deuce, two men to be brought from the five placed in the adversary's tables, for a gammon only. 20. Trois ace, to make the cinque point in his own tables, for a gammon or for a hit. 21. † Deuce ace, to play one man from the five men placed in the adversary's table for the deuce; and for the ace to play a man down upon the cinque point in his own tables, for a gammon only. 22. * Two trois, two of them to be played on the cinque point in his own tables, and with the other two he is to take the quatre point in the adversary's tables. 23. * Two deuces, two of them are to be played on the quatre point in his own tables, and with the other two he is to take the trois point in the adversary's tables. By playing these two cases in this manner, the player avoids being shut up in the adversary's tables, and has the chance of throwing out the tables to win the hit.

24. * Two fours, two of them are to take the adversary's cinque point in the adversary's tables, and for the other two, two men are to be brought from the five placed in the adversary's tables. 25. * Cinque ace, the cinque should be played from the five men placed in the adversary's tables, and the ace from the adversary's ace point. 26. * Quatre ace, the quatre to be played from the five men placed in the adversary's ace point. 27. * Deuce ace, the deuce to be played from the five men placed in the adversary's tables, and the ace from the adversary's ace point.

The three last chances are played in this manner; because an ace being laid down in the adversary's tables, there is a probability of throwing deuce ace, trois deuce, quatre trois, or size cinque, in two or three throws; either of which throws secures a point, and gives the player the best of the hit.

Cautions, &c. The player must understand by the directions given to play for a gammon, that he is to make some blots on purpose, the odds being in his favour that they are not hit: but if it should happen that any blot is hit, as in this case there will be three men in the adversary's tables, he must then endeavour to secure the adversary's cinque, quatre, or trois point, to prevent a gammon, and must be very cautious of his fourth man's not being taken up.

He must not crowd his game at any time if he can help it; that is to say, he should not put many men either upon the trois or deuce points in his own tables, being the same as losing those men, not having them in play. Besides, by crowding the game, and attempting to save a gammon, the player is often gammoned. His game being crowded in his own tables, the adversary has room to play as he thinks proper.

The following calculations will show the odds of entering a single man upon any certain number of points; and accordingly the game should be played.

It is necessary to know that there are thirty-six chances upon two dice, and the points that are upon these thirty-six chances are as follow:

Viz.	Points.
2 Aces	4
2 Deuces	8
2 Trois	12
2 Fours	16
2 Fives	20
2 Sixes	24
6 And 5 twice	22
6 And 4 twice	20
6 And 3 twice	18
6 And 2 twice	16
6 And 1 twice	14
5 And 4 twice	18
5 And 3 twice	16
5 And 2 twice	14
5 And 1 twice	12
4 And 3 twice	14
4 And 2 twice	12
4 And 1 twice	10
3 And 2 twice	10
3 And 1 twice	8
2 And 1 twice	6

Divide by 36)294(8
and it proves, that upon an average the player has a right to 8 points each throw — 288, remainder 6

The

Back-gammon.

The chances upon two dice calculated for back-gammon are as follow:

	2 Sixes	1
	2 Fives	1
	2 Fours	1
	2 Trois	1
	2 Deuces	1
†	2 Aces	1
	6 And 5 twice	2
	6 And 4 twice	2
	6 And 3 twice	2
	6 And 2 twice	2
†	6 And 1 twice	2
	5 And 4 twice	2
	5 And 3 twice	2
	5 And 2 twice	2
†	5 And 1 twice	2
	4 And 3 twice	2
	4 And 2 twice	2
†	4 And 1 twice	2
	3 And 2 twice	2
†	3 And 1 twice	2
†	2 And 1 twice	2
		36

As it may seem difficult to find out by this table of thirty-six chances what are the odds of being hit upon a certain or flat die, let the following method be pursued.

The player may observe in the table that what are thus † marked are,

†	2 Aces	1
†	6 And 1 twice	2
†	5 And 1 twice	2
†	4 And 1 twice	2
†	3 And 1 twice	2
†	2 And 1 twice	2
	Total,	11
	When deducted from	36
	There remains	25

So that it appears it is twenty-five to eleven against hitting an ace upon a certain or flat die.

The above method holds good with respect to any other flat die. For example what are the odds of entering a man upon 1, 2, 3, 4, or 5 points?

Answer.

To enter it upon	for against		for ag.
1 point is	11 to 25	Or about	4 to 9
2 points	20 - 16	-	5 4
3 -	27 - 9	-	3 1
4 -	32 - 4	-	8 1
5 -	35 - 1	-	35 1

The following table shows the odds of hitting with any chance, in the reach of a single die.

To hit upon	for against		for ag.
1 is -	11 to 25	Or about -	4 to 9
2 -	12 - 24	-	1 - 2
3 -	14 - 22	-	2 - 3
4 -	15 - 21	-	5 - 7
5 -	15 - 21	-	5 - 7
6 -	17 - 19	-	$8\frac{1}{2}$ $9\frac{1}{2}$

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The odds of hitting with double dice are as follow:

To hit upon	for against		for ag.
7 is -	6 to 30	Or about -	1 to 5
8 -	6 30	- -	1 5
9 -	5 31	- -	1 6
10 -	3 33	- -	1 11
11 -	2 34	- -	1 17
12 -	1 36	- -	1 35

How to find out the odds of being hit upon a six, by the table of thirty-six chances.

2 Sixes	1
2 Trois	1
2 Deuces	1
6 And 5 twice	2
6 And 4 twice	2
6 And 3 twice	2
6 And 2 twice	2
6 And 1 twice	2
5 And 1 twice	2
4 And 2 twice	2
	17
Which deducted from	36
There remains	19

By which it appears to be 19 to 17 against being hit upon a six.

The odds on the hits.

2 Love is about	5 to 2
2 to 1 is	2 1
1 Love is	3 2

Directions for the player to bear his men. If a player has taken up two of the adversary's men, and happens to have two, three, or more points made in his own tables, he should spread his men, that he either may take a new point in his tables, or be ready to hit the man which the adversary may happen to enter. If he finds upon the adversary's entering, that the game is upon a par, or that the advantage is on his own side, he should take the adversary's man up whenever he can, it being 25 to 11 that he is not hit: except when he is playing for a single hit only; then, if playing the throw otherwise gives him a better chance for it, he ought to do it.

It being five to one against his being hit with double dice, he should never be deterred from taking up any one man of the adversary's.

If he has taken up one of the adversary's men, and should happen to have five points in his own tables, and forced to leave a blot out of his tables, he should endeavour to leave it upon doublets preferable to any other chance, because in that case the odds are 35 to one that he is not hit; whereas it is only 17 to one but he is hit upon any other chance.

When the adversary is very forward, a player should never move a man from his own quarter, trois, or deuce points, thinking to bear that man from the point where he put it, as nothing but high doublets can give him any chance for the hit. Instead of playing an ace or a deuce from any of those points, he should play them from his own size or highest points, so that throwing two fives, or two fours, his size and cinque points being eased, would be a considerable advantage

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to him; whereas, had they been loaded, he must have been obliged to play otherwise.

It is the interest of the adversary to take up the player as soon as he enters. The blot should be left upon the adversary's lowest point; that is to say, upon his deuce point rather than upon his trois point; or upon his trois point rather than his quatre point, or upon his quatre point preferable to his cinque point, for a reason before mentioned; all the men the adversary plays upon his trois or his deuce points are deemed lost, being greatly out of play; so that those men not having it in their power to make his cinque point, and his game being crowded in one place, and open in another, the adversary must be greatly annoyed by the player.

If the player has two of the adversary's men in his tables, he has a better chance for a hit than if he had more, provided his game is forwarder than that of his antagonist; for if he had three or more of the adversary's men in his tables, he would stand a worse chance to be hit.

When a player is running to save the gammon, if he should have two men upon his ace point, and several men abroad, although he should lose one point or two in putting his men into his tables, it is his interest to leave a man upon the adversary's ace point, because it will prevent his adversary from bearing his men to the greatest advantage, and at the same time the player will have a chance of the adversary's making a blot, which he may chance to hit. However, if a player finds upon a throw, that he has a probability of saving his gammon, he should never wait for a blot, as the odds are greatly against his hitting it, but should embrace that opportunity.

How to calculate the odds of saving or winning the gammon. Suppose the adversary has so many men abroad as require three throws to put them into his tables, and at the same time that the player's tables are made up, and that he has taken up one of the adversary's men; in this case, it is about an equal wager that the adversary is gammoned. For in all probability the player has bore two men before he opens his tables, and when he bears the third man, he will be obliged to open his size or cinque point. It is then probable that the adversary is obliged to throw twice before he enters his men in the player's tables, twice more before he puts that man into his own tables and three throws more to put the men which are abroad into his own tables; in all seven throws. Now the player having 12 men to bear, he may be forced to make an ace or a deuce twice before he can bear all his men, and consequently will require seven throws in bearing them; so that, upon the whole, it is about equal whether the adversary is gammoned or not.

Suppose a player has three men upon his adversary's ace point and five points in his own tables, and that the adversary has all his men in his tables, three upon each of his five highest points. Has the player a probability of gammoning his adversary or not?

	Points.
For bearing three men from his 6th point is	18
From the 5th point	15
	33
Carried forwards	33
From his 4th point	12
From his 3d point	6
From his 2d point	9
In all	60
Bringing his three men from the adversary's ace point to his size point in his own tables, being 18 points each, and making together	54
There must remain	6

It is plain from this calculation, that the player has much the best of the probability of the gammon, exclusive of one or more blots which the adversary is liable to make in bearing his men, supposing at the same time the throws to be upon an equality.

Suppose two blots are left, either of which cannot be hit but by double dice; one must be hit by throwing eight and the other by throwing nine; so that the adversary has only one die to hit either of them. What are the odds of hitting either of them? The chances of two dice being in all 36

The chances to hit 8 or 6 and 2 twice	2
5 and 3 twice	2
2 Deuces	1
3 Fours	1
The chances to hit 9 or 6 and 3 twice	2
5 and 4 twice	2
2 Trois	1
For hitting in all	11
Chances for not hitting, remain	25

So that the odds are 25 to 11 against hitting either of these blots.

This method may be taken to find out the odds of hitting three, four, or five blots upon double dice; or blots made upon double and single dice at the same time. After knowing how many chances there are to hit any of these blots, they must be added all together, and then subtracted from the number 36, which are the chances of the two dice, and the question is solved.

A critical case for a Back-game. Suppose the foregame to be played by A, and that all his men are placed as usual; B has fourteen of his men placed upon his adversary's ace point, and one man upon his adversary's deuce point, and B is to throw. Who has the best of the hit?—*Answer*: A has the best of it, gold to silver: because, if B does not throw an ace to take his adversary's deuce point, which is 25 to 11 against him, A will take up B's men in his tables, either singly or to make points; and then if B secures either A's deuce or trois point, A will put as many men down as possible, in order to hit, and thereby get a back-game. It is evident that the back-game is very powerful; consequently, whoever practises it must become a greater proficient at the game than he could by any other means.

Another critical case. Suppose A to have five men placed upon his size point, as many upon his quatre point, and the same number upon his deuce point, all in his own tables. At the same time, let us suppose B to have three men placed upon A's ace point, as many

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many upon A's trois point, and the same number upon A's cinque point, in his own tables, and three men placed as usual out of his tables. Who has the best of the hit?—*Answer:* The game is equal till B has gained his cinque and quatre points in his own tables; which if he can effect, and by playing two men from A's cinque point, in order to force his adversary to blot by throwing an ace, which should B hit, he will have the best of the hit.

A case of curiosity and instruction: in which is shown the probability of making the hit last by one of the players for many hours, although they shall both play as fast as usual. Suppose B to have bore 13 men, and that A has his fifteen men in B's tables, viz. three men upon his size point, as many upon his cinque point, three upon his quatre point, the same number upon his trois point, two upon his deuce point, and one upon his ace point. A in this situation can prolong it, as aforesaid by bringing his 15 men home, always securing six close points till B has entered his two men, and brought them upon any certain point; as soon as B has gained that point, A will open an ace, deuce, or trois point, or all of them; which done, B hits one of them, and A taking care to have two or three men in B's tables, is ready to hit that man; and also he being certain of taking up the other man, has it in his power to prolong the hit almost to any length, provided he takes care not to open such points as two fours, two fives, or two sixes, but always to open the ace, deuce, or trois points, for B to hit him.

A critical game to play. Suppose A and B place their men for a hit in the following manner: A to have three men upon the size point in his own tables, three men out of his tables upon the usual point, and nine men upon his adversary's ace, deuce, and trois points: that is, three upon each: and suppose B's men to be placed in his own and his adversary's tables in the same order. So situated, the best player should win the hit. The game being so equal, that in this case the dice should be thrown for. Now if A throws first, he should endeavour to gain his adversary's cinque point: this being done, he should lay as many blots as possible, to tempt B to hit him, as it puts him backwards, and A thereby gains an advantage. A should always endeavour to have three men upon each of his adversary's ace and deuce points; because when B makes a blot, these points will remain secure, and when A has bore five, six, or more men, A yet may secure six close points out of his tables, in order to prevent B from getting his man home, at which time he should calculate who has the best of the hit. If he finds that B is foremost, he should then try to lay such blots as may be taken up by his adversary, that he may have a chance of taking up another man, in case B should happen to have a blot at home.

Laws of Back-gammon. 1. If a man is taken from any point, it must be played; if two men are taken from it, they also must be played. 2. A man is not supposed to be played till it is placed upon a point and quitted. 3. If a player has only fourteen men in play, there is no penalty inflicted, because by his playing with a lesser number than he is entitled to, he plays to a disadvantage for want of the deficient man to make up his tables. 4. If he bears any number of men before he has entered a man taken up, and which of course he was obliged to enter, such men so borne must be entered again in the adversary's tables as well as the man taken up. 5. If he has mistaken his throw and played it, and his adversary has thrown, it is not in the choice of either of the players to alter it, unless they both agree so to do.

Back-gammon, Back-painting.

Back-Painting, the method of painting mezzotinto prints, pasted on glass, with oil colours. See Mezzotinto.

The art consists chiefly in laying the print upon a piece of crown-glass, of such a size as fits the print.

In order to do this, take your print, and lay it in clean water for two days and two nights, if the print be on very strong, close, and hard gummed paper: but if upon an open, soft, spongy paper, two hours will sometimes suffice, or more, according as the paper is.

The paper or picture having been sufficiently soaked, take it out and lay it upon two sheets of paper, and cover it with two more; and let it lie there a little to suck out the moisture.

In the mean time take the glass the picture is to be put upon, and set it near the fire to warm; take Strasburg turpentine, warm it over the fire till it is grown fluid, then with a hog's hair brush spread the turpentine very smoothly and evenly on the glass.

When this has been done, take the mezzotinto print from between the papers, and lay it upon the glass; beginning first at one end, rubbing it down gently as you go on, till it lie close, and there be no wind bladders between.

Then, with your fingers, rub or roll off the paper from the backside of the print, till it looks black, i. e. till you can see nothing but the print like a thin film left upon the glass, and set it by to dry.

When it is dry, varnish it over with some white transparent varnish, that the print may be seen through it; and then it is fit for painting.

The utmost care will be necessary in rubbing or rolling the paper off the print, so as not to tear it, especially in the light parts.

You may, instead of soaking your prints two days and two nights, roll them up and boil them for about two hours, more or less, according to the quantity of the paper, in water; and that will render it as fit for rubbing, rolling, or peeling, as the other way.

This being done, and your oil-colours prepared, ground very fine, and tempered up very stiff, lay on the back side of the transparent prints such colours as each particular part requires; letting the master-lines of the print still guide your pencil, and so each particular colour will lie fair to the eye on the other side of the glass, and look almost as well as a painted piece, if it be done neatly.

The shadows of the print are generally sufficient for the shadow of every colour: but if you have a mind to give a shadow by your pencil, then let the shadows be laid on first, and the other colours afterward.

In laying on colours in this kind of back-painting, you need not be curious as to the laying them on smooth. This is not at all requisite here, where the chief aim is only to have the colours appear well on the fore side of the print; and therefore the only care to be be used in this work, is to lay the colours on thick enough, that its body may strike the colour of it plainly through the glass.

Back-Staff, a name formerly given to a sea-quadrant, invented by Captain Davis: because the back of the artist is turned towards the sun at the time of observation. See Quadrant.

Back-Stays, of a ship, are ropes belonging to the mainmast and foremast, and the masts belonging to them; serving to keep them from pitching forwards or overboard.

Back-Tack, in *Scots Law*: When a wadsetter, instead of possessing the wadset-lands, grants a tack thereof to the reverser for payment of a certain sum in name of tack-duty, that tack is called a *back tack*.

Back-Worm. See Filanders.

BACKER, or Bakker, Jaques, a painter of history, was born at Antwerp in 1530; and learned the principles of painting from his father, who was an artist very knowing in his profession, though his works were in no great estimation. After the death of his father, he lived in the house of Jacopo Palermo, a dealer in pictures, who avariciously took care to keep him incessantly employed, and sent his paintings to Paris to be disposed of, where they happened to be exceedingly admired. The judicious were very eager to purchase them; and though the transactor sold them at a great price, yet the poor artist was not proportionally rewarded, but continued in the same obscure and depressed condition. His merit, indeed, was universally allowed; but his name, and the narrowness of his circumstances, were as universally unknown. He had a clean light manner of penciling, and a tint of colour that was extremely agreeable.—He died in 1560.

Backer, or Bakker, *Jacob*, painter of portrait and history, was born at Harlingen in 1609, but spent the greatest part of his life at Amsterdam; and by all the writers on this subject, he is mentioned as an extraordinary painter, particularly of portraits, which he executed with strength, spirit, and a graceful resemblance. He was remarkable for an uncommon readiness of hand and freedom of pencil; and his incredible expedition in his manner of painting, appeared even in one portrait of a lady from Haerlem, that he painted at half length, which was begun and finished in one day, though he adorned the figure with rich drapery and several ornamental jewels. He also painted historical subjects with good success; and in that style there is a fine picture of Cimon and Iphigenia, which is accounted by the connoisseurs an excellent performance. In designing academy figures his expression was so just, and his outlines so correct, that he obtained the prize from all his competitors; and his works are still bought up at very high prices in the Low Countries. In the collection of the Elector Palatine there is an excellent head of Brouwer, painted by this master; and in the Carmelites church at Antwerp is preserved a capital picture of the Last Judgement, which is well designed and well coloured. He died in 1651.

BACKEREEL, called Bacquerelli, *William*, a painter of history, was born at Antwerp, and was a disciple of Rubens at the same time that Vandyck was educated in that school. When each of them quitted that master, and commenced painter, Backereel was very little inferior to Vandyck, if not nearly his equal. And this may be manifestly seen in the works of the former, which are in the church of the Augustine monks at Antwerp; where those two great artists painted in competition, and both were praised for their merit in their different ways; but the superiority was never determined in favour either of the one or the other. He had likewise a good taste for poetry; but, by exercising that talent too freely, in writing satires against the Jesuits, these ecclesiastics pursued him with unremitted revenge, till they compelled him to fly from Antwerp; and by that means deprived his own country of such paintings as would have contributed to its perpetual honour.—Sandrart takes notice, that in his time there were seven or eight painters, who were very eminent, of the name of Backereel, in Italy and the Low Countries.

BACKHUYSEN, Ludolph, an eminent painter, was born at Embden in 1631, and received his earliest instruction from Albert Van Everdingen; but acquired his principal knowledge by frequenting the painting rooms of different great masters, and observing their various methods of touching and colouring. One of these masters was Henry Dubbels, whose understanding in his art was very extensive: and he was as remarkably communicative of his knowledge to others. From him Backhuysen obtained more real benefit than from all the painters of his time, either by studying their works, or personally conversing with them. His subjects were sea-pieces, ships, and sea-ports. He had not practised very long when he became the object of general admiration; so that even his drawings were sought after, and several of them were bought up at 100 florins a-piece. It was observed of him, that while he was painting, he would not suffer even his most intimate friends to have access to him, lest his fancy might be disturbed, and the ideas he had formed in his mind be interrupted. He studied nature attentively in all her forms; in gales, calms, storms, clouds, rocks, skies, lights, and shadows; and he expressed every subject with so sweet a pencil, and such transparence and lustre, as placed him above all the artists of his time in that style, except the younger Vandervelde, who is deservedly esteemed the first in that manner of painting. It was a frequent custom with Backhuysen, whenever he could procure resolute mariners, to go to sea in a storm, in order to store his mind with grand images, directly copied from nature, of such scenes as would have filled any other head and heart with terror and dismay; and the moment he landed he always impatiently ran to his palette to secure those incidents, of which the traces might by delay be obliterated.—He perfectly understood the management of the chiaroscuro, and by his skill in that part of his art, he gave uncommon force and beauty to his objects. He observed strictly the art of perspective, in the distances of his vessels, the receding of the grounds on the shores, and the different buildings which he described in the sea-ports: whether they were the result of his own imagination, or sketched, as he usually did, after nature. His works may easily be distinguished by an observant eye, from the freedom and neatness of his touch; from the clearness and natural agitation or quiescence of the water; from a peculiar tint in his clouds and skies; and also from the exact proportions of

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of his ships, and the gracefulness of their position. For the burgomasters of Amsterdam he painted a large picture, with a multitude of vessels, and a view of the city at a distance, for which they gave him thirteen hundred guilders, and a considerable present; which picture they afterwards presented to the king of France, who placed it in the Louvre. No painter was ever more honoured by the visits of kings and princes than Backhuysen; the king of Prussia was one of the number; and the czar Peter the Great took delight to see him paint, and often endeavoured to draw after vessels which he had designed. He was remarkably assiduous, and yet it seems astonishing to consider the number of pictures which he finished, and the exquisite manner in which they are painted. He died in 1709.

BACKING, in *Horsemanship*. See HORSEMANSHIP.

Backing the Sails, in *Navigation*; to arrange them in a situation that will force the ship to retreat, or move backwards. This is, however, only done in narrow channels, when a ship is carried along sidewise by the tide or current, and wants to avoid any thing that may interrupt her progress, as shoals, vessels at anchor, &c. or in the line of battle, when a ship wants to be immediately opposite to another with which she is engaged.

BACKS, among dealers in leather, denote the thickest and best tanned hides, used chiefly for soles of shoes.

BACKS, in *Brewing* and *Distilling*. See BAC.

BACULARIUS, in writers of the middle age, an ecclesiastical apparitor, or verger; who carries a staff, *baculus*, in his hand, as an ensign of his office.

BACON, swines flesh salted, and dried in the chimney.—Old historians and law-writers speak of the *service of the bacon*, a custom in the manor of Whichenacre in Staffordshire, and priory of Dunmore in Essex; in the former of which places, by an ancient grant of the lord, a flitch of bacon, with half a quarter of wheat, was to be given to every married couple who could swear, that, having been married a year and a day, they would never within that time have once exchanged their mate for any other person on earth, however richer, fairer, or the like. But they were to bring two of their neighbours to swear with them that they believed they swore the truth. On this the lord of another neighbouring manor, of Rudlow, was to find a horse saddled, and a sack to carry the bounty in, with drums and trumpets, as far as a day's journey out of the manor: all the tenants of the manor being summoned to attend, and pay service to the bacon. The bacon of Dunmore, first erected under Henry III. was on much the same footing; only the tenor of the oath was, that the parties had never once repented, or wished themselves unmarried again.

BACON, *Roger*, a Franciscan friar of amazing genius and learning, was born near Ilchester in Somersetshire, in the year 1214. He began his studies at Oxford; but in what school or college is uncertain. Thence he removed to the university of Paris, which, in those times was esteemed the centre of literature. Here, we are told, he made so rapid a progress in the sciences, that he was esteemed the glory of that university, and was much caressed by several of his countrymen, particularly by Robert Grouthead, afterwards, bishop of Lincoln, his singular friend and patron. About the year 1240, he returned to Oxford; and assuming the Franciscan habit, prosecuted his favourite study of experimental philosophy with unremitting ardour and assiduity. In this pursuit, in experiments, instruments, and in scarce books, he tells us, he spent, in the space of 20 years, no less than 2000l.; which, it seems, was given him by some of the heads of the university, to enable him to prosecute his noble inquiries. But such extraordinary talents, and astonishing progress in sciences, which, in that ignorant age, were totally unknown to the rest of mankind, whilst they raised the admiration of the more intelligent few, could not fail to excite the envy and malice of his illiterate fraternity; who found no difficulty of possessing the vulgar with the notion of Bacon's dealing with the devil. Under this pretence, he was restrained from reading lectures; his writings were confined to his convent; and finally, in 1278, he himself was imprisoned in his cell. At this time he was 64 years of age. Nevertheless, being permitted the use of his books, he went on in the rational pursuit of knowledge, corrected his former labours, and wrote several curious pieces. When he had been ten years in confinement, Jerome de Ascoli being elected pope, Bacon solicited his holiness to be released; in which, it seems, he did not immediately succeed. However, towards the latter end of that pope's reign, he obtained his liberty, and spent the remainder of his life in the college of his order, where he died in the year 1294, in the 80th year of his age, and was buried in the Franciscan church. Such are the few particulars which the most diligent researches have been able to discover concerning this very great man; who, like a single bright star in a dark hemisphere, shone forth the glory of his country, and the pride of human nature. His works are, 1. *Epistola Fratris Rogeri Baconis de Secretis Operibus Artis et Naturæ, et de Nullitate Magiæ.* Paris, 1542, 4to. Basil, 1593, 8vo. 2. *Opus Majus.* Lond. 1733, folio, published by Dr Jebb. 3. *Thesaurus Chemicus*, Francf. 1603, 1620. This was probably the editor's title; but it contains several of our author's treatises on this subject. These printed works of Bacon contain a considerable number of essays, which, in the catalogue of his writings by Bale, Pits, &c. have been considered as distinct books; but there remain in different libraries several manuscripts not yet published. By an attentive perusal of his works, the reader will be astonished to find, that this great luminary of the 13th century was a great linguist and a skilful grammarian, that he was well versed in the theory and practice of perspective; that he understood the use of convex and concave glasses, and the art of making them; that the *camera obscura*, burning-glasses, and the power of the telescope were known to him; that he was well versed in geography and astronomy; that he knew the great error in the kalendar, assigned the cause, and proposed the remedy; that he understood chronology well; that he was an adept in chemistry, and was really the inventor of gun-powder; that he possessed great knowledge in the medical art; that he was an able mathematician, logician, metaphysician, and theologist.

BACON, *Sir Nicholas*, lord keeper of the great seal in the reign of Queen Elizabeth, was born at Chislehurst, in Kent, in 1510, and educated at the university

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ty of Cambridge; after which he travelled into France, and made some stay at Paris. On his return, he settled in Gray's Inn, and applied himself with such assiduity to the study of the law, that he quickly distinguished himself so, that on the dissolution of the monastery of St Edmund's Bury, in Suffolk, he had a grant from King Henry VIII. in the 36th year of his reign, of several manors. In the 38th of the same king, he was promoted to the office of attorney in the court of wards, which was a place both of honour and profit. In this office he was continued by King Edward VI.; and in 1552 he was elected treasurer of Gray's Inn. His great moderation and consummate prudence preserved him through the dangerous reign of Queen Mary. In the very dawn of that of Elizabeth he was knighted; and on the 22d of December 1558, the great seal of England, being taken from Nicholas Heath archbishop of York was delivered to him with the title of *lord keeper*, and he was also made one of the queen's privy council. He had a considerable share in the settling of religion: as a statesmen, he was remarkable for a clear head and deep counsels: but his great parts and high preferment were far from raising him in his own opinion, as appears from the modest answer he gave Queen Elizabeth, when she told him his house at Redgrave was too little for him: "Not so, madam, (returned he); but your majesty has made me too great for my house." After having had the great seal more than 20 years, this able statesman and faithful counsellor was suddenly removed from this life, as Mr Mallet informs us, by the following accident: he was under the hands of the barber, and thinking the weather warm, had ordered a window before him to be thrown open, but fell asleep as the current of fresh air was blowing in upon him, and awakened some time after distempered all over. He was immediately removed into his bed-chamber, where he died a few days after, on the 26th of February 1578-9, equally lamented by the queen and her subjects. He was buried in St Paul's, where a monument was erected to him, which was destroyed by the fire of London in 1666. Mr Granger observes, that he was the first lord keeper that ranked as lord chancellor; and that he had much of that penetrating genius, solidity, and judgement, persuasive eloquence, and comprehensive knowledge of law and equity, which afterwards shone forth with so great a lustre in his son, who was as much inferior to his father in point of prudence and integrity, as his father was to him in literary accomplishments.

Bacon, *Francis*, lord high chancellor of England under King James I. was son of Sir Nicholas Bacon lord keeper of the great seal in the reign of Queen Elizabeth, by Anne daughter of Sir Anthony Cook, eminent for her skill in the Latin and Greek tongues. He was born in 1560; and showed such marks of genius, that he was particularly taken notice of by Queen Elizabeth when very young. He was educated at Trinity College, Cambridge; and made such incredible progress in his studies, that, before he was 16, he had not only run through the whole circle of the liberal arts as they were then taught, but began to perceive those imperfections in the reigning philosophy, which he afterwards so effectually exposed, and thereby not only overturned that tyranny which prevented the progress of true knowledge, but laid the foundation of that free and useful philosophy which has since opened a way to so many glorious discoveries. On his leaving the university, his father sent him to France; where, before he was 19 years of age, he wrote a general view of the state of Europe: but Sir Nicholas dying, he was obliged suddenly to return to England; when he applied himself to the study of the common law, at Gray's Inn. At this period the famous earl of Essex, who could distinguish merit, and who passionately loved it, entered into an intimate friendship with him; zealously attempted, though without success, to procure him the office of queen's solicitor; and, in order to comfort his friend under the disappointment, conferred on him a present of land to the value of 1800l. Bacon, notwithstanding the friendship of so great a person; notwithstanding the number and power of his own relations; and, above all, notwithstanding the early prepossession of her majesty in his favour; met with many obstacles to his preferment during her reign. In particular, his enemies represented him as a speculative man, whose head was filled with philosophical notions, and therefore more likely to perplex than forward public business. It was not without great difficulty that lord treasurer Burleigh obtained for him the reversion of register to the star-chamber, worth about 1600l. a-year, which place fell to him about 20 years after. Neither did he obtain any other preferment all this reign; though if obedience to a sovereign in what must be the most disagreeable of all offices, viz. the casting reflections on a deceased friend, entitled him, he might have claimed it. The people were so clamorous even against the queen herself on the death of Essex, that it was thought necessary to vindicate the conduct of the administration. This was assigned to Bacon, which brought on him universal censure, nay his very life was threatened. Upon the accession of King James, he was soon raised to considerable honours; and wrote in favour of the union of the two kingdoms of Scotland and England, which the king so passionately desired. In 1616, he was sworn of the privy council. He then applied himself to the reducing and recomposing the laws of England. He distinguished himself, when attorney general, by his endeavours to restrain the customs of duels, then very frequent. In 1617, he was appointed lord keeper of the great seal. In 1618, he was made lord chancellor of England, and created lord Verulam. In the midst of these honours and applauses, and multiplicity of business, he forgot not his philosophy, but in 1620 published his great work entitled *Novum Organum*. We find by several letters of his, that he thought convening of parliaments was the best expedient for the king and people. In 1621 he was advanced to the dignity of Viscount St Albans, and appeared with the greatest splendour at the opening of the session of parliament. But he was soon after surprised with a melancholy reverse of fortune. For, about the 12th of March, a committee of the house of commons was appointed to inspect the abuses of the courts of justice. The first thing they fell upon was bribery and corruption, of which the lord chancellor was accused. For that very year complaints being made to the house of commons of his lordship's having received bribes, those complaints were sent up to the house of lords; and new ones being daily made of a like nature, things soon grew

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grew too high to be got over. The king found it was impossible to save both his chancellor, who was openly accused of corruption, and Buckingham his favourite, who was secretly and therefore more dangerously attacked as the encourager of whatever was deemed most illegal and oppressive: he therefore forced the former to abandon his defence, giving him positive advice to submit himself to his peers, and promising upon his princely word to screen him in the last determination, or, if that could not be, to reward him afterwards with an ample retribution of favour. The chancellor, though he foresaw his approaching ruin if he did not plead for himself, resolved to obey; and the house of peers, on the third of May 1621, gave judgement against him, "That he should be fined 40,000l. and remain prisoner in the Tower during the king's pleasure; that he should for ever be incapable of any office, place, or employment, in the state or commonwealth; and that he should never sit in parliament, or come within the verge of the court." The fault which, next to his ingratitude to Essex, thus tarnished the glory of this illustrious man, is said to have principally proceeded from his indulgence to his servants, who made a corrupt use of it. One day, during his trial, passing through a room where several of his domestics were sitting, upon their rising up to salute him, he said, "Sit down, my masters; your rise hath been my fall." *Stephens*, p. 54. And we are told by Rushworth, in his historical collections, "That he treasured up nothing for himself or family, but was over-indulgent to his servants, and connived at their takings, and their ways betrayed him to that error; they were profuse and expensive, and had at their command whatever he was master of. The gifts taken were for the most part for interlocutory orders; his decrees were generally made with so much equity, that though gifts rendered him suspected for injustice, yet never any decree made by him was reversed as unjust." It was peculiar to this great man (say the authors of the Biogr. Brit.) to have nothing narrow and selfish in his composition: he gave way without concern whatever he possessed; and believing other men of the same mould, he received with as little consideration. He retired, after a short imprisonment, from the engagements of an active life, to which he had been called much against his genius, to the shade of a contemplative one, which he had always loved. The king remitted his fine, and he was summoned to parliament in the first year of King Charles I. It appears from the works composed during his retirement, that his thoughts were still free, vigorous, and noble. The last five years of his life he devoted wholly to his studies. In his recess he composed the greatest part of his English and Latin works. He expired on the 9th of April 1626; and was buried in St Michael's church at St Alban's, according to the direction of his last will, where a monument of white marble was erected to him by Sir Thomas Meautys, formerly his secretary, and afterwards clerk of the privy council under two kings. A complete edition of this great man's works was published at London in the year 1740.—Addison has said of him, That he had the sound, distinct, comprehensive knowledge of Aristotle, with all the beautiful light graces and embellishments of Cicero. The honourable Mr Walpole calls him the *Prophet of Arts* which Newton was afterwards to reveal; and adds, that his genius and his works will be universally admired as long as science exists. "As long as ingratitude and adulation are despicable, so long shall we lament the depravity of this great man's heart. Alas! that he who could command immortal fame, should have stooped to the little ambition of power."

BACON, *Sir Nathaniel*, knight of the Bath, and an excellent painter, was a younger son of the lord keeper, and half brother to the great Sir Francis. He travelled into Italy, and studied painting there; but his manner and colouring approaches nearer to the style of the Flemish school. Mr Walpole observes, that at Culford, where he lived, are preserved some of his works; and at Gorhambury, his father's seat, is a large picture by him in oil, of a cook-maid with a dead fowl, admirably painted, with great nature, neatness, and lustre of colouring. In the same house is a whole length of him, by himself, drawing on a paper, his sword and pallet hung up, and a half length of his mother by him.

BACON, *John*, an eminent British sculptor. See SUPPLEMENT.

BACONTHORP, JOHN, called the *resolute doctor*, a learned monk, was born towards the end of the 13th century at Baconthorp, a village in Norfolk. He spent the early part of his life in the convent of Blackney, near Walsingham in the same county; whence he removed to Oxford, and from thence to Paris; where being distinguished for his learning, he obtained degrees in divinity and laws, and was esteemed the principal of the Averroists*. In 1329 he returned to England, and was immediately chosen twelfth provincial of the English Carmelites. In 1333 he was sent for to Rome; where, we are told, he first maintained the pope's sovereign authority in cases of divorce, but that he afterwards retracted his opinion. He died in London in the year 1346. Leland, Bale, and Pits, unanimously gave him the character of a monk of genius and learning. He wrote, 1. *Commentaria seu questiones super quatuor libros sententiarum*; and, 2. *Compendium legis Christi, et quodlibeta*; both which underwent several editions at Paris, Milan, and Cremona.

* See *Averroes*.

BACTRIA, or BACTRIANA, now *Chorassan* or *Khorasan*, an ancient kingdom of Asia, bounded on the west by Margiana, on the north by the river Oxus, on the south by Mount Paropismus, and on the east by the Asiatic Scythia and the country of the Massagetæ. It was a large, fruitful, and well-peopled country, containing according to Ammianus Marcellinus 1000 cities, though of these only a few are particularly mentioned by historians, of which that formerly called *Maracanda*, now *Samarcand*, is the most considerable.

Of the history of this country we know but little. Authors agree that it was subdued first by the Assyrians, afterwards by Cyrus, and then by Alexander the Great. Afterwards it remained subject to Seleucus Nicator and his successors till the time of Antiochus Theos; when Theodorus, from governor of that province, became king, and strengthened himself so effectually in his kingdom, while Antiochus was engaged in a war with Ptolemy Philadelphus king of Egypt, that he could never afterwards dispossess him of his acquisitions. His posterity continued to enjoy the king-

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dom for some time, till they were driven out by the Scythians, who reigned in Bactria at the time of Adrian, Antoninus Pius, &c. The Scythians were in their turn driven out by the Huns or Turks, and these often conquered by the Saracens and Tartars; nevertheless they continued in possession of this country in the time of Ladislaus IV. king of Hungary.

In early times the Bactrians differed little in their manners from the Nomades; and being near neighbours of the Scythians, who were a very warlike people, the Bactrian soldiers were reckoned the best in the world. Their appearance was very savage; being of an enormous stature, having a terrible aspect, rough beards, and long hair hanging down their shoulders. Some authors assert that they kept dogs on purpose to devour such as arrived at extreme old age, or who were exhausted by long sickness. They add, that for all their fierceness, the Bactrian husbands were such dupes to their wives, that they durst not complain of them even for conjugal infidelity, to which it seems the latter were very much addicted.

BACTROPERATA, an ancient appellation given to philosophers by way of contempt, denoting a man with a staff and a budget.

We suppose it is of the same people that Pauchasias Radbertus speaks under the corrupt name of *Bacoperitæ* or *Bacchionitæ*, whom he described as philosophers who had so great a contempt for all earthly things, that they kept nothing but a dish to drink out of; and that one of this order seeing a peasant scooping up the water in his hand, threw away his cup as a superfluity: which is nothing but the old story of Diogenes the Cynic.

BACCULE, in *Fortification*, a kind of portcullis, or gate, made like a pit-fall with a counterpoise, and supported by two great stakes. It is usually made before the corpade-guard, not far from the gate of a place.

BACULOMETRY, the art of measuring accessible or inaccessible heights, by the help of one or more baculi, staves, or rods. See GEOMETRY.

BACURIUS, or BATURIUS, king of the Iberians, a people on the side of the Caspian sea. One day being a-hunting, he lost sight of his company, through a great storm and sudden darkness; upon which he vowed to the God of his Christian slave, that if he were delivered he would worship him alone: the day breaking up immediately, he made good his promise, and became the apostle of his country.

BADAGSHAN, a very ancient city of Great Bukharia, in the province of Balkh, situated at the foot of those high mountains which separate Hindostan from Great Tartary. The city is exceedingly strong by its situation; and belongs to the khan of Proper Bukharia, who uses it as a kind of state-prison to secure those he is jealous of. The town is not large, but well built, and very populous. It stands on the north side of the river Amu, about 100 miles from its source, and is a great thoroughfare for the caravans travelling to Little Bukharia. The inhabitants are enriched by mines of gold, silver, and rubies, which are in the neighbourhood; and those who live at the foot of the mountains gather a great quantity of gold and silver dust brought down in the spring by torrents occasioned by the melting of the snow on the top.

BADAJOZ, a large and strong town, capital of Estremadura in Spain. It is seated on the river Guadiana, over which there is a fine bridge built by the Romans. On this bridge the Portuguese were defeated in 1661, by Don John of Austria. The population of Badajoz is computed at 14,500 inhabitants. It was taken by storm by the British under Lord Wellington, after a memorable conflict, on the 6th April 1812. W. Long. 7. 3. N. Lat. 38. 35.

BADELONA, a town of Catalonia in Spain, seated on the Mediterranean. Lord Peterborough landed here in 1704, when, with Charles then king of Spain, he laid siege to Barcelona, from which it is ten miles distant. E. Long. 2. 20. N. Lat. 41. 12.

BADEN, a district in Swisserland, has three cities, Baden, Keifers Stoul, and Klingnaw, besides a town that passes for a city, named *Zurzach*. It is one of the finest countries in Swisserland; and is watered with three navigable rivers, the Limmet, Russ, and Are. The land is fertile in corn and fruit, and there are places on the sides of the Limmet which produce wine. It maintains a communication between the cantons of Zurich and Berne, being seated between their north extremities. It extends on one side to the Are, as far as the place where it falls into the Rhine, and on the other side beyond the Rhine, where there are some villages which depend thereon. Most of the inhabitants are Papists. By the treaty of peace at the conclusion of the war which broke out in 1712 between the Protestant and Popish cantons, this country was yielded to the Protestant cantons of Zurich and Bern. The constitution of 1798 restored it for a time to its original independence; but on the reorganization of the cantons by Bonaparte in 1803, it was united to that of Argau. It contained at that time 46,381 inhabitants.

BADEN, the capital of the above district, is an agreeable city, moderately large, seated on the side of the Limmet, in a plain flanked by two high hills, between which the river runs. This city owes its rise to its baths, which were famous before the Christian era. Several monuments of antiquity have been found here from time to time, particularly in 1240. When they were opening the large spring of the baths, they found statues of several heathen gods, made of alabaster; Roman coins, made of bronze, of Augustus, Vespasian, Decius, &c.; and several medals of the Roman emperors, of gold, silver, copper, and bronze. There are two churches in Baden; one of which is collegiate, and makes a good appearance; the other is a monastery of the Capuchins, near the townhouse. This last building served formerly not only for the assemblies of their own council, but also for those of the cantons. The diet assembled in a handsome room made for that purpose; the deputies of Zurich sat at the bottom behind a table, as the most honourable place; the ambassadors of foreign powers were seated on one side to the right, and the deputies of the other cantons were ranged on each side the room. The bailiff of Baden resides in a castle at the end of a handsome wooden bridge, which is covered in. Before this castle there is a stone pillar, erected in honour of the emperor Trajan, who paved a road in this country 85 Italian miles in length. The inhabitants are rigid Roman Catholics, and formerly behaved in a most insolent manner to the Protestants, but they are now obliged by their masters to be more

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more submissive. The baths which are on each side of the river are a quarter of a league from the city. Joining to the small baths there is a village, and to the large a town which may pass for a second Baden. It is seated on a hill, of which the ascent is steep. There the baths are brought into inns and private houses, by means of pipes, which are about 60 in all. There are also public baths in the middle of the town, from a spring which rises in the street, where the poor bathe *gratis*, but they are exposed quite naked to all that pass by. All the baths are hot, and one to so great a degree as to scald the hand; and they are impregnated with a great deal of sulphur, with some alum and nitre. They are useful for drinking as well as bathing; and are said to cure all diseases from a cold cause, headaches, vertigoes, &c. They strengthen the senses, cure diseases of the breast and bowels, asthmas, and obstructions. They are peculiarly excellent for women's diseases. E. Long. 8. 25. N. Lat. 47. 27.

BADEN, formerly a margravate, now a grand duchy in Germany. It is bounded by Hesse Darmstadt and Bavaria on the north; by Wirtemburg, on the east; by Switzerland, on the south; and by the Rhine, which divides it from Alsace, on the west. It is about 170 miles in length, from north to south; but not above 30 or 40 in breadth; and contained, in 1816, 5800 square English miles, with 1,001,700 inhabitants. It was erected into a duchy in 1806, and was subsequently divided into ten circles. The French code was introduced in the time of Bonaparte, and is still in force, with some modifications. The public revenue of the duchy is estimated at 550,000l. sterling. The country is generally fertile, producing corn and wine. About two-thirds of the people are Lutherans, the other third are Calvinists. In 1819 the grand duke gave his subjects a representative constitution. The principal rivers are the Rhine, Neckar, Ems, and Wirmbs. Carlsruhe is the chief town, and seat of the government.

BADEN, the chief city of the margravate, contains 2000 inhabitants, and has a few manufactures of pottery, leather, soap, &c. The town is seated among hills, on rocky and uneven ground, which renders the streets inconvenient and crooked. It is famous for its baths, the springs of which are said to be above 300. Some of them are hot, and accounted to be very good in nervous cases. They partake of salt, alum, and sulphur. E. Long. 8. 15. N. Lat. 48. 50.

BADEN, a town of Germany, in the archduchy of Austria, seated on the Little Suechat, is a neat little walled town, standing in a plain not far from a ridge of hills which run out from the mountain Cetius. It is much frequented by the people of Vienna, and the neighbouring parts, on account of its baths. The springs supply two convenient baths within the town, five without the walls, and one beyond the river. They are good for distempers of the head, the gout, dropsy, and most chronic diseases. E. Long. 16. 10. N. Lat. 48. 0.

BADENOCH, the most easterly part of Inverness-shire, in Scotland, extending about 33 miles in length from east to west, and 27 from north-east to south-west where broadest. It has no considerable town, and is very barren and hilly, but abounds with deer, and other kinds of game.

BADEN-WEILLER, a town of Germany, belonging to the lower margravate of Baden. E. Long. 7. 50. N. Lat. 47. 55.

BADENS, FRANCIS, historical and portrait painter, was born at Antwerp in 1571; and the first rudiments of the art were communicated to him by his father, who was but an ordinary artist. However, he visited Rome, and several parts of Italy, and there formed a good taste of design, and a manner exceedingly pleasing. When he returned to his own country his merit procured for him great employment, and still greater reputation, and he was usually distinguished by the name of the Italian painter. His touch was light and spirited, and his colouring warm; and he had the honour of being the first who introduced a good taste of colouring among his countrymen. While his acknowledged merit was rewarded with every public testimony of esteem and applause, unhappily he received an account of the death of his brother, who had been assassinated on a journey; and the intelligence affected him so violently, that it occasioned his own death, to the inexpressible regret of every lover of the art, in 1603.

BADGE, in naval architecture, signifies a sort of ornament placed on the outside of small ships, very near the stern, containing either a window for the convenience of the cabin, or a representation of it. It is commonly decorated with marine figures, martial instruments, or such like emblems.

BADGER, in *Zoology*, the English name of a species of ursus. See URSUS.

BADGER, in old law-books, one that was licensed to buy corn in one place and carry it to another to sell, without incurring the punishment of an engrosser.

BADIA, an ancient town of Bætica, on the Anas; now supposed to be Badajoz on the Guadiana.

BADIAGA, in the *Materia Medica*, the name of a sort of spongy plant, common in the shops in Moscow, and some other northern kingdoms. The use of it is the taking away of livid marks from blows and bruises, which the powder of this plant is said to do in a night's time.

BADIANE, or BANDIAN, the seed of a tree which grows in China, and smells like anise-seed. The Chinese, and the Dutch in imitation of them, sometimes use the badiane to give their tea an aromatic taste.

BADIGEON, a mixture of plaster and free-stone, well ground together, and sifted; used by statuaries to fill up the little holes, and repair the defects in stones, whereof they make their statues and other work.

The same term is also used by joiners for saw-dust mixed with strong glue, wherewith they fill up the chaps and other defects in wood after it is wrought.

BADILE, ANTONIA, history and portrait painter, was born at Verona in 1480, and by great study and application acquired a more extensive knowledge of the true principles of painting than any of his predecessors. He was confessedly a most eminent artist; but he derived greater honour from having two such disciples as Paolo Veronese and Baptista Zelotti, than he did even from the excellence of his own compositions. He died in 1560. His colouring was admirably good; his carnations beautiful; and his portraits preserved the perfect resemblance of flesh and real life: nor had he any cause to envy the acknowledged merit

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merit of Titian, Giorgione, or the best of his cotemporaries.

BADIS, a fortress of Livonia, subject to Russia. E. Long. 23. 10. N. Lat. 59. 15.

BADIUS, Conrad, and Stephen Robert, his brother; French refugees; celebrated as printers at Geneva, and Conrad as an author. The latter died in 1566.

BÆCKEA. See Botany *Index*.

BÆTERRÆ, an ancient town of the Tectosages in Gallia Narbonensis; now *Besiers*, on the east bank of the Obris, now *Orbis* or *Orbe*, in Lower Languedoc.

BÆTICA, a province of ancient Spain, so called from the famed river Bætis, afterwards *Tartessus*, now *Guadalquiver*, or the great river. It was bounded on the west by Lusitania; on the south, by the Mediterranean, and Sinus Gaditanus: on the north by the Cantabric sea, now the bay of Biscay. On the east and north-east, its limits cannot be so well ascertained, as they are very reasonably thought to have been in a continual state of fluctuation, as each petty monarch had an opportunity of encroaching upon his neighbour. The province was divided in two by the river Bætis already mentioned. On the one side of which, towards the Anas, were situated the Turdetani, from whence the kingdom was called *Turdetania*, though more generally known by the name of *Bæturia*. On the other side were situated the Bastuli, Batestani, and Contestani, along the Mediterranean coasts. The Bastuli were supposed to be of Phœnician extraction, and dwelt along the coasts of the Mediterranean, till, driven from thence by the Moors, they fled into the mountainous parts of Galicia, which they then called from their own name *Bastulia*. The Batestani were seated higher up, on the same coasts. The teritories of both these made part of what has since become the kingdom of *Granada*; in which there is a ridge of very high mountains, called from the above-mentioned people, the *Batestanian mountains*. Mention is also made of their capital Batestana; a place of such strength, that King Ferdinand was six months besieging it before he could take it from the Moors. The whole province of Bætica, according to the most probable account, contained what is now called *Andalusia*, part of the kingdom of Granada, and the outward boundaries of Estremadura.

BÆTIS. See Bætica.

BÆTULO, a town of ancient Spain in the Tarraconensis; now *Badelona* in Catalonia.

BÆTYLIA, anointed stones, worshipped by the Phœnicians, by the Greeks before the time of Cecrops, and by other barbarous nations. They were commonly of a black colour, and consecrated to some god, as Saturn, Jupiter, the Sun, &c. Some are of opinion that the true original of these idols is to be derived from the pillar of stone which Jacob erected at Bethel, and which was afterwards worshipped by the Jews.

These *bætylia* were much the object of the veneration of the ancient heathens. Many of their idols were no other. In reality, no sort of idol was more common in the eastern countries, than that of oblong stones erected, and hence termed by the Greeks, κιονες, *pillars*. In some parts of Egypt they were planted on both sides of the highways. In the temple of Heliogabalus, in Syria, there was one pretended to have fallen from heaven. There was also a famous black stone in Phrygia, said to have fallen from heaven. The Romans sent for it and the priests belonging to it with much ceremony, Scipio Nasica being at the head of the embassy.

BÆZA, a city of Andalusia in Spain, seated on a high hill three miles from the Guadalquiver; it is the see of a bishop, and has a kind of university founded by John d'Avila. It was taken from the Moors about the end of the 15th century. E. Long. 3. 15. N. Lat. 37. 45.

BAFFETAS, or Bastas, a cloth made of coarse white cotton thread, which comes from the East Indies. That of Surat is the best.

BAFFIN's bay, a gulf of North America, running north-east from Cape Farewell in West Greenland, from 6° to 8° of north latitude.

BAFFO, a considerable town in the island of Cyprus, with a fort built near ancient Paphos, of which some considerable ruins yet remain, particularly some broken columns, which probably belonged to the temple of Venus. E. Long. 32. 20. N. Lat. 34. 50.

BAG, in commerce, a term signifying a certain quantity of some particular commodity: a bag of almonds, for instance, is about 300 weight; of aniseseeds, from 300 to 400, &c.

Bags, are used in most countries to put several sorts of coin, either of gold, silver, brass or copper. Bankers, and others, who deal much in current cash, label their bags of money, by tying a ticket or note at the mouth of the bag, signifying the coin therein contained, the sum total, its weight, and of whom it was received. Tare is allowed for the bag.

Bag, among farriers, is when, in order to retrieve a horse's lost appetite, they put in an ounce of asafœtida, and as much powder of savin, into a bag, to be tied to the bit, keeping him bridled for two hours, several times a-day; as soon as the bag is taken off he will fall to eating. The same bag will serve a long time.

BAGAMADER, or Bagamedri, a province of the kingdom of Abyssinia in Africa. It is said to receive its name from the great number of sheep bred in it; *meder* signifying land or earth, and *bag* a sheep. Its length is estimated about 60 leagues, and its breadth 20: but formerly it was much more extensive; several of its provinces having been dismembered from it, and joined to that of Tigre. A great part of it, especially towards the east, is inhabited by wandering Gallas and Caffres.

BAGAUDÆ, or Bacaudæ, an ancient faction of peasants, or malecontents, who ravaged Gaul. The Gauls being oppressed with taxes, rose about the year of Christ 290, under the command of Amand and Elian; and assumed the name *bagaudæ*, which, according to some authors, signified in the Gallic language *forced rebels;* according to others, *tribute;* according to others, *robbers;* which last signification others allow the word had, but then it was only after the time of the *bagaudæ*, and doubtless took its rise from them.

BAGDAD, a celebrated city of Asia in Irak Arabia, seated on the eastern banks of the Tigris, in E. Long. 44. 10. N. Lat. 33. 15. By many authors this city is very

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Bagdad. very improperly called *Babylon*. The latter stood on the Euphrates at a considerable distance.

This city, for many years the capital of the Saracen empire, was founded by the caliph Al Mansur, the second of the house of Al Abbas, after an attempt by the Rawandians to assassinate him, as already mentioned. See ARABIA, N° 184.

1 Why the city was built. The reasons assigned by the Arabian historians for building the city of Bagdad are, That the above-mentioned attempt to assassinate the caliph had disgusted him at his Arabian subjects in general, and that the spot where Bagdad stood was at a considerable distance from the city of Cufa particularly; the inhabitants of which were remarkable for their treachery and inconstancy, Al Mansur himself having felt several instances of it. Besides, the people of Irac, who had always continued faithful to him, represented, that by building his capital near the confluence of the Euphrates and Tigris, it would be in a great measure secured from the insults and attacks of those who should have an inclination to dispute the caliphate with him; and that by being situated as it were in the middle of the tract comprehending the districts of Basrah, Cufa, Waset, Mawsel, and Swada, at no great distance from these cities, it would be plentifully supplied with provisions by means of the aforesaid rivers.

2 Ancient city described. Concerning the origin of the name *Bagdad*, there are various accounts, which, being equally uncertain and trifling, merit no attention. The first city that went by this name was situated on the western bank of the Tigris; from whence Al Mansur despatched his son Al Mohdi with a body of Moslem troops to the opposite bank. Here the young prince took post, and fortified the place on which he had encamped with a wall, in order to cover his troops, as well as the workmen employed by his father on the other side of the river, from the incursions of the Persians, who seemed to have taken umbrage at the erection of a new metropolis so near the frontiers of their dominions. Hence that part of the city soon after built on the eastern banks of the Tigris, received the name of the *Camp* or *Fortress of Al Mohdi*. The caliph had a superb and magnificent palace both in the eastern and western part of the town. The eastern palace was surrounded on the land side by a semicircular wall that had six gates; the principal of which seems to have been called *the gate of prefects*, whose entrance was generally kissed by the princes and ambassadors that came to the caliph's court. The western part of the city was entirely round, with the caliph's palace in the centre, and having the great mosque annexed to it. The eastern part consisted of an interior and exterior town, each of which was surrounded by a wall. For some time the building of the city went but slowly on, owing to a scarcity of materials for building; for which reason the caliph was sometimes inclined to remove the materials of Al Madayen, the ancient metropolis of the Persian empire. But, upon trial, he found the stones to be of such immense size, that the removal of them to Bagdad would be attended with great difficulty and expence; besides, he considered that it would be a reflection upon himself to have it said that he could not finish his metropolis without destroying such a pile of building, as perhaps could not be paralleled in the whole world; for which reasons he at length gave over his design, and erected the city of Bagdad most probably out of the ruins of the ancient cities of Seleucia and Ctesiphon, putting an end to his undertaking in the 149th year of the Hegira, or four years after the city was begun.

From the building of the city of Bagdad to the death of Al Mansur nothing very remarkable happened, excepting some irruptions made into the territories of the Greeks, and by the Arabs into some of the caliph's other territories. In the 157th year of the Hegira also, a grievous famine was felt in Mesopotamia, which was quickly after followed by a plague that destroyed great numbers. This year likewise, the Christians, who had been all along very severely dealt with by Al Mansur, were treated with the utmost rigour by Musa Ebn Mosaab the caliph's governor; every one who was unable to pay the enormous tribute exacted of them being thrown into prison without distinction.

3 Death of Al Mansur. The next year, being the 158th of the Hegira, the caliph set out from Bagdad, in order to perform the pilgrimage to Mecca: but, being taken ill on the road, he expired at Bir Maimun, whence his body was carried to Mecca; where, after a hundred graves had been dug, that his sepulchre might be concealed, he was interred, having lived according to some 63, according to others 68 years, and reigned 22. He is said to have been extremely covetous, and to have left in his treasury 600,000,000 dirhems, and 24,000,000 dinars. He is reported to have paid his cook by assigning him the heads and legs of the animals dressed in his kitchen, and to have obliged him to procure at his own expence all the fuel and vessels he had occasion for.

4 Succeeded by Al Mohdi. When Al Mansur expired at Bir Maimun, he had only his domestics and Rabi his freedman with him. The latter of these, for some time, kept his death concealed, and pretended to have a conference with him, in which, as he gave out, the caliph commanded him to exact an oath of allegiance to Al Mohdi his son, as his immediate successor, and to Isa Ebn Musa his cousin-german, as the next apparent heir to the crown. He then despatched a courier to Bagdad with the news of Al Mansur's death; upon which Al Mohdi was unanimously proclaimed caliph. Isa Ebn Musa, however, no sooner heard this news, than he began to entertain thoughts of setting up for himself at Cufa, where he then resided; and in order to facilitate the execution of his scheme, fortified himself in that city. But Al Mohdi being apprised of his defection, sent a detachment of 1000 horse to bring him to Bagdad; which being done, Al Mohdi not only prevailed upon him to own his allegiance to him, but also to give up his right to the succession for 10,000 according to some, or according to others for 10,000,000 dinars.

5 Rebellion of Al Mokanna. From the accession of Al Mohdi to the 164th year of the Hegira, the most remarkable event was the rebellion of Al Mokanna. This impious impostor, whose true name was *Hakem Ebn Hesham*, came originally from Khorasan, and had been an under secretary to Abu Moslem governor of that province. He afterwards turned soldier, and passed thence into Mawaralnahr, where he gave himself out for a prophet. The name of Al Mokanna, as also that of Al Borkai, that is, the *veiled*, he took from his custom of covering his face with a veil or girdle mask, to conceal his deformity; he having lost an eye in the wars, and being otherwise

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Bagdad. otherwise of a despicable appearance; though his followers pretended he did this for the same reason that Moses did, viz. lest the splendour of his countenance should dazzle the eyes of his beholders. In some places he made a great many proselytes, deluding the people with a number of juggling tricks which they swallowed as miracles, and particularly by causing the appearance of a moon to rise out of a well for many nights together; whence he was also called in the Persian tongue, *Sazendeh mak*, or the *moon-maker*. This wretch, not content with being reckoned a prophet, arrogated to himself divine honours; pretending that the Deity resided in his person, having proceeded to him from Abu Moslem, in whom he had taken up his residence before. At last this impostor raised an open rebellion against the caliph, and made himself master of several fortified places in Khorasan, so that Al Mohdi was obliged to send one of his generals with an army against him. Upon the approach of the caliph's troops, Al Mokanna retired into one of his strong fortresses which he had well provided for a siege; and sent his emissaries abroad to persuade the people that he raised the dead to life, and foretold future events.

6 Dreadful catastrophe of him and all his family.

But being closely besieged by the caliph's forces, and seeing no possibility of escaping, he gave poison in wine to his whole family and all that were with him, in the castle; when they were dead, he burnt their bodies, together with all their furniture, provisions, and cattle; and lastly, he threw himslf into the flames, or, as others say, into a tub of aquafortis, or some other preparation, which consumed every part of him except the hair. When the besiegers therefore entered the place, they found no living creature in it, except one of Al Mokanna's concubines, who, suspecting his design, had hid herself, and now discovered the whole matter. This terrible contrivance, however, failed not to produce the desired effect. He had promised his followers, that his soul should transmigrate into the form of an old man riding on a grayish-coloured beast, and that after so many years he would return and give them the earth for their possession; which ridiculous expectation kept the sect in being for several years.

7 Harun Al Raschid's success against the Greeks.

All this time war had been carried on with the Greeks, but without any remarkable success on either side. In the 164th year of the Hegira, however, Al Mohdi ordered his son Harun Al Raschid to penetrate into the Greek territories with an army of 95,000 men. Harun, then, having entered the dominions of the empress Irene, defeated one of her commanders that advanced against him; after which he laid waste several of the imperial provinces with fire and sword, and even threatened the city of Constantinople itself. By this the empress was so terrified, that she purchased a peace with the caliph by paying him an annual tribute of 70,000 pieces of gold; which, for the present at least, delivered her from the depredations of these barbarians.

8 Unaccountable darkness.

After the signing of the treaty, Harun returned home laden with spoils and glory. This year, according to some of the oriental historians, the sun one day, a little after his rising, totally lost his light in a moment, without being eclipsed, when neither any fog nor any cloud of dust appeared to obscure him. This frightful darkness continued till noon, to the great astonishment of the people settled in the countries where it happened.

9 Al Mohdi poisoned;

In the 169th year of the Hegira, Al Mohdi was poisoned, though undesignedly, by one of his concubines named *Hasanah*. She had designed to destroy one of her rivals whom she imagined to have too great an ascendant over the caliph, by giving her a poisoned pear. This the latter, not suspecting any thing, gave to the caliph; who had no sooner eaten it than he felt himself in exquisite torture, and soon after expired.

10 as likewise his successor Al Hadi.

On the death of Al Mohdi, he was succeeded by his eldest son Al Hadi; who having formed a design to deprive his younger brother Harun Al Raschid of his right of succession, and even to assassinate him, was poisoned by his vizier in the 170th year of the Hegira; and on his death the celebrated caliph Harun Al Raschid ascended the throne.

11 Harun Al Raschid caliph.

This was one of the best and wisest princes that ever sat on the throne of Bagdad. He was also extremely fortunate in all his undertakings, though he did not much extend his dominions by conquest. In his time the Moslem empire may be said to have been in its most flourishing state, though by the independency of the Moslems in Spain, who had formerly set up a caliph of the house of Ommiyah, his territories were not quite so extensive as those of some of his predecessors.

12 Extent of his empire.

He possessed the provinces of Syria, Palestine, Arabia, Persia, Armenia, Natolia, Media or *Aderbijan*, Babylonia, Assyria, Sindia, Sijistan, Khorasan, Tabrestan, Jorjan, Zablestan or *Sablestan*, Mawaralnahr or *Great Bukharia*, Egypt, Libya, Mauritania, &c.; so that his empire was by far the most powerful of any in the world, and extended farther than the Roman empire ever had done.

13 He finds a ring he had thrown into the Tigris.

The first instance of Harun's good fortune, and which was taken for a presage of a prosperous and happy reign, was his finding a valuable ring which he had thrown into the Tigris to avoid being deprived of it by his brother Al Hadi. He was able to give the divers no other direction than by throwing a stone from the bridge of Bagdad, about the same place of the river in which he had thrown the ring; notwithstanding which, they found it without any great difficulty.

14 Divides the empire among his sons, and settles the succession.

In the 186th year of the Hegira, beginning January 10. 802, the caliph divided the government of his extensive dominions among his three sons, in the following manner: To Al Amin the eldest, he assigned the provinces of Syria, Irak, the three Arabias, Mesopotamia, Assyria, Media, Palestine, Egypt, and all that part of Africa extending from the confines of Egypt and Ethiopia to the straits of Gibraltar, with the dignity of caliph; to Al Mamun the second, he assigned Persia, Kerman, the Indies, Khorasan, Tabrestan, Cablestan, and Zablestan, together with the vast province of Mawaralnahr; and to his third son Al Kasem, he gave Armenia, Natolia, Jorjan, Georgia, Circassia, and all the Moslem territories bordering upon the Euxine sea. As to the order of succession, Al Amin was to ascend the throne immediately after his father's decease; after him, Al Mamun; and then Al Kasem, whom he had surnamed *Al Mutaman*.

The most considerable exploits performed by this caliph

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Bagdad.

15 His successful wars with the Greeks.

caliph were against the Greeks, who by their perfidy provoked him to make war upon them, and whom he always overcame. In the 187th year of the Hegira, the caliph received a letter from the Greek emperor Nicephorus, soon after he had been advanced to the imperial dignity, commanding him to return all the money he had extorted from the empress Irene, though that had been secured to him by the last treaty concluded with that princess, or expect soon to see an imperial army in the heart of his territories. This insolent letter so exasperated Harun, that he immediately assembled his forces and advanced to Heraclea, laying the country through which he passed waste with fire and sword. For some time also he kept that city straitly besieged; which so terrified the Greek emperor, that he submitted to pay an annual tribute. Upon this Harun granted him a peace, and returned with his army. But a hard frost soon after happening in these parts, Nicephorus took for granted that Al Rashid would not pay him another visit, and therefore broke the treaty he had concluded. Of this the caliph receiving advice, he instantly put himself in motion; and, notwithstanding the inclemency of the weather, forced the emperor to accept of the terms proposed. According to a Persian historian, before the hostilities at this time commenced, Nicephorus made the caliph a present of several fine swords, giving him thereby plainly to understand that he was more inclinable to come to blows than to make peace with him. All these swords Harun cut asunder with his famous sword *Samsamah*, as if they had been so many radishes, after which severe proof there did not appear the least flaw in the blade; a clear proof of the goodness of the sword, as the cutting the others with it was of the strength of Harun's arm. This sword had fallen into Al Rashid's hands among the spoils of Ebn Dakikan, one of the last Hamyaritic princes of Yaman; but is said to have belonged originally to a valiant Arab named *Amru Ebn Maadi Carb*, by whose name it generally went among the Moslems. This man is said to have performed very extraordinary feats with his sword, which induced a certain prince to borrow it from him; but he not being able to perform any thing remarkable with it, complained to Amru that it had not the desired effect: upon which that brave man took the liberty to tell him, that he had not sent him his arm along with his sword.

In the 188th year of the Hegira, war was renewed with the Greeks, and Nicephorus with a great army attacked the caliph's forces with the utmost fury. He was, however, defeated with the loss of 40,000 men, and received three wounds in the action; after which the Moslems committed terrible ravages in his territories, and returned home laden with spoils. The next year Harun invaded Phrygia; defeated an imperial army sent to oppose him; and having ravaged the country, returned without any considerable loss. In the 190th year of the Hegira, commencing November 27. 805, the caliph marched into the imperial territories with an army of 135,000 men, besides a great number of volunteers and others who were not enrolled among his troops. He first took the city of Heraclea, from whence he is said to have carried 16,000 prisoners; after which he made himself master of several other places: and in the conclusion of the expedition, he made a descent on the island of Cyprus, which he plundered in a terrible manner. This success so intimidated Nicephorus, that he immediately sent the tribute due to Harun, the withholding of which had been the cause of the war, and concluded a peace upon the caliph's own terms; one of which was, that the city of Heraclea should never be rebuilt. This perhaps Harun would not have so readily granted, had not one 16
Rafe Ebn Al Leith revolted against him at Samarcand, Rebellion
and assembled a considerable force to support him in in Khorasan.
his defection.

The next year being the 191st of the Hegira, the caliph removed the governor of Khorasan from his employment, because he had not been sufficiently attentive to the motions of the rebel Rafe Ebn Al Leith. As this governor had also tyrannized over his subjects in the most cruel manner, his successor no sooner arrived than he sent him in chains to the caliph; but notwithstanding all Harun's care, the rebels made this year a great progress in the conquest of Khorasan.

Next year the caliph found it necessary to march in person against the rebels, who were daily becoming more formidable. The general rendezvous of his troops was in the plains of Rakka, from whence he advanced at the head of them to Bagdad. Having at that place supplied the troops with every thing necessary, he continued his march to the frontiers of Jorjan, where he was seized with an illness which grew more violent after he had entered that province. Finding himself therefore unable to pursue his journey, he resigned the command of the army to his son Al Mamun, retiring himself to Tus in Khorasan. We were told by Khondemir, 17
that, before the caliph departed from Rakka, he had a The caliph's death
dream, wherein he saw a hand over his head full of red predicted
earth, and at the same time heard a person pronouncing by a dream.
these words, "See the earth where Harun is to be buried." Upon this he demanded where he was to be buried; and was instantly answered, "At Tus." This dream greatly discomposing him, he communicated it to his chief physician, who endeavoured to divert him, telling the caliph that the dream had been occasioned by the thoughts of his expedition against the rebels. He therefore advised him to pursue some favourite diversion that might draw his attention another way. The caliph accordingly, by his physician's advice, prepared a magnificent regale for his courtiers, which lasted several days. After this, he put himself at the head of his forces, and advanced to the confines of Jorjan, where he was attacked by the distemper that proved fatal to him. As his disorder increased, he found himself obliged to retire to Tus; where being arrived, he sent for his physician, and said to him, "Gabriel, do you remember my dream at Rakka? We are now arrived at Tus, the place, according to what was predicted in that dream, of my interment. Send one of my eunuchs to fetch me a handful of earth in the neighbourhood of this city." Upon this, *Masrur*, one of his favourite eunuchs, was despatched to bring a little of the soil of the place to the caliph. He soon returned and brought a handful of red earth, which he presented to the caliph with his arm half bare. At the sight of this Harun instantly cried out, "In truth this is the earth, and this the very arm, that I saw in my dream." His spirits immediately failing, and his malady being greatly increased by the perturbation of mind ensuing

upon

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Bagdad.

upon this sight, he died three days after, and was buried in the same place. According to Abul Faraj, Bashir Ebn Al Leith the arch rebel's brother was brought in chains to the caliph, who was then at the point of death. At the sight of whom Harun declared, that if he could speak only two words he would say *kill him*; and immediately ordered him to be cut to pieces in his presence. This being done, the caliph soon after expired, in the year of the Hegira 193, having reigned 23 years. The distemper that put an end to his days is said to have been the bloody flux.

18 He dies according to the prediction.

19 Succeeded by his son Al Amin.

Upon the arrival of a courier from Tus, with the news of Al Rashid's death, his son Al Amin was immediately proclaimed caliph; and was no sooner seated on the throne, than he formed a design of excluding his brother Al Mamun from the succession. Accordingly he deprived him of the furniture of the imperial palace of Khorasan; and in open violation of his father's will, who had bestowed on Al Mamun the perpetual government of Khorasan, and of all the troops in that province, he ordered these forces to march directly to Bagdad. Upon the arrival of this order, Al Mamun expostulated with the general Al Fadl Ebn Rabbi who commanded his troops, and endeavoured to prevent his marching to Bagdad; but without effect, for he punctually obeyed the orders sent by the caliph. Al Mamun, however, took care not to be wanting in fidelity to his brother. He obliged the people of Khorasan to take an oath of fidelity to Al Amin, and reduced some who had actually excited a considerable body of the people to revolt, while the general Al Fadl having ingratiated himself with the caliph by his ready compliance with his orders, was chosen prime vizir, and governed with an absolute sway: Al Amin abandoning himself entirely to drunkenness.

20 Infamous behaviour of the new caliph.

Al Fadl was a very able minister; though fearing Al Mamun's resentment if ever he should ascend the throne, he gave Al Amin such advice as proved in the end the ruin of them both. He told him that his brother had gained the affection of the people of Khorasan by the good order and police he had established among them; that his unwearied application to the administration of justice had so attracted their esteem, that the whole province was entirely at his devotion; that his own conduct was by no means relished by his subjects, whose minds were almost totally alienated from him; and therefore that he had but one part to act, which was to deprive Al Mamun of the right of succession that had been given him by his father, and transfer it to his own son Musa, though then but an infant. Agreeable to this pernicious advice, the caliph sent for his brother Al Kasem from Mesopotamia, and recalled Al Mamun from Khorasan, pretending he had occasion for him as an assistant in his councils.

21 Al Mamun takes up arms against his brother.

By this treatment Al Mamun was so much provoked, that he resolved to come to an open rupture with his brother, in order if possible to frustrate his wicked designs. Instead, therefore, of going to Bagdad as he had been commanded, he cut off all communication between his own province and that capital: pretending, that as his father Harun had assigned him the lieutenancy of Khorasan, he was responsible for all the disorders that might happen there during his absence. He also coined money, and would not suffer Al Amin's name to be impressed upon any of the dirhems, or dinars struck in that province. Not content with this, he prevailed upon Rafe Ebn Al Leith, who had been for some time in rebellion, to join him with a body of troops; whose example was soon after followed by Harthema Ebn Aafan; which put him in possession of all the vast territory of Khorasan. Here he governed with an absolute sway, officiated in the mosque as *Imam*, and from the pulpit constantly harangued the people.

The following year, being the 195th year of the Hegira, beginning October 4. 810, the caliph Al Amin, finding that his brother set him at defiance, declared war against him, and sent his general Ali Ebn Isa with an army of 60,000 men to invade Khorasan. Al Mamun, being informed that Ali was advancing against him with such a powerful army, put on foot all the troops he could raise, and gave the command to Thaher Ebn Hosein, one of the greatest generals of his age. Thaher being a man of undaunted resolution, chose only 4000 men, whom he led against Al Amin's army. Ali, seeing so small a number of troops advancing against him, was transported with joy, and promised himself an easy victory. Despising his enemies, therefore, he behaved in a secure and careless manner; the consequence of which was, that his army was entirely defeated, and himself killed, his head being afterwards sent as a present to Al Mamun, who amply rewarded Thaher and Harthema for their services.

22 Al Amin's forces defeated.

After this victory, Al Mamun assumed the title of *caliph*, ordered Al Amin's name to be omitted in the public prayers, and made all necessary preparations for carrying the war into the very heart of his brother's dominions. For this purpose he divided his forces into two bodies, and commanded them to march into Irak by different routes. One of them obeyed the orders of Thaher, and the other of Harthema. The first directed his march towards Ahwas, and the other towards Holwan, both of them proposing to meet in the neighbourhood of Bagdad, and after their junction to besiege that city.

23 Al Mamun's rapid conquests.

In the 196th year of the Hegira, Thaher Ebn Hosein made a most rapid progress with the troops under his command. Having advanced towards Ahwas, he there defeated a body of the caliph's forces; and though the victory was by no means decisive, it so intimidated the commander of Ahwas, that he thought fit to surrender that fortress to him. This opened him a way to Waset upon the Tigris, and facilitated the conquest of that place. After this he marched with his army to Al Madayen; the inhabitants of which immediately opened their gates to him. The rapidity of these conquests, and the infamous conduct of Al Amin, excited the people of Egypt, Syria, Hejaz, and Yaman, unanimously to declare for Al Mamun; who was accordingly proclaimed caliph in all these provinces.

24 Siege of Bagdad.

The next year, Al Mamun's forces under Thaher and Harthema, laid siege to Bagdad. As the caliph was shut up in that place, and it had a numerous garrison, the besieged made a vigorous defence, and destroyed a great number of their enemies. The besiegers, however, incessantly played upon the town with their catapults and other engines, though they were in their turn not a little annoyed by the garrison with the same sort of military machines. The latter likewise made continual

continual sallies, and fought like men in despair, though they were always at last beaten back into the town with considerable loss. In short the siege continued during the whole of this year, in which the greatest part of the eastern city, called the *Camp of Al Mohdi*, was demolished or reduced to ashes. The citizens, as well as the garrison, were reduced to the last extremity, by the length and violence of the siege.

In the beginning of the 198th year of the Hegira, Al Amin finding himself deserted by his troops, as well as by the principal men of Bagdad, who had kept a private correspondence with Thaher, was obliged to retire to the old town on the west bank of the Tigris. He did not, however, take this step, before the inhabitants of the new town had formally deposed him, and proclaimed his brother Al Mamun caliph. Thaher, receiving advice of this, caused the old town to be immediately invested, planted his engines against it, and at last starved it to surrender. Al Amin being thus reduced to the necessity of putting himself into the hands of one of the generals, chose to implore the protection of Harthema, whom he judged to be of a more humane disposition than Thaher. Having obtained this, he embarked in a small vessel in order to arrive at that part of the camp where Harthema was posted; but Thaher being informed of his design, which, if put in execution, he thought would eclipse the glory he had acquired, laid an ambush for him, which he had not the good fortune to escape. Upon his arrival in the neighbourhood of Harthema's tent, Thaher's soldiers

25 Al Amin murdered.

rushed upon him, drowned all his attendants, and put himself in prison. Here he was soon after massacred by Thaher's servants, who carried his head in triumph to their master, by whose order it was afterwards exposed to public view in the streets of Bagdad. Thaher afterwards sent to Al Mamun in Khorasan, together with the ring or seal of the caliphate, the sceptre and the imperial robe. At the sight of these, Al Mamun fell down on his knees, and returned thanks to God for his success; making the courier who brought them a present of a million of dirhems, in value about 100,000l. sterling.

26 Succeeded by Al Mamun.

The same day that Al Amin was assassinated, his brother Al Mamun was proclaimed caliph at Bagdad. He had not long been seated on the throne when he

27 Khorasan dismembered from the empire.

was alarmed by rebellions breaking out in different parts of the empire. These, however, were at last happily extinguished; after which, Thaher Ebn Hosein had the government of Khorasan conferred upon him and his descendants with almost absolute and unlimited power. This happened in the 205th year of the Hegira, from which time we may date the dismemberment of that province from the empire of the caliphs.

During the reign of this caliph nothing remarkable happened; only the African Moslems invaded the

28 Death of Al Mamun.

island of Sicily, where they made themselves masters of several places. He died of a surfeit in the 218th year of the Hegira, having reigned 20, and lived 48 or 49 years.

On the death of Al Mamun, his brother Al Motasem, by some of the oriental historians surnamed *Billah*, was saluted caliph. He succeeded by virtue of Al Mamun's express nomination of him, to the exclusion of his own son Al Abbas and his other brother Al Kasem, who had been appointed by Harun Al Raschid. In the beginning of his reign he was obliged to employ the whole forces of his empire against one Babec, who had been for a considerable time in rebellion in Persia and Persian Irak. This Babec first appeared in the year of the Hegira 201, when he began to take upon him the title of a *prophet*. What his particular doctrine was, is now unknown; but his religion is said to have differed from all others then known in Asia. He gained a great number of proselytes in Aderbijan and the Persian Irak, where he soon grew powerful enough to wage war with the caliph Al Mamun, whose troops he often beat, so that he was now become extremely formidable. The general sent by Al Motasem to reduce him was Haider Ebn Kaus, surnamed *Afshin*, a Turk by nation, who had been brought a slave to the caliph's court, and having been employed in disciplining the Turkish militia there, had acquired the reputation of a great captain. By him Babec was defeated with prodigious slaughter, no fewer than 60,000 men being killed in the first engagement. The next year, being the 220th of the Hegira, he received a still greater overthrow, losing 100,000 men either killed or taken prisoners. By this defeat he was obliged to retire into the Gordyæan mountains; where he fortified himself in such a manner, that Afshin found it impossible to reduce him till the year of the Hegira 222. This commander having reduced with invincible patience all Babec's castles one after another, the impostor was obliged to shut himself up in a strong fortress called *Cashabad*, which was now his last resource. Here he defended himself with great bravery for several months; but at last finding he should be obliged to surrender, he made his escape into a neighbouring wood, from whence he soon after came to Afshin, upon that general's promising him pardon. But Afshin no sooner had him in his power, than he first caused his hands and feet, and afterwards his head, to be cut off. Babec had supported himself against the power of the caliphs for upwards of 20 years, during which time he had cruelly massacred 250,000 people; it being his custom to spare neither man, woman, nor child, of the Mahometans or their allies. Amongst the prisoners taken at Cashabad there was one Nud, who had been one of Babec's executioners, and who owned that in obedience to his master's commands he had destroyed 20,000 Moslems with his own hands; to which he added, that vast numbers had also been executed by his companions, but that of these he could give no precise account.

29 War between the new caliph Al Motasem and Babec.

30 Babec defeated.

31 Taken prisoner and put to death.

32 He destroyed vast numbers of Moslems.

In the 223d year of the Hegira, the Greek emperor Theophilus invaded the caliph's territories, where he behaved with the greatest cruelty, and by destroying Sozopetra the place of Al Motasem's nativity, notwithstanding his earnest entreaties to the contrary, occasioned the terrible destruction of *Amorium* mentioned under that article. The rest of this caliph's reign is remarkable for nothing but the execution of Afshin, who was accused of holding correspondence with the caliph's enemies. After his death a great number of idols were found in his house, which were immediately burned, as also several books said to contain impious and detestable opinions.

33 Death of Al Motasem.

In the 227th year of the Hegira died the caliph Al Motasem, in the 48th or 49th year of his age. He reigned eight years eight months and eight days, was born

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Bagdad.

born in the eighth month of the year, fought eight battles, had 8000 slaves, and had 8,000,000 dinars and 80,000 dirhems in his treasury at his death; whence the oriental historians gave him the name of *Al Mothaman*, or the *Octonary*. He is said to have been so robust, that he once carried a burden of 1000 pounds weight several paces. As the people of Bagdad disturbed him with frequent revolts and commotions, he took the resolution to abandon that city, and build another for his own residence. The new city he built was first called *Samarra*, and afterwards *Sarra Manray*, and stood in the Arabian Irak. He was attached to the opinion of the Motazalites, who maintain the creation of the Koran; and both he and his predecessor cruelly persecuted those who believed it to be eternal.

34 He built the city of Sarra Manray.

35 His successors Al Wathek and Al Motawakkel.

Al Motasem was succeeded by Al Wathek Bilah, who, the following year, being the 228th of the Hegira, invaded and conquered Sicily. Nothing remarkable happened during the rest of his reign; he died in the 232d year of the Hegira, and was succeeded by his brother Al Motawakkel.

36 Monstrous cruelty of Al Motawakkel.

The new caliph began his reign with an act of the greatest cruelty. The late caliph's vizir having treated Al Motawakkel ill in his brother's lifetime, and opposed his election to the caliphate, was on that account now sent to prison. Here the caliph ordered him to be kept awake for several days and nights together: after this, being suffered to fall asleep, he slept a whole day and night; and after he awoke was thrown into an iron furnace lined with spikes or nails heated red hot, where he was miserably burnt to death. During this reign nothing remarkable happened, except wars with the Greeks, which were carried on with various success. In the year 859 too, being the 245th of the Hegira, violent earthquakes happened in many provinces of the Moslem dominions; and the springs at Mecca failed to such a degree, that the celebrated well Zemzem was almost dried up, and the water sold for 100 dirhems a bottle.

37 He is assassinated.

In the 247th year of the Hegira, the caliph was assassinated at the instance of his son Al Montaser; who succeeded him, and died in six months after. He was succeeded by Al Mostain, who in the year of the Hegira 252 was forced to abdicate the throne by his brother Al Motazz, who afterwards caused him to be privately murdered. He did not long enjoy the dignity of which he had so iniquitously possessed himself; being deposed by the Turkish militia (who now began to set up and depose caliphs as they pleased) in the 255th year of the Hegira. After his deposition he was sent under an escort from Sarra Manray to Bagdad, where he died of thirst or hunger, after a reign of four years and about seven months.

38 Hard fate of Al Motazz, a succeeding caliph.

The fate of this caliph was peculiarly hard: the Turkish troops had mutinied for their pay; and Al Motazz, not having money to satisfy their demands, applied to his mother named *Kabiha* for 50,000 dinars. This she refused, telling him that she had no money at all, although it afterwards appeared that she was possessed of immense treasures. After his deposition, however, she was obliged to discover them, and even deposite them in the hands of the new caliph Al Mokhtadi. They consisted of 1,000,000 dinars, a bushel of emeralds, and another of pearls, and three pounds and three quarters of rubies of the colour of fire.

Al Mokhtadi, the new caliph, was the son of one of Al Wathek's concubines named *Korb*, or *Karb*, who is by some supposed to have been a Christian. The beginning of his reign is remarkable for the irruption of the Zenjians, a people of Nubia, Ethiopia, and the country of the Caffres, into Arabia, where they penetrated into the neighbourhood of Basra and Cufa. The chief of this gang of robbers, who, according to some of the Arab historians, differed but little from wild beasts, was Ali Ebn Mohammed Ebn Abdalrahman, who falsely gave himself out to be of the family of Ali Ebn Abu Taleb. This made such an impression upon the Shiites in those parts, that they flocked to him in great numbers; which enabled him to seize upon the cities of Basra and Ramla, and even to pass the Tigris at the head of a formidable army. He then took the title of *Prince of the Zenjians*, in order to ingratiate himself with those barbarians, of whom his army was principally composed.

Bagdad. 39 Irruption of the Zenjians in the reign of Al Mokhtadi.

In the 256th year of the Heigra, Al Mokhtadi was barbarously murdered by the Turks who had raised him to the throne, and was succeeded by Al Montamed the son of Al Motawakkel. This year the prince of the Zenjians, Ali, or as he is also called *Al Habib*, made incursions to the very gates of Bagdad, doing prodigious mischief wherever he passed. The caliph therefore sent against him one Jolan with a considerable army; he was overthrown, however, with very great slaughter by the Zenjian, who made himself master of 24 of the caliph's largest ships in the bay of Basra, put a vast number of the inhabitants of Obolla to the sword, and seized upon the town. Not content with this, he set fire to it, and soon reduced it to ashes, the houses mostly consisting of the wood of a certain plane tree called by the Arabians *Saj*. From thence he marched to Ahadan, which likewise surrendered to him. Here he found immense treasure, which he enabled him to possess himself of the whole district of Ahwaz. In short, his forces being now increased to 80,000 strong, most of the adjacent territories, and even the caliph's court itself, were struck with terror.

40 Al Habib's success.

In the 257th year of the Hegira. Al Habib continued victorious, defeated several armies sent against him by the caliph, reduced the city of Basra, and put 20,000 of the inhabitants to the sword. The following year, the caliph, supported by his brother Al Mowaffek, had formed a design of circumscribing the power of the Turkish soldiery, who had for some time given law to the caliphs themselves. But this year the Zenjians made so rapid a progress in Persia, Arabia, and Irak, that he was obliged to suspend the execution of his design, and even to employ the Turkish troops to assist his brother Al Mowaffek in opposing these robbers. The first of the caliph's generals who encountered Al Habib this year, was defeated in several engagements, and had his army at last entirely destroyed. After this Al Mowaffek and another general named *Mosleh*, advanced against him. In the first engagement Mosleh being killed by an arrow, the caliph's troops retired; but Al Mowaffek put them afterwards in such a posture of defence, that the enemy durst not renew the attack. Several other sharp encounters happened this year, in which neither party gained great advantage; but, at last, some contagious distempers breaking out

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Bagdad. out in Al Mowaffek's army, he was obliged to conclude a truce, and retire to Waset to refresh his troops.

In the 259th year of the Hegira, commencing Nov. 7. 872, the war between the caliph and Al Habib still continued. Al Mowaffek, upon his arrival at Bagdad, sent Mohammed surnamed *Al Mowalled* with a powerful army to act against the Zenjians; but he could not hinder them from ravaging the province of Ahwaz, cutting off about 50,000 of the caliph's subjects, and dismantling the city of Ahwaz; and notwithstanding the utmost efforts of all the caliph's generals, no considerable advantages could be gained either this or the following year.

41 Rebellion in Fars, Ahwaz, and Basra.

In the 261st year of the Hegira, beginning October 16. 874, Mohammed Ebn Wasel, who had killed the caliph's governor of Fars, and afterwards made himself master of that province, had several engagements with Al Habib, but with what success is not known. The caliph, having been apprised of the state of affairs on that side, annexed the government of Fars, Ahwaz, and Basra, to the prefecture he had given to Musa Ebn Baga, whom he looked upon as one of the best generals he had. Musa, soon after his nomination to that post, sent Abdalrahman Ebn Mosleh as his deputy to Ahwaz, giving him as a colleague and assistant one Tisam, a Turk. Mohammed Ebn Wasel, however, refusing to obey the orders of Abdalrahman and Tisam, a fierce conflict ensued, in which the latter was defeated, and Abdalrahman taken prisoner. After this victory, Mohammed advanced against Musa Ebn Baga himself; but that general finding he could not take possession of his new government without a vast effusion of blood, recalled the deputies from their provinces, and made the best of his way to Sarra Manray. After this, Yakub Ebn Al Leit, having taken Khorasan from the descendants of Thaher, attacked and defeated Mohammed Ebn Wasel, seizing on his palace, where he found a sum of money amounting to 40,000,000 dirhems.

42 Rebels defeated, but cannot be reduced.

The next year Yakub Ebn Leit being grown formidable by the acquisition of Ahwaz and a considerable portion of Fars, or at least the Persian Irak, declared war against the caliph. Against him Al Motamed despatched Al Mowaffek; who having defeated him with prodigious slaughter, plundered his camp, and pursued him into Khorasan; where meeting with no opposition, he entered Nisabur, and released Mahomet the Thaherian, whom Yakub had detained in prison three years. As for Yakub himself, he made his escape with great difficulty, though he and his family continued several years in possession of many of the conquests he had made. This war with Yakub proved a seasonable diversion in favour of Al Habib, who this year defeated all the forces sent against him, and ravaged the district of Waset.

43 Al Habib still victorious.

The following year, being the 263d of the Hegira, beginning September 24. 876, the caliph's forces, under the command of Ahmed Ebn Lebuna, gained two considerable advantages over Al Habib; but being at last drawn into an ambuscade, they were almost totally destroyed, their general himself making his escape with the utmost difficulty; nor were the caliph's forces able, during the course of the next year, to make the least impression upon these rebels.

In the 265th year of the Hegira, beginning September 3. 878, Ahmed Ebn Tolun rebelled against the caliph, and set up for himself in Egypt. Having assembled a considerable force, he marched to Antioch, and besieged Sima the governor of Aleppo and all the provinces known among the Arabs by the name of *Al Awasem*, in that city. As the besieged found that he was resolved to carry the place by assault, they thought fit, after a short defence, to submit, and to put Sima into his hands. Ahmed no sooner had that officer in his power, than he caused him to be beheaded; after which he advanced to Aleppo, the gates of which were immediately opened unto him. Soon after, he reduced Damascus, Hems, Hamath, Kinnisrin, and Al Rakka, situated upon the eastern bank of the Euphrates. This rebellion so exasperated Al Motamed, that he caused Ahmed to be publicly cursed in all the mosques belonging to Bagdad and Irak; and Ahmed on his part ordered the same malediction to be thundered out against the caliph in all the mosques within his jurisdiction. This year also a detachment of Al Habib's troops penetrated into Irak, and made themselves masters of four of the caliph's ships laden with corn; then they advanced to Al Nomanic, laid the greatest part of it in ashes, and carried off with them several of the inhabitants prisoners. After this they possessed themselves of Jarjaraya, where they found many prisoners more, and destroyed all the adjacent territory with fire and sword.

Bagdad. 44 Rebellion in Egypt which cannot be suppressed.

This year there were four independent powers in the Moslem dominions, besides the house of Ommiyah in Spain, viz. the African Moslems, or Aglabites, who had for a long time acted independently; Ahmed in Syria and Egypt; Al Leit in Khorasan; and Al Habib in Arabia and Irak.

45 Four independent powers in the caliph's nominal dominions.

In the 266th year of the Hegira, beginning August 23. 879, Al Habib reduced Ramhormoz, burnt the stately mosque there to the ground, put a vast number of the inhabitants to the sword, and carried away great numbers, as well as a vast quantity of spoil.—This was his last successful campaign; for the year following, Al Mowaffek, attended by his son Abul Abbas, having attacked him with a body of 10,000 horse and a few infantry, notwithstanding the vast disparity of numbers (Al Habib's army amounting to 100,000 men), defeated him in several battles, recovered most of the towns he had taken, together with an immense quantity of spoil, and released 5000 women that had been thrown into prison by these barbarians. After these victories, Al Mowaffek took post before the city of Al Mabiya', built by Al Habib, and the place of his residence; burnt all the ships in the harbour; thoroughly pillaged the town; and then entirely dismantled it. After the reduction of this place, in which he found immense treasures, Al Mowaffek pursued the flying Zenjians, put several of their chiefs to the sword, and advanced to Al Mokhtara, a city built by Al Habib. As the place was strongly fortified, and Al Habib was posted in his neighbourhood, with an army, according to Abu Jaafer Al Tabari, of 300,000 men, Al Mowaffek perceived that the reduction of it would be a matter of some difficulty. He therefore built a fortress opposite to it, where he erected a mosque, and coined money. The new city, from its founder, was called by the Arabs *Al Mowaffekkia*, and soon rendered considerable by the settlement of several wealthy merchants there. The city of Al Mokhtara being reduced to great straits, was at last taken by storm, and given up to be

46 Al Habib's bad success and death.

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Bagdad. be plundered by the caliph's troops; after which Al Mowaffek defeated the numerous forces of Al Habib in such a manner, that they could no more be rallied during that campaign.

The following year, being the 268th of the Hegira, Al Mowaffek penetrated again into Al Mabiya', and demolished the fortifications which had been raised since its former reduction, though the rebels disputed every inch of ground. Next year he again attacked Al Habib with great bravery; and would have entirely defeated him, had he not been wounded in the breast with an arrow, which obliged him to sound a retreat. However, as soon as he was cured of his wound, Al Mowaffek advanced a third time to Al Mabiya', made himself master of that metropolis, threw down the walls that had been raised, put many of the inhabitants to the sword, and carried a vast number of them into captivity.

The 270th year of the Hegira, commencing July 11. 883, proved fatal to the rebel Al Habib. Al Mowaffek made himself a fourth time master of Al Mabiya', burnt Al Habib's palace, seized upon his family, and sent them to Sarra Manray. As for the usurper himself, he had the good fortune to escape at this time; but being closely pursued by Al Mowaffek into the province of Ahwaz, where the shattered remains of his forces were entirely defeated, he at last fell into the hands of the victor, who ordered his head to be cut off, and carried through a great part of that region which he had so long disturbed. By this complete victory Al Mowaffek obtained the title of *Al Nasir Lidmilbah*, that is, *the protector of Mahometanism*. This year also died Ahmed Ebn Tolun, who had seized upon Egypt and Syria, as we have already observed; and was succeeded by his son *Khamarawiyah*.

47 Success of the Sultan of Egypt. The next year, a bloody engagement happened between the caliph's forces commanded by Al Mowaffek's son, and those of Khamarawiyah, who had made an irruption into the caliph's territories. The battle was fought between Al Ramla and Damascus. In the beginning, Khamarawiyah found himself so hard pressed, that his men were obliged to give way; upon which, taking for granted that all was lost, he fled with great precipitation, even to the borders of Egypt; but, in the mean time, his troops being ignorant of the flight of their general, returned to the charge, and gained a complete victory. After this, Khamarawiyah, by his just and mild administration, so gained the affections of his subjects, that the caliph found it impossible to gain the least advantage over him. In the 276th year of the Hegira, he overthrew one of the caliph's generals named Abul Saj, at Al Bathnia near the city of Damascus; after which he advanced to Al Rakka on the Euphrates, and made himself master of that place. Having annexed several large provinces to his former dominions, and left some of his friends in whom he could confide to govern them, he then returned into Egypt, the principal part of his empire, which now extended from the Euphrates to the borders of Nubia and Ethiopia.

48 Al Mowaffek dies. The following year, being the 278th of the Hegira, was remarkable for the death of Al Mowaffek. He died of the elephantiasis or leprosy; and while in his lats illness, could not help observing, that of 100,000 men whom he commanded, there was not one so miserable as himself. This year is also remarkable for the first disturbances raised in the Moslem empire by the Karmatians. The origin of this sect is not certainly known; but the most common opinion is, that a poor fellow, by some called *Karmata*, came from Khuzestan to the villages near Cufa, and there pretended great sanctity and strictness of life, and that God had enjoined him to pray 50 times a-day; pretending also to invite people to the obedience of a certain imam of the family of Mahomet; and this way of life he continued till he had made a very great party, out of whom he chose twelve as his apostles to govern the rest, and to propagate his doctrines. He also assumed the title of *prince*, and obliged every one of his earlier followers to pay him a dinar a-year. But Al Haidam, the governor of that province, finding men neglected their work, and their husbandry in particular, to say those 50 prayers a-day, seized the fellow, and having put him in prison, swore that he should die. This being overheard by a girl belonging to the governor, she, out of compassion, took the key of the dungeon at night from under her master's head, released the man, and restored the key to its place while her master slept. The next morning the governor found his prisoner gone; and the accident being publicly known, raised great admiration; Karmata's adherents giving out that God had taken him into heaven. After this he appeared in another province, and declared to a great number of people he got about him, that it was not in the power of any person to do him hurt; notwithstanding which, his courage failing him, he retired into Syria, and was never heard of any more. After his disappearance, the sect continued and increased; his disciples pretending that their master had manifested himself to be a true prophet, and had left them a new law, wherein he had changed the ceremonies and form of prayer used by the Moslems, &c. From this year, 278, these sectaries gave almost continual disturbance to the caliphs and their subjects, committing great disorders in Chaldæa, Arabia, and Mesopotamia, and at length established a considerable principality.

49 Origin of the Karmatians.

In the 279th year of the Hegira died the caliph Al Motamed; and was succeeded by Al Motaded, son to Al Mowakeff. The first year of his reign, Al Motaded demanded in marriage the daughter of Khamarawiyah, sultan, or caliph, of Egypt; which was agreed to by him with the utmost joy, and their nuptials were solemnized with great pomp in the 282d year of the Hegira. He carried on a war with the Karmatians; but very unsuccessfully, his forces being defeated with great slaughter, and his general Al Abbas taken prisoner. This caliph also granted to Harun, son to Khamarawiyah, the perpetual prefecture of Awasam and Kinnisrin, which he annexed to that of Egypt and Syria, upon condition that he paid him an annual tribute of 45,000 dinars. He died in the year of the Hegira 289, and was succeeded by his son Al Moctasi. 50 Sultan of Egypt's daughter married to the caliph Al Motaded.

This caliph proved a warlike and successful prince. He gained several advantages over the Karmatians, but was not able to reduce them. The Turks, however, having invaded the province of Mawaralnahr, were defeated with great slaughter; after which Al Moctasi carried on a successful war against the Greeks, from whom he took Seleucia. After this he invaded Syria and 51 Egypt, &c. recovered by the caliph Al Moctasi.

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Bagdad. and Egypt, which provinces he recovered from the house of Ahmed Ebn Tolun.

52 Distressed state of the caliphs after his death.

The reduction of Egypt happened in the 292d year of the Hegira, after which the war was renewed with success against the Greeks and Karmatians. The caliph died in the 295th year of the Hegira, after a reign of about six years and a half. He was the last of the caliphs who made any figure by their warlike exploits. His successors Al Moktader, Al Kaher, and Al Radi, were so distressed by the Karmatians and numberless usurpers who were every day starting up, that by the 325th year of the Hegira they had nothing left but the city of Bagdad. In the 324th year of the Hegira, commencing November 30. 935, the caliph Al Radi, finding himself distressed on all sides by usurpers, and having a vizir of no capacity, instituted a new office superior to that of vizir, which he entitled *Emir Al Omra*, or *Commandant of commandants*. This great officer was trusted with the management of all military affairs, and had the entire management of the finances in a much more absolute and unlimited manner than any of the caliphs vizirs ever had. Nay, he officiated for the caliph in the great mosque at Bagdad, and had his name mentioned in the public prayers throughout the kingdom. In short, the caliph was so much under the power of this officer, that he could not apply a single dinar to his own use without the leave of the Emir Al Omra. In the year 325, the Moslem empire, once so great and powerful, was shared among the following usurpers.

53 New office of Emir Al Omra instituted by Al Radi.

54 Division of the Moslem empire in the 325th year of the Hegira.

The cities of Waset, Basra, and Cufa, with the rest of the Arabian Irak, were considered as the property of the Emir Al Omra, though they had been in the beginning of the year seized upon by a rebel called *Al Baridi*, who could not be driven out of them.

The country of Fars, Farsestan, or *Persia* properly so called, was possessed by Amado'ddawla Ali Ebn Buiya, who resided in the city of Shiraz.

Part of the tract denominated *Al Jebal*, together with Persian Irak, which is the mountainous part of Persia, and the country of the ancient Parthians, obeyed Rucno'ddawla, the brother of Amado'ddawla, who resided at Ispahan. The other part of that country was possessed by Washmakin the Deylamite.

Diyar Rabia, Diyar Becr, Diyar Modar, and the city of Al Mawsel, or Mosul, acknowledged for their sovereigns a race of princes called *Hamdanites*.

Egypt and Syria no longer obeyed the caliphs, but Mahomet Ebn Taj, who had formerly been appointed governor of these provinces.

Africa and Spain had long been independent.

Sicily and Crete were governed by princes of their own.

The provinces of Khorasan and Mawaralnahr, were under the dominion of Al Nasr Ebn Ahmed, of the dynasty of the Sammarians.

The provinces of Tabrestan, Jorjan or Georgia, and Mazanderan, had kings of the first dynasty of the Deylamites.

The province of Kerman was occupied by Abu Ali Mahomet Ebn Eylia Al Sammani, who had made himself master of it a short time before. And,

Lastly, the provinces of Yamama and Bahrein, including the district of Hajr, were in the possession of Abu Thaher the Karmatian.

Thus the caliphs were deprived of all their dominions, and reduced to the rank of sovereign pontiffs; in which light, though they continued for some time to be regarded by the neighbouring princes, yet their power never arrived at any height. In this low state the caliphs continued till the year of the Hegira 656, commencing January 8. 1258. This year was rendered remarkable by the taking of Bagdad by Hulaku the Mogul or Tartar; who likewise abolished the caliphate, putting the reigning caliph Al Mostasem Bilah to a most cruel death. These diabolical conquerors, after they had taken the city, massacred, according to custom, a vast number of the inhabitants; and after they had plundered it, set it on fire. The spoil they took from thence was prodigiously great, Bagdad being then looked upon as the first city in the world.

55 Bagdad taken by the Tartars.

56 History of the city since that time.

Bagdad remained in the hands of the Tartars or Moguls to the year of the Hegira 795, of Christ 1392, when it was taken by Tamerlane from Sultan Ahmed Ebn Weis; who being incapable of making head against Tamerlane's numerous forces, found himself obliged to send all his baggage over the Tigris, and abandoned his capital to the conqueror. He was, however, hotly pursued by his enemy's detachments to the plain of Karbella, where several skirmishes happened, and a considerable number of men were lost on both sides. Notwithstanding this disaster, he found means to escape the fury of his pursuers, took refuge in the territories of the Greek emperor, and afterwards repossessed himself of the city of Bagdad. There he remained till the year of the Hegira 803, when the city was taken a second time by Tamerlane; who nevertheless restored it to him, and he continued sovereign of the place till driven from thence by Miram Shaw. Still, however, he found means to return; but in the 815th year of the Hegira was finally expelled by Kara Yusef the Turcoman. The descendants of Kara Yusef continued masters of Bagdad till the year of the Hegira 875, of Christ 1470, when they were driven out by Usun Cassun. The family of this prince continued till the year of the Hegira 914, of our Lord 1508, when Shah Ishmael, surnamed *Sufi* or *Sofi*, the first prince of the royal family reigning in Iran, or Persia, till the dethroning of the late Shah Hosein, made himself master of it. From that time to this Bagdad has continued to be a bone of contention between the Turks and Persians. It was taken by Soliman surnamed the *Magnificent*, and retaken by Shah Abbas the Great, king of Persia; but being at length besieged by Amruth or Morad IV. with a formidable army, it was finally obliged to surrender to him in the year 1638; since which time the Persians have never been able to make themselves masters of it for any length of time.

57 Its present state.

The city is large and populous; and the advantage of the Tigris is considerable, with regard to commerce. The climate is excessively hot, and in other respects far from being agreeable. The number of its inhabitants is probably from 60,000 to 90,000; but earlier writers carry it as high as 300,000; and Mr Eton in his Survey, states, that it had fallen even so low as 20,000 after the plague in 1773. The bashaw is continually extorting money from the poor inhabitants, and none suffer more than the unfortunate Jews and Christians, many of whom are put to the most cruel tortures in

order

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Bagdad. order to force their property from them. This series of tyranny and oppression has almost entirely driven them out of the city; in consequence of which the trade must suffer very considerably, they being generally the principal merchants in the place. In the months of June, July, and August, the weather is so extremely hot, as to oblige the inhabitants to live for these months in subterraneous apartments, which are arched over, to admit the free circulation of the air. The houses are generally large, built of brick and cement, and are arched over. Many of the windows are made of elegant Venetian glass; the ceilings are mostly ornamented with a kind of chequered work, which has generally a noble appearance; most of the houses have a court-yard before them, in the middle of which is a little plantation of orange trees, &c. that has a very pleasing effect. The soil, which would produce not only every conveniency in life, but almost every luxury, is through the natural indolence of the Turks, and the many faults in the government of the country, in a great measure uncultivated and neglected. The revenues are computed at 125 lacks of piastres, or 1,562,500l. sterling: but a quarter part of this is not collected, owing to the slothfulness of the Turks, who suffer the Arabs to plunder them of the remainder. This in some measure accounts for the cruelties and extortions that are continually practised here. As the bashaw lives in all the splendour of a sovereign prince, and maintains a very large army, he could not be able to defray his expences, was he not to have recourse to oppression and injustice; and he, by his extensive power, acting almost independent of the Porte, only acknowledges it to bring in a balance from thence yearly in his favour.

The bazars or markets here are large and extensive; being covered over with arches built of masonry, and divided into different streets, filled with shops of all kinds of merchandise, to the number of 1200. Every thing an Asiatic can have occasion for may be had there, though a European has many wants which could not be supplied. Each house and shop pay an annual tribute to the bashaw, which produces a very considerable sum. Besides the revenue derived from this source, the bashaw exacts large sums under the pretext of their being necessary to keep the fortifications in repair, though very little is actually expended on such objects. Likewise clearing the river and mending the bridge become a charge greater than their income, and probably not the value of an English shilling is expended.— To support the expence of the seraglio, their clothes, caparisons of their horses, and every outward pomp, the amount is considerable.

On the north side of the town stands the citadel which commands the river; and consists of curtains and bastions, on which some very long cannon are mounted, with two mortars in each bastion, placed on no other beds than the ground, and in very bad condition. The carriages of the guns are likewise so unwieldy, and in such a shattered condition, that from their appearance they would not support one firing, but would be shaken in pieces. Their elevations were from 30 to 40 degrees, but they had no quoins to level them. There are, besides, a number of small towers, and loop-holes for musketry, placed at certain distances, all well encompassed by a ditch of 25 feet deep, which can be filled at any time by the waters of the Tigris. The citadel is so close to the houses, that it might be easily taken if possession was once gained of the town; but an attack made towards the land would not probably be successful, as sluices might with the greatest facility be cut into the ditch, and so overflow the country for miles round; but it is said an advantageous attack might be made from the water.

The city, which is fortified by lofty thick walls of brick covered with earth, and strengthened by great towers much resembling cavalier bastions, the whole being surrounded by a deep ditch, is in the form of an irregular square; but the walls in many places are broken down, occasioned by the disputes which happened on the death of Abdulla Bashaw a few years ago, when two competitors arose in Bagdad for the bashawic, who fought several times in the town and citadel, and laid great part of it in ruins. In the interim, the governor of Moussul and Nineveh being appointed bashaw by the Porte, came hither with a considerable army, and took possession of the sovereignty, vanquishing his two opponents. Opposite to the city, on the other side of the river, are very extensive suburbs, from whence shells might be thrown into the town, which would have a dreadful effect on a place so closely built. There is a communication between the city and suburbs by a bridge of boats; the only kind of bridge which that river will admit of, as it is broad and deep, and in its ordinary course very rapid. At certain seasons it swells to a prodigious height, and overflowing the country occasions many morasses on that side opposite to the city. Among these are several towns and villages, whose inhabitants are said to be the ancient Chaldeans: they are of a particular religion, which they pretend is that of Seth. The inhabitants of this city are composed chiefly of Persians, Armenians, Turks, Arabs, and Jews, which last act in the capacity of schroffs, or bankers, to the merchants. The Jews, notwithstanding the severe treatment they meet with from the government, are induced to live here from a reverence to the prophet Ezekiel, whose mausoleum they pretend is a day's journey from the city. Besides the Jews who reside here, there are many that come every year out of devotion to visit the prophet's tomb. There are also some European gentlemen, Venetians, and Frenchmen, with a small number of Romish priests generally. Two chapels are permitted for those of the Romish and Greek persuasions; at the former the priests officiate. In the city are several large beautiful mosques, but into which Christians are never suffered to enter if known to be such, for fear it should defile them. The Mahometan women are very richly dressed, wearing bracelets on their arms and jewels in their ears: the Arabian women have the partition between their nostrils bored, wherein they wear rings.

There are also a number of antique buildings. At the distance of about ten miles stand the ruins of an ancient tower called the *Tower of Nimrod.* Whether this tower was at first of a square or round form is now difficult to determine; though the former is most probable, because all the remaining bricks are placed square,

square, and not in the least circular. The bricks are all twelve inches square and four and a half thick. The cement is of mud or slime, mixed with broken reed, as we mix hair with mortar; which slime might either have been had from one of the great rivers, or taken out of one of the swamps in the plain, with which the country hereabout very much abounds. The height of the ruin is 126 feet; the diameter of the largest and middle part about 100 feet. It would appear to be solid to the centre; yet near the top there is a regular opening of an oval form. The circumference of that part of the tower which remains, and is above the rubbish, is about 300 feet; but probably could the foundation be come at, it would be found of far greater extent. The present Turks, Jews, and Arabians, are fond of believing this to be the identical ruin of the ancient tower of Babel, for which they assign a variety of reasons; but all so void of the appearance of truth, that to set about confuting them would be losing time in trifles. It appears to have been a beacon or watch-tower, to give notice of the approach of an enemy: or perhaps was used as an observatory to inspect the various motions of the heavenly bodies; which science was so much cultivated among the ancient inhabitants of this country, that even the Grecians, though desirous of being esteemed the inventors of all arts and sciences, could never deny the Babylonians the honour of having laid the foundation of astronomy.

BAGGAGE, in military affairs, denotes the clothes, tents, utensils of divers sorts, provisions, and other necessaries, belonging to the army.

Before a march, the baggage with the waggons is marshalled according to the rank which the several regiments bear in the army; being sometimes ordered to follow the respective columns of the army, sometimes to follow the artillery, and sometimes to form a column by themselves. The general's baggage marches first; and each waggon has a flag, showing the regiment to which it belongs.

Packing up the BAGGAGE, *vasa colligere*, was a term among the Romans, for preparing to go to war, or to be ready for an expedition.

The Romans distinguished two sorts of baggage; a *greater* and *less*. The lesser was carried by the soldier on his back, and called *sarcina;* consisting of the things most necessary to life, and which he could not do without. Hence *colligere sarcinas*, packing up the baggage, is used for decamping, *castra movere*. The greater and heavier was carried on horses and vehicles, and called *onera*. Hence *onera vehiculorum, sarcinæ hominum*. The baggage-horses were denominated *sagmentarii equi*.

The Roman soldiers in their marches were heavy loaden; insomuch, that they were called by way of jest *muli mariani*, and *ærumnæ*. They had four sorts of luggage, which they never went without, viz. corn or *buccellatum*, utensils, valli, and arms. Cicero observes, that they used to carry with them above half a month's provisions; and we have instances in Livy, where they carried provisions for a whole month. Their utensils comprehended those proper for gathering fuel, dressing their meat, and even for fortification or intrenchment; and what is more, a chain for binding captives. For arms, the foot carried a spear, shield, saw, basket, rutrum, hatchet, lorum, falx, &c. Also stakes or pales, *valli*, for the sudden fortifying a camp; sometimes seven or even twelve of these pales were carried by each man, though generally, as Polybius tells us, only three or four. On Trajan's column we see soldiers represented with this fardle of corn, utensils, pales, &c. gathered into a bundle and laid on their shoulders. Thus inured to labour, they grew strong, and able to undergo any fatigue in battle; the greatest heat of which never tired them, or put them out of breath. In aftertimes, when discipline grew slack, this luggage was thrown on carriages and porters shoulders.

The Macedonians were not less inured to hardship than the Romans; when Philip first formed an army, he forbade all use of carriages; yet, with all their load, they would march, in a summer's day, 20 miles in military rank.

BAGLANA, or BUGLANA, a province of the kingdom of Dekkan in Hindostan. It is bounded on the north and east by Guzzerat and Ballagat; and on the south and west by that part of Visiapour called *Konkan*, belonging to the Mahrattas. It ends in a point at the sea coast between Daman and Balsora, and is the least province in the kingdom. The Portuguese territories begin in this province at the port Daman, 21 leagues south of Surat; and run along the coast by Bassaim, Bombay, and Chawl, to Dabul, almost 50 leagues to the north of Goa.

BAGLIVI, GEORGE, a most illustrious physician of Italy, was a native of Apulia, and born about the year 1668. He studied at Padua, where he became doctor; and then went to Rome, where he was chosen professor of anatomy. He was a man of most uncommon force of understanding, of which he gave ample proofs in many curious and accurate productions, philosophical as well as medicinal. He died at Rome in 1706, in the flower of his age, and when he was no more than 38. A collection of his works was printed first in 1710, quarto; and has since been reprinted, in the same size, at various places. His *Praxis Medica*, and *De Fibra Matricis*, are the principal pieces. He wrote a Dissertation upon the Anatomy, Bite, and Effects, of the Tarantula, which is the production of his country; and gave a particular account of the earthquake at Rome and the adjacent cities in 1703. His works are all in Latin.

BAGNAGAR, a town of Asia, in Hindostan, better known by the name of Hyderabad. It is situated on the south bank of the river Musa, six miles from the strong fortress of Golconda. It is a fine and populous city, about seven miles in circumference, and is surrounded by a wall as a security against sudden incursions. It is chiefly remarkable for a magnificent reservoir of water, surrounded with a colonnade supported by arches. E. Long. 78. 20. N. Lat. 17. 10.

BAGNARA, a sea-port town of Italy in the kingdom of Naples, in the farther Calabria, with the title of a duchy. E. Long. 16. 8. N. Lat. 38. 15.

BAGNAREA, a town of Italy in St Peter's patrimony, and in the territory of Orvieta, with a bishop's see. E. Long. 12. 10. N. Lat. 42. 36.

BAGNERES, a town of France in Gascony, and

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in the county of Bigorre, now the department of the Upper Pyrenees, so called from its mineral waters, which are much resorted to. It is seated on the river Adour, in E. Long. 0. 12. N. Lat. 43.3.

BAGNIALACK, a large town of Turkey in Europe, in the province of Bosnia. E. Long. 18. 10. N. Lat. 44. 0.

BAGNIO, an Italian word signifying *a bath*. We use it for a house with conveniences for bathing, cupping, sweating, and otherwise cleansing the body; and sometimes for worse purposes. In Turkey it is become a general name for the prisons where the slaves are enclosed, it being usual in these prisons to have baths.

BAGNOLAS, a town of Lower Languedoc, now the department of Gard in France, containing 4800 inhabitants. It has a handsome square, and two fountains which rise in the middle of the town; the waters of which, being received in a bason, are conveyed by a canal out of town, and from thence to the lands about it. E. Long. 4. 43. N. Lat. 44. 10.

BAGNOLIANS, or BAGNOLANSES, in church history, a sect of heretics, who in reality were Manichees, though they somewhat disguised their errors. They rejected the Old Testament and part of the New; held the world to be eternal: and affirmed that God did not create the soul when he infused it into the body.

BAGOI, among the ancient Persians, were the same with those called by the Latins *spadones*, viz. a species of eunuchs, in whom the canal of the penis was so contorted by a tight vinculum, that they could not emit the semen.

BAG-PIPE, a musical instrument, of the wind kind, chiefly used in Scotland and Ireland. The peculiarity of the bag-pipe, and from which it takes its name, is, that the air which blows it is collected into a leathern bag, from whence it is pressed out by the arm into the pipes. These pipes consist of a bass, and tenor or rather treble; and are different according to the species of the pipe. The bass part is called the *drone*, and the tenor or treble part the *chanter*. In all the species, the bass never varies from its uniform note, and therefore very deservedly gets the name of *drone;* and the compass of the chanter is likewise very limited. There is a considerable difference between the Highland and Lowland bag-pipe of Scotland; the former being blown with the mouth, and the latter with a small bellows: though this difference is not essential, every species of bag-pipes being capable, by a proper construction of the reeds, of producing music either with the mouth or bellows. The following are the species of bag-pipes most commonly known in this country.

1. The *Irish Pipe*. This is the softest, and in some respects the most melodious of any, so that music-books have been published with directions how to play on it. The chanter, like that of all the rest, has eight holes like the English flute, and is played on by opening and shutting the holes as occasion requires; the bass consists of two short drones and a long one. The lowest note of the chanter is D on the German flute, being the open note on the counter-string of a violin; the small drone (one of them commonly being stopped up) is tuned in unison with the note above this, and the large one to an octave below; so that a great length is required in order to produce such a low note, on which account the drone hath sometimes two or three turns. The instrument is tuned by lengthening or shortening the drone till it sounds the note desired.

2. The *Highland Bag-Pipe*. This consists of a chanter and two short drones, which sound in unison the lowest note of the chanter except one. This is exceedingly loud, and almost deafening if played in a room; and is therefore mostly used in the field, for marches, &c. It requires a prodigious blast to sound it; so that those unaccustomed to it cannot imagine how Highland pipers can continue to play for hours together, as they are often known to do. For the same reason, those who use the instrument are obliged either to stand on their feet or walk when they play. This instrument hath but nine notes; its scale, however, hath not yet been reduced to a regular standard by comparing it with that of other instruments, so that we can say nothing about its compass. Those who are best acquainted with it, however, affirm that it plays only the natural notes, without being capable of variation by flats or sharps.

3. The *Scots Lowland Pipe*. This is likewise a very loud instrument, though less so than the former. It is blown with bellows, and hath a bass like the Irish pipe. This species is different from all the rest, as it cannot play the natural notes, but hath F and C sharp. The lowest note of a good bag-pipe of this kind is unison with C sharp on the tenor of a violin tuned concert-pitch; and, as it hath but nine notes, the highest is D in alt. From this peculiar construction, the Highland and Lowland bag-pipes play two species of music essentially different from one another, as each of them also is from every other species of music in the world. Hence these two species of bag-pipes deserve notice as curiosities; for the music which they play is accompanied with such peculiar ornaments, or what are intended as such, as neither violin, or even organ, can imitate, but in a very imperfect manner.

This kind of bag-pipe was formerly very much used in Scotland at weddings and other festivals; being indeed extremely well calculated for playing that peculiar species of Scots music called *reels*. It has been often a matter of surprise how this was possible, as the instrument has only a compass of nine or ten notes at the utmost, and which cannot be varied as in other instruments. In this repect, however, it has a very great compass, and will play an inconceivable variety of tunes. As its notes are naturally so high, there is scarce any one tune but what is naturally transposed by it, so that what would be a flat note on the key proper for the violin, may be a sharp one on the bag-pipe; and though the latter cannot play any flat note, it may nevertheless in this manner play tunes which on other instruments would be flat, to as great perfection as these instruments themselves.

4. The *Small Pipe*. This is remarkable for its smallness, the chanter not exceeding eight inches in length; for which reason, the holes are so near each other, that it is with difficulty they can be closed. This hath only eight notes, the lower end of the chanter being commonly stopped. The reason of this is, to prevent the slurring of all the notes, which is unavoidable in the other

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Bag-pipe. other species; so that in the hands of a bad player they become the most shocking and unintelligible instruments imaginable: but this, by having the lower hole closed, and also by the peculiar way in which the notes are expressed, plays all its tunes in the way called by the Italians *staccato*, and cannot slur at all. It hath no species of music peculiar to itself; and can play nothing which cannot be much better done upon other instruments; though it is surprising what volubility some performers on this instrument will display, and how much they will overcome the natural disadvantages of it. Some of this species, instead of having drones like the other, have their bass parts consisting of a winding cavity in a kind of short case, and are tuned by opening these to a certain degree by means of sliding covers; from which contrivance they are called *shuttle-pipes*. Besides these there are a variety of others, called *Italian*, *German*, *Organ*, &c. bag-pipes, which have nothing different in their construction from those above described, nor any good quality to recommend them.

As to the origin of bag-pipe music, some are of opinion that it is to be derived from the Danes; but Mr Pennant thinks differently, and gives the following reasons for deriving it from Italy.

Voyage to the Hebrides, p. 30.

"Neither of these instruments (the Highland and Lowland bag-pipes above described) were the invention of the Danes, or, as is commonly supposed, of any of the northern nations; for their ancient writers prove them to have been animated by the *clangor tubarum*. Notwithstanding they have had their sœck pipe long amongst them, as their old songs prove, yet we cannot allow them the honour of inventing this melodious instrument, but must assert, that they borrowed it from the invaded Caledonians. We must still go farther, and deprive even that ancient race of the credit; and derive its origin from the mild climate of Italy, perhaps from Greece.

"There is now in Rome a most beautiful bas relievo, a Grecian sculpture of the highest antiquity, of a bag-piper playing on his instrument, exactly like a modern Highlander. The Greeks had their Ασκαυλης, or instrument composed of a pipe and blown-up skin: the Romans in all probability borrowed it from them, and introduced it among their swains, who still use it under the names of *piva* and *cornu-musa*.

"That master of music, Nero, used one; and had not the empire been so suddenly deprived of that great artist, he would (as he graciously declared his intention) have treated the people with a concert, and among other curious instruments, would have introduced the *utricularius* or bag-pipe. Nero perished; but the figure of the instrument is preserved on one of his coins, but highly improved by that great master: it has the bag and two of the vulgar pipes; but was blown with a bellows like an organ, and had on one side a row of nine unequal pipes, resembling the syrinx of the god Pan. The bag-pipe, in the unimproved state, is also represented in an ancient sculpture; and appears to have had two long pipes or drones, and a single short pipe for the fingers. Tradition says, that the kind played on by the mouth was introduced by the Danes; as theirs was wind-music, we will admit that they might have made improvement, but more we cannot allow: they were skilled in the use of the trumpet; the Highlanders in the piobb, or bag-pipe.

Non tuba in usu illis, conjuncta at tibia in utrem
Dat belli signum, et martem vocat horrida in arma."*

* *Melvini Topogr. Scot.*

The bag-pipe appears to have been an instrument of great antiquity in Ireland, though it is uncertain whence they derived it. Mr Pennant, by means of an antique found at Richborough in Kent, has determined that the bag-pipe was introduced at a very early period into Britain; whence it is probable that both Irish and Danes might borrow the instrument from the Caledonians with whom they had such frequent intercourse. Aristides Quintilianus informs us, that it prevailed in the Highlands in very early ages; and indeed the genius of the people seems to render the opinion highly probable. The attachment of that people to their music called *pibrachs* is almost incredible, and on some occasions is said to have produced effects little less marvellous than those ascribed to the ancient music. At the battle of Quebec in 1760, while the British troops were retreating in great disorder, the general complained to a field officer in Frazer's regiment of the bad behaviour of his corps. "Sir (said he with some warmth), you did very wrong in forbidding the pipers to play this morning: nothing encourages the Highlanders so much in the day of action. Nay, even now they would be of use."—"Let them blow like the devil, then (replies the general), if it will bring back the men." The pipers were then ordered to play a favourite martial air; and the Highlanders, the moment they heard the music, returned and formed with alacrity in the rear. In the late war in India, Sir Eyre Coote, aware of the attachment of the Highlanders to their favourite instrument, gave them 50l. to buy a pair of bag-pipes after the battle of Porto Nuovo.

Formerly there was a kind of college in the island of Skye, where the Highland bag-pipe was taught; the teachers making use of pins stuck into the ground instead of musical notes. This college, however, has been for some time entirely dissolved, and the use of the Highland pipe become much less general than before. At last a society of gentlemen, thinking it perhaps impolitic to allow the ancient martial music of the country to decline, resolved to revive it by giving an annual prize to the best performers on the instrument. These competitions were first held at Falkirk, but for a good number of years at Edinburgh; where the only surviving member of the ancient college of Skye is now *professor* of bag-pipe music.

The Lowland pipe, as has been already observed, is an instrument essentially different from the Highland pipe; it was reformed, and the music improved, by George Mackie, who is said to have attended the college of Skye seven years. He had before been the best performer on that instrument in that part of the country where he lived: but, while attending the college at Skye, he adapted the graces of the Highland music to the Lowland pipe. Upon his return, he was heard with astonishment and admiration; but unluckily, not being able to commit his improvements to writing, and indeed the nature of the instrument scarcely admitting of it, the knowledge of this kind of music hath continued to decay ever since, and will probably soon wear out altogether. What contributes much to this is, that bag-pipers, not content with the natural nine notes, which their instrument can play easily, force

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force it to play tunes requiring higher notes, which disorders the whole instrument in such a manner as to produce the most horrid discords; and this practice brings, though undeservedly, the instrument itself into contempt.

BAGUETTE, in *Architecture*, a small round moulding, less than an astragal, and so called from the resemblance it bears to a ring.

BAHAMA, or LUCAYA, ISLANDS, are the eastermost of the Antilles, lying in the Atlantic ocean. They are situated to the south of Carolina, between 22 and 27 degrees N. Lat. and 73 and 81 degrees W. Long. They extend along the coast of Florida quite down to the isle of Cuba, and are said to be 500 in number, some of them only bare rocks; but twelve of them are large, fertile, and in nothing different from the soil of Carolina: only a few are inhabited. Providence, which is 200 miles east of the Floridas, is the seat of government; though some others are larger and more fertile, on which the English have plantations. Between them and the continent of Florida is the gulf of Bahama or Florida, through which the Spanish galeons sail in their passage to Europe.

These islands are the first fruits of Columbus's discoveries; but they were not known to the English till 1667, when Captain Seyle, being driven among them in his passage to Carolina, gave his name to one of them; and being a second time driven upon it, gave it the name of *Providence*. The English, observing the advantageous situation of these islands for being a check on the French and Spaniards, attempted to settle them in the reign of Charles II. Some unlucky accidents prevented this settlement from being of any advantage; and the isle of Providence became a harbour for the bucaneers or pirates, who for a long time infested the American navigation. This obliged the government in 1718 to send out Captain Woodes Rogers with a fleet to dislodge the pirates, and for making a settlement. This the captain effected; a fort was erected, and an independent company was stationed in the island. Ever since this last settlement these islands have been improving, though they advance but slowly. In 1773 there were 2052 white inhabitants, and 2241 blacks; but in 1803 the whole population was 14,318, of whom 11,395 were persons of colour and blacks. The Spaniards and Americans captured these islands during the last war; but they were retaken by a detachment from St Augustine, April 7. 1783. Cotton is now successfully cultivated; sugar does not succeed so well; but coffee, with oranges, lemons, and most of the tropical fruits, are raised in considerable quantities. Cattle and sheep thrive, and salt is procured in abundance from salt ponds.

BAHAR, or BARRE, in *Commerce*, weights used in several places in the East Indies.

There are two of these weights; one the great bahar, with which they weigh pepper, cloves, nutmegs, ginger, &c. and contains 550 pounds of Portugal, or about 524 lb. 9 oz. avoirdupois weight. With the little bahar, they weigh quicksilver, vermilion, ivory, silk, &c. It contains about 437 lb. 9 oz. avoirdupois weight.

BAHAREN, an island in the Persian gulf, situated in E. Long. 50. 0. N. Lat. 26. 0. This island is chiefly remarkable for its pearl-fishery, and has often changed its masters. It fell with Ormus under the dominion of the Portuguese, was again restored to Persia by Thamas Kouli Khan; and after his death the confusion into which his empire was thrown, gave an opportunity to an enterprising and ambitious Arab of taking possession of the island, where he still maintains his authority. Baharen was famous for its pearl-fishery even at the time when pearls were found at Ormus, Karek, Kashy, and other places in the Persian gulf: but it is now become of much greater consequence; all the other banks having been exhausted, while this has suffered no sensible diminution. The time of fishing begins in April, and ends in October. It is confined to a tract four or five leagues in breadth. The pearls taken at Baharen, though not so white as those of Ceylon or Japan, are much larger than those of the former place, and more regularly shaped than those of the latter. They have a yellowish colour; but have also this good quality, that they preserve their golden hue, whereas the whiter kind lose much of their lustre by keeping, especially in hot countries. The annual revenue from the Baharen pearl-fishery is computed at about 157,500l. The greatest part of the pearls that are uneven are carried to Constantinople and other ports of Turkey, where the larger go to compose ornaments for head-dresses, and the smaller are used in embroideries. The perfect pearls must be reserved for Surat, whence they are distributed through all Indostan.

BAHI, a province of Luçon or Manilla, one of the Philippine islands in the East Indies, belonging to the Spaniards. It is remarkable for producing excellent betel, which the inhabitants, Spaniards as well as natives, perpetually chew from morning till night. It is also the place where most of the ships are built. But the natives suffer much from this work; several hundreds of them being constantly employed in it, on the mountains, or at the port of Cavite. The king allows these labourers a piece of eight per month, with a sufficient quantity of rice. The whole province contains about 6000 tributary natives.

BAHIA, DE TODOS LOS SANCTOS, a province of Brasil in South America, belonging to the Portuguese, and the richest in the whole country; but unhappily the air and climate do not correspond with other natural advantages; yet so fertile is the province in sugar and other commercial articles, that the Portuguese flock hither not only as it is the seat of affluence, but also of pleasure and grandeur. The capital, called *St Salvador*, or *Cividad de Bahia*, is populous, magnificent, and one of the most gay and opulent cities in Brasil. It stands on a bay in S. Lat. 12. 11. is strong by nature, well fortified, and always defended by a numerous garrison. It contains 12,000 or 14,000 Portuguese, and about three times as many negroes, besides people of different nations who choose to reside in that city.

BAHIR, a Hebrew term signifying *famous* or *illustrious;* but particularly used for a book of the Jews, treating of the profound mysteries of the cabbala, being the most ancient of the Rabbinical works.

BAHUS, a strong town of Sweden, and capital of a government of the same name, seated on a rock in a small island, in E. Long. 11. 10. N. Lat. 57. 52.

BAJA, BAYJAH, or BEGIA, a town of the kingdom of Tunis in Africa, supposed to be the ancient *Vacca* of Sallust, and *Oppidum Vaggense* of Pliny. It was

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Baja, Baiæ.

was formerly, and still continues to be, a place of great trade, and the chief market of the kingdom for corn; of which the adjacent territories produce such abundance, that they can supply more than the whole kingdom with it; and the Tunisians say, that if there was in the kingdom such another town as this for plenty of corn, it would become as cheap as sand. Here is also a great annual fair, to which the most distant Arabian tribes resort with their families and flocks. Notwithstanding all this, however, the inhabitants are very poor, and great part of the land about the town remains uncultivated, through the cruel exactions of the government, and the frequent incursions of the Arabs, who are very powerful in these parts. The town stands on the declivity of a hill on the road to Constantina, about ten leagues from the northern coast, and 36 south-west from Tunis; and hath the convenience of being well watered. On the highest part is a citadel that commands the whole place, but is now of no great strength. The walls were raised out of the ruins of the ancient Vacca, and have some ancient inscriptions.

BAJA, a populous town of Hungary, on the Danube, in E. Long. 19. 50. N. Lat. 46. 40.

BAIÆ, an ancient village of Campania in Italy, between the promontory of Misenum and Puteoli, on the Sinus Balanus; famous for its natural hot baths, which served the wealthier Romans for the purposes both of medicine and pleasure. The variety of those baths, the softness of its climate, and the beauty of its landscape, captivated the minds of opulent nobles, whose passion for bathing knew no bounds. Abundance of linen, and disuse of ointments, render the practice less necessary in modern life: but the ancients performed no exercise, engaged in no study, without previous ablutions, which at Rome required an enormous expence in aqueducts, stoves and attendants: a place therefore, where waters naturally heated to every degree of warmth bubble spontaneously out of the ground, in the pleasantest of all situations, was such a treasure as could not be overlooked. Baiæ was this place in the highest perfection; its easy communication with Rome was also a point of great weight. Hither at first retired for a temporary relaxation the mighty rulers of the world, to string anew their nerves and revive their spirits, fatigued with bloody campaigns and civil contests. Their habitations were small and modest; but soon increasing luxury added palace to palace with such expedition and sumptuosity, that ground was wanting for the vast demand; enterprising architects, supported by infinite wealth, carried their foundations into the sea, and drove that element back from its ancient limits: it has since taken ample revenge, and recovered much more than it ever lost. From being a place of resort for a season, Baiæ now grew up to a permanent city: whoever found himself disqualified by age, or infirmity, for sustaining any longer an active part on the political theatre; whoever, from an indolent disposition, sought a place where the pleasures of a town were combined with the sweets of a rural life; whoever wished to withdraw from the dangerous neighbourhood of a court, and the baneful eye of informers, flocked hither to enjoy life untainted with fear and trouble. Such affluence of wealthy inhabitants rendered Baiæ as much a miracle of art as it was before of nature; its splendour may be inferred from its

Swinburne's Sicily.

innumerable ruins, heaps of marbles, mosaics, stucco, and other precious fragments of taste.—It flourished in full glory down to the days of Theodoric the Goth; but the destruction of these enchanted palaces followed quickly upon the irruption of the northern conquerors, who overturned the Roman system, sacked and burnt all before them, and destroyed or dispersed the whole race of nobility. Loss of fortune left the Romans neither the means, nor indeed the thought, of supporting such expensive establishments, which can only be enjoyed in perfection during peace and prosperity. No sooner had opulence withdrawn her hand, than the unbridled sea rushed back upon its old domain; moles and buttresses were torn asunder and washed away; whole promontories, with the proud towers that once crowned their brows, were undermined and tumbled headlong into the deep, where, many feet below the surface, pavements of streets, foundations of houses, and masses of walls, may still be descried. Internal commotions of the earth contributed also largely to this general devastation; mephitic vapours and stagnated waters have converted this favourite seat of health into the den of pestilence, at least during the estival heats: yet Baiæ in its ruined state, and stripped of all its ornaments, still presents many beautiful and striking subjects for the pencil. E. Long. 14. 45. N. Lat. 41. 6.

Baiæ || Bajazet.

BAJADOR, a cape on the west coast of Africa, south of the Canary islands. W. Long. 15. 20. N. Lat. 27. 0.

BAIANUS SINUS, a bay so called from *Baiæ*, (Suetonius); *Portus Baiarum*, (Pliny); which was enlarged by Augustus, by giving entrance to the sea into the Lacus Lucrinus and Averni, ordering it to be called *Portus Julius apud Baias*, (Suetonius). We also read *Baianus Lacus* in Tacitus, which some interpret the *Lucrinus*. The modern name is *Golfo de Pozzuolo*. From the highest point that forms the bay, a large castle commands the road where foreign ships of war usually ride at anchor, the harbour of Naples not being spacious enough for the reception of a fleet; here they enjoy good shelter, watering, and victualling; but in summer risk the health of their crews, on account of the unwholesomeness of the air.

BAJAZET I. sultan of the Turks, a renowned warrior but a tyrant, was conquered by Tamerlane, and exposed by him in an iron cage; the fate he had destined (it is said) for his adversary if he had been the victor.

The iron cage, however, so long and so often repeated as a moral lesson, has been rejected as a fable by modern writers, who smile at the vulgar credulity. They appeal to the Persian history of Sherefeddin Ali, of which a French version has been given, and from which Mr Gibbon has collected the following more specious narrative of this memorable transaction. "No sooner was Timour informed that the captive Ottoman was at the door of his tent, than he graciously stepped forwards to receive him, seated him by his side, and mingled with just reproaches a soothing pity for his rank and misfortune. "Alas! (said the emperor) the decree of fate is now accomplished by your own fault: it is the web which you have woven, the thorns of the tree which yourself have planted. I wished to spare, and even to assist, the champion of the Moslems; you braved our threats, you despised our friendship;

Bajazet. ship; you forced us to enter your kingdom with our invincible armies. Behold the event. Had you vanquished, I am not ignorant of the fate which you reserved for myself and my troops. But I disdain to retaliate: your life and honour are secure; and I shall express my gratitude to God by my clemency to man." The royal captive showed some signs of repentance, accepted the humiliation of a robe of honour, and embraced with tears his son Mousa, who, at his request, was sought and found among the captives of the field. The Ottoman princes were lodged in a splendid pavilion; and the respect of the guards could be surpassed only by their vigilance. On the arrival of the haram from Boursa, Timour restored the queen Despina and her daughter to their father and husband; but he piously required, that the Servian princess, who had hitherto been indulged in the profession of Christianity, should embrace without delay the religion of the prophet. In the feast of victory, to which Bajazet was invited, the Mogul emperor placed a crown on his head, and a sceptre in his hand, with a solemn assurance of restoring him with an increase of glory to the throne of his ancestors. But the effect of this promise was disappointed by the sultan's untimely death: amidst the care of the most skilful physicians, he expired of an apoplexy at Akshehr, the Antioch of Pisidia, about nine months after his defeat. The victor dropped a tear over his grave; his body, with royal pomp, was conveyed to the mausoleum which he had erected at Boursa; and his son Mousa, after receiving a rich present of gold and jewels, of horses and arms, was invested by a patent in red ink with the kingdom of Anatolia.

"Such is the portrait of a generous conqueror, which has been extracted from his own memorials, and dedicated to his son and grandson, 19 years after his decease; and, at a time when the truth was remembered by thousands, a manifest falsehood would have implied a satire on his real conduct. On the other hand, of the harsh and ignominious treatment of Bajazet there is also a variety of evidence. The Turkish annals in particular, which have been consulted or transcribed by Leunclavius, Pocock, and Cantemir, unanimously deplore the captivity of the iron cage; and some credit may be allowed to national historians, who cannot stigmatize the Tartar without uncovering the shame of their king and country." From these opposite premises, Mr Gibbon thinks a fair and moderate conclusion may be deduced. He is satisfied that Sherefeddin Ali has faithfully described the first ostentatious interview, in which the conqueror, whose spirits were harmonized by success, affected the character of generosity. But his mind was insensibly alienated by the unseasonable arrogance of Bajazet; the complaints of his enemies the Anatolian princes, were just and vehement; and Timour betrayed a design of leading his royal captive in triumph to Samarcand. An attempt to facilitate his escape by digging a mine under the tent, provoked the Mogul emperor to impose a harsher restraint; and in his perpetual marches, an iron cage on a waggon might be invented, not as a wanton insult but as a rigorous precaution. Timour had read in some fabulous history a similar treatment of one of his predecessors, a king of Persia; and Bajazet was condemned to represent the person and expiate the guilt of the Roman Cæsar. But the strength of his mind and body fainted under the trial, and his premature death might without injustice be ascribed to the severity of Timour. He warred not, however, with the dead; a tear, and a sepulchre were all that he could bestow on a captive who was delivered from his power; and if Mousa, the son of Bajazet, was permitted to reign over the ruins of Boursa, the greatest part of the province of Anatolia had been restored by the conqueror to their lawful sovereigns.

Bajazet || Bail.

BAIKAL, a great lake in Siberia, lying between 52 and 55 degrees of north latitude. It extends 366 miles in length; its breadth varies from 20 to 53 miles, and its depth from 20 to 90 fathoms. It is environed on all sides by high mountains. In one part of it, which lies near the river Bargusian, it throws up an inflammable sulphureous liquid called *maltha*, which the people of the adjacent country burn in their lamps. There are likewise several sulphureous springs near this lake. Its water at a distance appears of a sea-green colour: it is fresh, and so clear, that objects may be seen in it several fathoms deep. It does not begin to freeze till near the latter end of December, and thaws again about the beginning of May: from which time till September, a ship is seldom known to be wrecked upon it; but by the high winds which then blow, many shipwrecks happen. This lake is called by the neighbouring people *Swiatoie More*, or *the Holy Lake*; and they imagine, that when storms happen on it, they will be preserved from all danger, by complimenting it with the title of *sea*. When it is frozen over, people travel upon it in the road to China; but they must be very sharp shod, otherwise they cannot stand upon the ice, which is exceedingly smooth. Notwithstanding that the ice on this lake is sometimes two ells thick, there are some open places in it to which tempestuous winds will often drive those who are crossing it; in which case they are irrecoverably lost. The camels that pass along have a particular kind of shoes sharp at bottom, and the oxen have sharp irons driven through their hoofs, without which it would be impossible for them to pass. Here are plenty of large sturgeon and pike; with many seals of the black, but none of the spotted, kind. It contains several islands; and the borders are frequented by black sables and civet-cats.

BAIL, Ballium, (from the French *bailler*, which comes of the Greek βαλλειν, and signifies to deliver into hands), is used in our common law for the freeing or setting at liberty of one arrested or imprisoned upon any action, either civil or criminal, on surety taken for his appearance at a day and place certain.

The reason why it is called *bail*, is because by this means the party restrained is delivered into the hands of those that bind themselves for his forthcoming, in order to a safe keeping or protection from prison; and the end of bail is to satisfy the condemnation and costs, or render the defendant to prison.

With respect to bail in civil cases, it is to be observed that there is both common and special bail. Common bail is an action of small concernment, being called *common*, because any sureties in that case are taken; whereas in causes of great weight, as actions upon bonds, or speciality, &c. where the debt amounts to 10l. *special* bail or surety must be taken,

 such

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such as subsidy men at least, and they according to the value.

The commitment of a person being only for safe custody, wherever bail will answer the same intention, it ought to be taken, as in most of the inferior crimes: but in felonies, and other offences of a capital nature, no bail can be a security equivalent to the actual custody of the person. For what is there that a man may not be induced to forfeit to save his own life? and what satisfaction or indemnity is it to the public, to seize the effects of them who have bailed a murderer, if the murderer himself be suffered to escape with impunity? Upon a principle similar to which, the Athenian magistrates, when they took a solemn oath never to keep a citizen in bonds that could give three sureties of the same quality with himself, did it with an exception to such as had embezzled the public money, or been guilty of treasonable practices.

Bail may be taken either in court, or, in some particular cases, by the sheriff or other magistrate; but mostly used by the justices of the peace. To refuse or delay to bail any person bailable, is an offence against the liberty of the subject, in any magistrate, by the common law; as well as by the statute Westm. 1. 3 Edw. I. c. 15. and the *habeas corpus* act, 31 Car. II. c. 2. And, lest the intention of the law should be frustrated by the justices requiring bail to a greater amount than the nature of the case demands, it is expressly declared by statute 1 W. and M. st. 2. c. 1. that excessive bail ought not to be required; though what bail shall be called *excessive*, must be left to the courts, on considering the circumstances of the case, to determine. And on the other hand, if the magistrate take insufficient bail, he is liable to be fined, if the criminal doth not appear.

In *civil* cases, every defendant is bailable. But it is otherwise in

Criminal matters. Regularly, in all offences, either against the common law or act of parliament, that are below felony, the offender ought to be admitted to bail unless it be prohibited by some special act of parliament.—By the ancient common law, before and since the Conquest, all felonies were bailable, till murder was excepted by statute: so that persons might be admitted to bail almost in every case. But the statute West. 1. 3 Edw. I. c. 15. takes away the power of bailing in treason, and in divers instances of felony. The statutes 23 Hen. VI. c. 9. and 1 and 2 Ph. and Mar. c. 13. gave farther regulations in this matter: and upon the whole we may collect, that no justices of the peace can bail. 1. Upon an accusation of treason: nor, 2. Of murder: nor, 3. In case of manslaughter, if the prisoner be clearly the slayer, and not barely suspected to be so; or if any indictment be found against him; nor, 4. Such as, being committed for felony, have broken prison; because it not only carries a presumption of guilt, but is also superadding one felony to another: 5. Persons outlawed: 6. Such as have abjured the realm: 7. Persons taken with the mainour, or in the fact of felony: 8. Persons charged with arson: 9. Excommunicated persons, taken by writ *de excommunicato capiendo*: all which are clearly not admissible to bail by the justices. Others are of a dubious nature; as, 10. Thieves openly defamed and known: 11. Persons charged with other felonies, or manifest and enormous offences, not being of good fame: and, 12. Accessories to felony, that labour under the same want of reputation. These seem to be in the discretion of the justices, whether bailable or not. The last class are such as *must* be bailed upon offering sufficient surety; as, 13. Persons of good fame, charged with a bare suspicion of manslaughter, or other infamous homicide: 14. Such persons being charged with petit larceny or any felony, not before specified: or, 15. With being accessory to any felony. Lastly, it is agreed, that the court of king's bench, (or any judge thereof in time of vacation) may bail for any crime whatsoever, be it treason, murder, or any other offence, according to the circumstances of the case. And herein the wisdom of the law is very manifest. To allow bail to be taken commonly for such enormous crimes, would greatly tend to elude the public justice: and yet there are cases, though they rarely happen, in which it would be hard and unjust to confine a man in prison, though accused even of the greatest offence. The law has therefore provided one court, and only one, which has a discretionary power of bailing in any case: except only, even to this high jurisdiction, and of course to all inferior ones, such persons as are committed by either house of parliament, so long as the session lasts; or such as are committed for contempts by any of the king's superior courts of justice. See Law.

Clerk of the Bails, is an officer belonging to the court of the kings bench: he files the bail-pieces taken in that court, and attends for that purpose.

Bail, or Bale, in the sea-language. The seamen call throwing the water by hand out of the ship's or boat's hold, *bailings*. They also call those hoops that bear up the tilt of a boat, its *bails*.

BAILIE, in *Scots Law*, a judge anciently appointed by the king over such lands not erected into a regality as happened to fall to the crown by forfeiture or otherwise, now abolished. It is also the name of a magistrate in royal boroughs, and of the judge appointed by a baron over lands erected into a barony. See Law.

BAILIFF, (*ballivus*) from the French word *bayliff*, that is, *præfectus provinciæ;* and as the names of the office itself was answerable to that of France; where there are eight parliaments, which are high courts from whence there lies no appeal, and within the precincts of the several parts of that kingdom which belong to each parliament there are several provinces to which justice is administered by certain officers called *bailiffs:* and in England there are several counties in which justice hath been administered to the inhabitants by the officer who is now called *sheriff* or *viscount* (one of which names descends from the Saxons, the other from the Normans); and though the sheriff is not called *bailiff*, yet it is probable that was one of his names also, because the county is often called *balliva*. And in the statute of Magna Charta, cap. 28. and 14 Ed. III. c. 9. the world *bailiff* seems to comprise as well sheriffs as bailiffs of hundreds. As the realm is divided into counties, so every county is divided into hundreds; within which in ancient times the people had justice ministered to them by the officers of every hundred. But now the hundred courts, except certain franchises, are swallowed up in the county-courts; and the bailiff's bailiff's name and office is grown into contempt, they being generally officers to serve writs, &c. within their liberties. Though in other respects, the name is still in good esteem: for the chief magistrates in divers towns are called *bailiffs*, or *bailies;* and sometimes the persons to whom the king's castles are committed are termed *bailiffs*, as the *bailiff of Dover Castle*, &c.

Of the ordinary bailiffs there are several sorts, viz. sheriffs bailiffs, bailiffs of liberties, &c.

Sheriffs bailiffs, or sheriffs officers, are either bailiffs of hundreds, or special bailiffs. Bailiffs of hundreds are officers appointed over those respective districts by the sheriffs, to collect fines therein; to summon juries; to attend the judges and justices at the assises and quarter sessions; and also to execute writs and process in the several hundreds. But as these are generally plain men, and not thoroughly skilful in this latter part of their office, that of serving writs and making arrests and executions, it is now usual to join special bailiffs with them; who are generally mean persons employed by the sheriffs on account only of their adroitness and dexterity in hunting and seizing of their prey.

Bailiffs of liberties are those bailiffs who are appointed by every lord within his liberty, to execute process, and do such offices therein as the bailiff errant doth at large in the county; but bailiffs errant or itinerant, to go up and down the county to serve process, are out of use.

There are also bailiffs of forests, and bailiffs of manors, who direct husbandry, fell trees, gather rents, pay quit-rent, &c.

Water-Bailiff, an officer appointed in all port-towns, for the searching of ships, gathering the toll for anchorage, &c. and arresting persons for debts, &c. on the water.

BAILII, David, painter of perspective views and portraits, was the son of Peter Bailii, an artist of some note; and was born at Leyden in 1584. From his father he learned to draw and design; but he was afterwards placed under the care of Adrian Verburg, and continued with him for some time; and when he quitted that master, he studied to much greater advantage with Cornelius Vandervoort, an excellent portrait painter, and with him he spent about six years. As Vandervoort possessed many capital paintings of some great masters, Bailii, for his own improvement, copied them with critical care and observation; and particularly copied one perspective view of the inside of a church, originally painted by Stenwyck, which he finished with such accuracy, that even Stenwyck himself could scarcely determine which was the original, or which the copy when both were placed before him. He travelled through several parts of Italy to see the works of the celebrated masters of that country, and for a few years resided at Rome; and abroad, as well as in his own country, the correctness of his drawing, and the delicate handling of his pictures, procured him employment, admirers, and friends. In the latter part of his life he discontinued painting, and only drew portraits on vellum with a pen, which he heightened with black lead, and gave them wonderful force and roundness. He died in 1638.

BAILIWICK, that liberty which is exempted from the sheriff of the county; over which liberty the lord thereof appoints his own bailiff, with the like power within his precinct as an under sheriff exercises under the sheriff of the county: Or it signifies the precinct of a bailiff, or the place within which his jurisdiction is terminated.

BAILLET, Adrian, a very learned French writer and critic, born in 1649 at the village of Neuville near Beauvais in Picardy. His parents were too poor to give him a proper education, which, however, he obtained by the favour of the bishop of Beauvais, who afterwards presented him with a small vicarage. In 1680 he was appointed librarian to M. de Lamoignon, advocate-general to the parliament of Paris; of whose library he made a copious index in 35 vols. folio, all written with his own hand. He died in 1706, after writing many works, the principal of which are, *A History of Holland from 1609, to the peace of Nimeguen in 1679*, 4 vols. 12mo; *Lives of the Saints*, 3 vols. folio, which he professed to have purged from fables; *Jugemens des Sçavans*, which he extended to 9 vols. 12mo.; and *The Life of Des Cartes*, 2 vols. 4to, which he abridged, and reduced to one vol. 12mo.

BAILLEUL, a town of France, in the department of the North, formerly very strong, but now without any fortifications. It has been several times burnt by accident, and contains now only about 500 houses. E. Long. 2. 45. N. Lat. 50. 45.

BAILLY, Jean Sylvain, a celebrated philosopher and astronomer, was born at Paris on the 15th September 1736. He was originally intended for the profession of painting, which his family had pursued for several generations, and he even had made some progress in the art. But the bias of his mind leaned too much to literary pursuits, especially to poetry, and works of imagination, to permit him to give that application which is necessary to secure success and eminence in any profession.

The friends of Bailly, who had witnessed the early dawn of his genius, saw that it was equally fitted to appear with advantage in the study of polite literature, or to shine in the walks of science: and recommended the latter chiefly to his attention. His acquaintance with La Caille the celebrated geometer commenced, and this at once decided the object of his studies, which were now almost entirely devoted to scientific investigations. The first of his labours was the calculation of the comet which appeared in the year 1759. In January 1763, he was admitted a member of the Academy of Sciences; and in the same year he published a reduction of the observations made by La Caille in 1760 and 1761 on the zodiacal stars; an elaborate compilation, and of extensive utility. His attention was afterwards directed to the consideration of the theory of Jupiter's satellites. La Grange, who now promised to be the first mathematician in Europe, was the formidable rival of Bailly in the competition for this prize question in 1764. The results of his investigations were collected into a treatise, which also contained the history of that part of astronomy, and were published in 1766. In 1771 appeared his interesting and important memoir on the Light of the Satellites, which was marked with a degree of precision and accuracy till that time altogether unknown in the observations of their eclipses.

The studies of Bailly were not entirely limited to the cultivation of abstract science, or to profound physical

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sical speculations; his genius shone with equal lustre in those departments of literature which require the rare talent of nice discrimination of characters, and no common power of eloquence, to reach excellence. The eloges which he composed for Charles V. Corneille, Leibnitz, Moliere, Cook, La Caille, and Gresset, were universally admired as valuable specimens of fine writing, and added much to his reputation. The distinguished place of secretary of the Academy of Sciences became vacant in 1771; and supported by the patronage and influence of Buffon, he offered himself a candidate. But here he was unsuccessful. Condorcet, who was then rising into reputation, and was supported by the active influence of D'Alembert, was preferred to the office.

In the year 1775, he published at Paris the first volume of the "History of Ancient Astronomy." The second volume of the same work appeared in 1787. In 1779 he gave to the world his "History of Modern Astronomy," from the foundation of the Alexandrian school to the present age. These works are of inestimable value, distinguished by animated description, luminous narration, and interesting detail. He also published a work entitled, "Letters on the Origin of the Sciences, and of the People of Asia;" which was afterwards followed by another series of "Letters on the Atlantis of Plato, and the ancient History of Asia," as a continuation of the same work. These volumes were addressed to Voltaire, with whom he had commenced an ingenious correspondence and discussion on this curious subject. The coincidence of his opinions with those of Buffon in points respecting some of the favourite theories of the latter, brought him into an intimate acquaintance and close friendship with that celebrated naturalist, which, however, declined and was entirely dissolved, in consequence of the opposition which Bailly made to the election of the abbé Maury into the French Academy. Bailly had been chosen secretary of this academy in 1784; and in the following year he was admitted into the Academy of Inscriptions and Belles Lettres. This was the only instance, since the time of Fontenelle, of the same person being at once a member of all the three academies.

In the year 1784 he was nominated one of the commission to investigate the nature of the animal magnetism of Mesmer, which was practised by Deslon; and he drew up an elegant report, which was presented to the Academy of Sciences. This report, which was soon afterwards translated into English, not only marked the acuteness and discernment of the author, and contained the most satisfactory and decisive evidence with regard to its object, but may be held up as an excellent model of imitation for those who are engaged in similar investigations. In developing the physical effects produced by moral causes, it is of the greatest value; and it is particularly interesting when we consider the political influence which causes of this nature have imposed on the general opinions of society, and even on the destiny of nations.

Hitherto we have contemplated Bailly in the shades of retirement, and in the calm undisturbed retreats of philosophy, employing the energy of a vigorous and comprehensive mind in the profound researches of physical truth: we are now to follow him in his political career, and behold him struggling with the adverse interests of party faction, and contending with the unbridled fury of a lawless mob, in defence of the rights of a people whose minds were not prepared to understand, and whose habits were not yet formed to enjoy, the blessings of rational liberty. He was one of the first and most zealous promoters of the revolution in France,—a revolution which not only astonished and convulsed all Europe, but of which the immediate consequences to themselves, and to their country, were neither foreseen nor imagined by those who embarked in it, nor can its ultimate effects even at the present period be appreciated or conjectured,—a revolution which holds out an awful lesson to the leaders of popular faction to curb and repress, rather than to excite and encourage, that spirit of tumult and disorder among a people thrown loose from the necessary restraints of law, which bursts forth with ungovernable fury, and at last involves all in one general ruin. In the part which he acted in this bloody struggle, Bailly has had the good fortune to be well spoken of by opposite parties. He has not been charged with want of integrity or selfish designs in any part of his conduct; but actuated by a misguided zeal, and dazzled with the prospect of freedom which the warmth of imagination held out, he rashly stepped forward in a cause which he espoused with enthusiasm, and supported with his utmost exertions. But in that cause he fell a sacrifice to the unrelenting spirit of violence and party faction which had been roused, and which could neither be subdued nor regulated. When the states-general of France were assembled in 1789, he was elected a deputy to the *Tiers Etat;* was afterwards chosen president; and when the national assembly was constituted, he continued in the chair, and was president at the time that the king's proclamation was issued ordering them to disperse. During the struggle which took place between the popular part of the assemblies and the court, Bailly was among the most forward in asserting those popular rights which were then new in France: and he dictated the famous oath to the members of the *Tiers Etat,* "to resist tyrants and tyranny, and never to separate till they had obtained a free constitution." On the 14th of July following, the day on which the Bastile was stormed and taken by the people, he was appointed, with universal consent, mayor of Paris. In this high office, he is allowed to have discharged the arduous and difficult duties of it with great integrity, courage, and moderation. And while he held this conspicuous situation, he was a powerful agent in promoting the various measures by which the popular party prevailed over that of the court: and for this, and various other popular actions, he obtained a high degree of favour among the people. But the tide of public opinion now swelled beyond all bounds; no restraint could oppose its violent course. The multitude, unshackled by the fetters of despotism, fond of novelty, and with enthusiastic and unsettled notions of freedom, daily panting for change, could bear no opposition. Bailly, who perhaps now saw when it was too late the general disposition of the people to anarchy, still wished the laws to be respected, and hoped by their vigorous execution to restore and preserve tranquillity. He ordered some deputies from the military insurgents of Nancy to be arrested, and he firmly opposed the rash proceedings of Marat and Hubert; he became

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came a member of a less promiscuous club than that of the Jacobins; and exerted himself strongly to persuade the populace to permit the king and royal family to depart to St Cloud. But these measures, which were little relished by a frantic and lawless people, he lost their confidence and favour. But what finally destroyed his popularity, was the tumultuous meeting of the populace on the 17th of July 1791, to demand the abolition of monarchy, when, being called by the national assembly to disperse the mob, who had assaulted the soldiery, he ordered the latter to fire, by which 40 persons were killed and above 100 wounded. Thus become obnoxious to the people whom he had faithfully served, it was no longer desirable for him to hold his charge. He therefore resigned his office at the dissolution of the constituent assembly in the end of the year 1791. After this period he lived in retirement, having resumed his philosophical researches. But the times of bloody proscription approached, and he must fall a sacrifice to the ferocious vengeance of the tyrant who now bore unlimited sway. He was accordingly denounced as an enemy to the republic, apprehended and thrown into prison. He was arraigned before a sanguinary tribunal, summarily condemned to death as a conspirator, and was executed the day following, near the spot where he had given the order for the military to fire on the people. On the day of execution, his sufferings, which he bore with the utmost calmness and magnanimity, were studiously protracted. Instead of that sympathy and compassion which even the worst and the lowest criminal often experiences when he is about to expiate his offences with his life, he was treated by an incensed and barbarous populace, with the most ignominious indignity and cruelty. He wore the red shirt, or badge of conspiracy, and was placed in a cart, with his hands tied behind his back. During the whole time of his progress to the place of execution, the rain poured incessantly on his head. The populace as he passed threw mud at him, and cruelly insulted him with every kind of opprobrious language. It was found necessary to remove the guillotine from the place where it was first erected to firmer ground. During this time he was forced to get out of the cart, and walk round the field, to gratify more fully the implacable and unrelenting malice of the mob. When he was ascending the platform, a spectator who was near him, in a tone of insult exclaimed, "Bailly, you tremble: "Yes (he instantly replied), but not with fear."

Thus perished Bailly in the 57th year of his age. In his person he was tall, and of a sedate but striking countenance. He possessed great firmness and decision of character, but far removed from sullenness or apathy. Few philosophers have been more distinguished in so many various departments of science and literature, or have acquired such deserved reputation. In his public stations, as well as in the retirement of domestic life, his integrity and disinterestedness remained pure and untainted. In the time of his magistracy he spent part of his fortune in relieving the wants of the poor. His wife, whom he married in 1787, survived him. She was the widow of Raymond Gaye, who had been his intimate friend 25 years.

BAILMENT, in *Law*, is a delivery of goods in trust upon a contract, expressed or implied, that the trust shall be faithfully executed on the part of the bailee. As if cloth be delivered, or (in our legal dialect) bailed, to a taylor to make a suit of clothes, he has it upon an implied contract to render it again when made, and that in a workmanly manner. If money or goods be delivered to a common carrier to convey from Oxford to London, or from Glasgow to Edinburgh, &c. he is under a contract in law to pay, or carry them to the person appointed. If a horse or other goods be delivered to an innkeeper or his servants, he is bound to keep them safely, and restore them when his guest leaves the house. If a man takes in a horse, or other cattle, to graze and depasture in his grounds, which the law calls *agistment*, he takes them upon an implied contract to return them on demand to the owner. If a pawnbroker receives plate or jewels as a pledge or security for the repayment of money lent thereon at a day certain, he has them upon an express contract or condition to restore them if the pledger performs his part by redeeming them in due time; for the due execution of which contract, many useful regulations are made by statute 30 Geo. II. c. 24. And so, if a landlord distrains goods for rent, or a parish officer for taxes, these for a time are only a pledge in the hands of the distrainers; and they are bound by an implied contract in law to restore them on payment of the debt, duty, and expences, before the time of sale; or when sold, to render back the overplus. If a friend delivers any thing to his friend to keep for him, the receiver is bound to restore it on demand: and it was formerly held, that in the mean time he was answerable for any damage or loss it might sustain, whether by accident or otherwise; unless he expressly undertook to keep it only with the same care as his own goods, and then he should not be answerable for theft or other accidents. But now the law seems to be settled on a much more rational footing; that such a general bailment will not charge the bailee with any loss, unless it happens by gross neglect, which is construed to be an evidence of fraud: but if the bailee undertakes specially to keep the goods safely and securely, he is bound to answer all perils and damages that may befal them for want of the same care with which a prudent man would keep his own.

BAILO; thus they style at Constantinople the ambassador of the republic of Venice, who resides at the Porte. This minister, besides the political charge, acts there the part of a consul of Venice.

BAINBRIDGE, Dr John, an eminent physician and astronomer, born at Ashby de la Zouche in Leicestershire, in 1582. He taught a grammar school for some years, and practised physic, employing his leisure hours in astronomy, which was his favourite study: at length he removed to London, was admitted a fellow of the college of physicians, and raised his character by his description of the comet in 1618. The next year Sir Henry Savile appointed him his first professor of astronomy at Oxford; and the masters and fellows of Merton-college made him first junior, and then superior, reader of Linacre's lecture. He died in 1643, having written many works, some of which have never been published: but the MSS. are preserved in the library of Trinity-college, Dublin.

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BAIOCAO, a copper coin, current at Rome, and throughout the whole state of the church, ten of which make a julio, and a hundred a Roman crown.

BAIRAM, or BEIRAM, a Turkish word which signifies a solemn feast. The Mahometans have two Bairams, the *Great* and the *Little*. The *Little* Bairam is properly that held at the close of the fast Ramazan, beginning with the first full moon in the following month Shawal. This is called in Arabic *Id al Fetz*, or *the Feast of breaking the Fast;* by European writers, *the Turkish Easter*, because it succeeds Ramazan, which is their Lent, more usually the *Great Bairam*, because observed with great ceremony and rejoicing at Constantinople, and through Turkey, for three days, and in Persia for five six days, at least by the common people, to make themselves amends for the mortification of the preceding month. The feast commencing with the new moon, the Mahometans are very scrupulous in observing the time when the new moon commences; to which purpose, observers are sent to the tops of the highest mountains, who, the moment they spy the appearance of a new moon, run to the city, and proclaim *Mushdaluk*, "welcome news;" as it is the signal for beginning the festivity.—The *Great Bairam*, is properly that held by the pilgrims at Mecca, commencing on the tenth of Dhu'lhajia, when the victims are slain, and lasting three drys. This is called by the Arabs *Id al adha*, that is, *the feast of sacrifice*, as being celebrated in memory of the sacrifice of Abram, whose son God redeemed with a great victim. By European writers it is called the *Lesser Bairam*, as being less taken notice of by the generality of the people, who are not struck with it, because the ceremonies it is observed withal, are performed at Mecca, the only scene of the solemnity.—On the feast of Bairam, after throwing little stones, one after another, into the valley of Mina, they usually kill one or more sheep, some a goat, bullock, or even a camel; and after giving a part thereof to the poor, eat the rest with their friends. After this, they shave themselves. The second is a day of rest. On the third, they set out on their return home.

BAIRUT. See BEEROOT.

BAIT, among fishermen, implies a substance proper to be fastened to a hook, in order to catch the different sorts of fish. See FISHING.

BAITING, the act of smaller or weaker beasts attacking and harassing greater and stronger. In this sense we hear of the baiting of bulls or bears by mastiffs or bull-dogs with short noses, that they may take the better hold.

Utility is pled in justification of *bull-baiting*. This animal is rarely killed without being first baited; the chafing and exercise whereof makes his flesh tenderer and more digestible. In reality, it disposes it for putrefaction; so that, unless taken in time, baited flesh is soon lost. But a spirit of barbarism had the greatest share in supporting the sport: bulls are kept on purpose, and exhibited as standing spectacles for the public entertainment. The poor beasts have not fair play: they are not only tied down to a stake, with a collar about their necks and a short rope, which gives them not above four or five yards play; but they are disarmed too, and the tips of their horns cut off, or covered with leather, to prevent their hurting the dogs. In this sport, the chief aim of the dog is to catch the bull by the nose, and hold him down; to which end he will even creep on his belly: the bull's aim, on the contrary, is, with equal industry, to defend his nose; in order to which, he thrusts it close to the ground, where his horns are also in readiness to toss the dog.—Bull-baiting was first introduced into England as an amusement in the reign of King John, about 1209.

BAJULUS, an ancient officer in the court of the Greek emperors. There were several degrees of bajuli; as, the grand *bajulus*, who was preceptor to the emperor; and the simple *bajuli*, who were sub-preceptors. The word is derived from the Latin verb *bajulare*, "to carry or bear a thing on the arms or on the shoulders;" and the origin of the office is thus traced by antiquaries. Children, and especially those of condition, had anciently, beside their nurse, a woman called *gerula*, as appears from several passages of Tertullian; when weaned, or ready to be weaned, they had men to carry them about and take care of them, who were called *geruli* and *bajuli*, *à gerendo et bajulando*. Hence it is, that governors of princes and great lords were still denominated *bajuli*, and their charge or government *bajulatio*, even after their pupils were grown too big to be carried about. The word passed in the same sense into Greece.

BAJULUS is also used by Latin writers in the several other senses wherein BAILIFF is used among us.

BAJULUS was also the name of a conventual officer in the ancient monasteries, to whom belonged the charge of gathering and distributing the money and legacies left for masses and obits; whence he was also denominated *bajulus obituum novorum*.

BAKAN, a large and handsome town of Asia in the East Indies, in the kingdom of Ava. E. Long. 98. 0. N. Lat. 19. 33.

BAKER, SIR RICHARD, author of the Chronicle of the Kings of England, was born at Sessinghers̄t, in Kent, about the year 1568. After going through the usual course of academical learning at Hart-hall, in Oxford, he travelled into foreign parts; and upon his return home was created master of arts, and soon after, in 1603, received from King James I. the honour of knighthood. In 1620, he was high sheriff of Oxfordshire; but engaging to pay some of the debts of his wife's family, he was reduced to poverty, and obliged to betake himself for shelter to the Fleet prison, where he composed several books; among which are, 1. Meditations and Disquisitions on the Lord's Prayer. 2. Meditations, &c. on several of the Psalms of David. 3. Meditations and Prayers upon the seven Days of the Week. 4. *Cato Variegatus*, or Cato's Moral Distichs varied, &c.—Mr Granger observes, that his Chronicle of the Kings of England was ever more esteemed by readers of a lower class than by such as had a critical knowledge of history. The language of it was, in this reign, called polite; and it long maintained its reputation, especially among country gentlemen. The author seems to have been sometimes more studious to please than to inform, and with that view to have sacrificed even chronology itself to method. In 1658, Edward Philips, nephew to Milton, published a third edition of this work, with the addition of the reign of Charles I. It has been several times reprinted since, and is now carried as low as the reign of George I.

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Baker.

Sir Richard also translated several works from the French and Italian; and died very poor in the Fleet prison, on the 18th of February 1645.

BAKER, *Thomas*, an eminent mathematician, was born at Ilton in Somersetshire about the year 1625, and entered at Magdalen hall, Oxon, in 1640; after which he was vicar of Bishop's-Nymmet, in Devonshire, where he wrote The Geometrical Key, or the Gate of Equations unlocked; by which he gained a considerable reputation. A little before his death, the members of the Royal Society sent him some mathematical queries, to which he returned so satisfactory an answer, that they presented him a medal with an inscription full of honour and respect. He died at Bishop's Nymmet on the 5th of June 1690.

BAKER, *Thomas*, a very ingenious and learned antiquary, descended from a family ancient and well esteemed, distinguished by its loyalty and affection for the crown, was born at Crook in 1656. He was educated at the free school at Durham, and thence removed to St John's college Cambridge in 1674. He proceeded B. A. 1677; M. A. 1681; was elected fellow, March 1679-80; ordained deacon by Bishop Compton of London, December 20. 1685; priest by Bishop Barlow of Lincoln, December 19. 1686. Dr Watson tutor of the college, who was nominated, but not yet consecrated, bishop of St David's, offered to take him for his chaplain, which he declined, probably on the prospect of a like offer from Lord Crew bishop of Durham, which he soon after accepted. His lordship collated him to the rectory of Long-Newton in his diocese, and the same county, June 1687; and, as Dr Grey was informed by some of the bishop's family, intended to have given him that of Sedgefield, worth 600l. or 700l. a-year, with a golden prebend, had he not incurred his displeasure and left his family for refusing to read King James II.'s declaration for liberty of conscience. The bishop, who disgraced him for this refusal, and was excepted out of King William's pardon, took the oaths to that king, and kept his bishopric till his death. Mr Baker resigned Long Newton August 1. 1690, refusing to take the oaths; and retired to his fellowship at St John's, in which he was protected till January 20. 1716-17, when, with one-and twenty others, he was dispossessed of it. After the passing the Registering Act 1723, he was desired to register his annuity of 40l. which the last act required before it was amended and explained. Though this annuity, left him by his father for his fortune, with 20l. per annum out of his collieries by his elder brother from the day of his death August 1699, for the remaining part of the lease, which determined at Whitsuntide 1722, was now his whole subsistence, he could not be prevailed on to secure himself, against the act. He retained a lively resentment of his deprivations; and wrote himself in all his books, as well as in those which he gave to the college library, *socius ejectus*, and in some *ejectus rector*. He continued to reside in the college as commoner-master, till his death, which happened July 2. 1740, of a paralytic stroke, being found on the floor of his chamber. In the afternoon of June 29. being alone in his chamber, he was struck with a slight apoplectic fit; which abating a little, he recovered his senses, and knew all about him, who were his nephew Burton, Drs Bedford and Heberden. He seemed perfectly satisfied and resigned; and when Dr Bedford desired him to take some medicine then ordered, he declined it, saying, he would only take his usual sustenance, which his bed-maker knew the times and quantities of giving: he was thankful for the affection and care his friends showed him; but, hoping the time of his dissolution was at hand, would by no means endeavour to retard it. His disorder increased, and the third day from this seizure he departed. Being appointed one of the executors of his elder brother's will, by which a large sum was bequeathed to pious uses, he prevailed on the other two executors, who were his other brother Francis and the Hon. Charles Montagu, to lay out 1310l. of the money upon an estate to be settled upon St John's college for six exhibitioners. He likewise gave the college 100l. for the consideration of 6l. a-year (then only legal interest) for his life; and to the library several choice books, both printed and MS. medals, and coins; (besides what he left to it by his will; which were "all such books, printed and MS. as he had, and were wanting there." All that Mr Baker printed was, 1. "Reflections on Learning, showing the insufficiency thereof in its several particulars, in order to evince the usefulness and necessity of Revelation, Lond. 1709-10," (which went through eight editions: and Mr Boswel, in his "Method of Study," ranks it among the English classics for purity of style); and, 2. "The preface to Bishop Fisher's Funeral Sermon for Margaret countess of Richmond and Derby, 1708; both without his name. Dr Grey had the original MS. of both in his own hands. The latter piece is a sufficient specimen of the editor's skill in antiquities to make us regret that he did not live to publish his "History of St John's College from the foundation of old St John's house to the present time; with some occasional and incidental account of the affairs of the university, and of such private colleges as held communication or intercourse with the old house or college: collected principally from MSS. and carried on through a succession of masters to the end of Bishop Gunning's mastership, 1670." The original, fit for the press, is among the Harleian MSS. N° 7028. His MS. collections relative to the history and antiquities of the university of Cambridge, amounting to 49 volumes in folio and three in quarto, are divided between the British Museum and the public library at Cambridge; the former possesses 23 volumes, which he bequeathed to the earl of Oxford, his friend and patron; the latter 16 in folio and three in quarto, which he bequeathed to the university. Dr Knight styles him "the greatest master of the antiquities of this our university;" and Hearne says, *Optandum est ut sua quoque collectanea de antiquitatibus Cantabrigiensibus juris faciat publici Cl. Bakerus, quippe qui eruditione summa judicioque acri et subacto polleat.* Mr Baker intended something like an *Athenæ Cantabrigienses*, on the plan of the *Athenæ Oxonienses*.

BAKER, *Henry*, an ingenious and diligent naturalist, was born in Fleet-street London, either near the end of the 17th, or very early in the beginning of the 18th, century. His father's profession is not known; but his mother was, in her time, a midwife of great practice. He was brought up under an eminent bookseller, who preceded the elder Dodsley, to the business of a bookseller; in which, however, he appears

Baker.

pears not to have engaged at all after his apprenticeship; or, if he did, it was soon relinquished by him: for though it was in his power to have drawn away all his master's best customers, he would not set up against him. Mr Baker being of a philosophical turn of mind, and having diligently attended to the methods which might be practicable and useful in the cure of stammering, and especially in teaching deaf and dumb persons to speak, he made this the employment of his life. In the prosecution of so valuable and difficult an undertaking, he was very successful; and several of his pupils, who are still living, bear testimony to the ability and good effect of his instructions. He married Sophia, youngest daughter of the famous Daniel Defoe, who brought him two sons, both of whom he survived. On the 29th of January 1740, Mr Baker was elected a fellow of the Society of Antiquaries; and, on the 12th of March following, the same honour was conferred upon him by the Royal Society. In 1744, Sir Godfrey's Copley's gold medal was bestowed upon him, for having, by his microscopical experiments on the crystallizations and configuration of saline particles, produced the most extraordinary discovery during that year. Having led a very useful and honourable life, he died at his apartments in the Strand on the 25th of November 1774, being then above 70 years of age. His wife had been dead some time before; and he only left one grandson, William Baker, who was born February 17. 1763, and to whom, on his living to the age of 21, he bequeathed the bulk of his fortune, which he had acquired by his profession of teaching deaf and dumb persons to speak. His furniture, printed books (but not MSS.), curiosities, and collections of every sort, he directed should be sold, which was accordingly done. His fine collection of native and foreign fossils, petrifactions, shells, corals, vegetables, ores, &c. with some antiquities and other curiosities, were sold by auction March 13. 1775, and the nine following days. He was buried, as he desired, in an unexpensive manner, in the churchyard of St Mary-le-strand; within which church, on the south wall, he ordered a small tablet to be erected to his memory. "An inscription for it (he said) would probably be found among his papers; if not, he hoped some learned friend would write one agreeable to truth." This friendly office, however, remains as yet to be performed. Mr Baker was a constant and useful attendant at the meetings of the Royal and Antiquarian Societies, and in both was frequently chosen one of the council. He was peculiarly attentive to all the new improvements which were made in natural science, and very solicitous for the prosecution of them. Several of his communications are printed in the Philosophical Transactions; and besides the papers written by himself, he was the means, by his extensive correspondence, of conveying to the society the intelligence and observations of other inquisitive and philosophical men, both at home and abroad. The Society for the encouragement of arts, manufactures, and commerce, is under singular obligations to our worthy naturalist. As he was one of the earliest members of it, so he contributed in no small degree to its rise and establishment. At its first institution he officiated for some time *gratis* as secretary. He was many years chairman of the committee of accounts; and he took an active part in the general deliberations of the society. He drew up a short account of the original of this society, and of the concern he himself had in forming it; which was read before the society of antiquaries, and would be a pleasing present to the public. Mr Baker was a poetical writer in the early part of his life. His *Invocation of Health* got abroad without his knowledge; but was reprinted by himself in his *Original Poems, serious and humorous*, Part I. 8vo. 1725. Part II. came out in 1726. Among these poems are some tales as witty and as loose as Prior's. He was the author likewise of *The Universe*, a poem intended to restrain the pride of man; which has been several times reprinted. His account of the water polype, which was originally published in the Philosophical Transactions, was afterwards enlarged into a separate treatise, and hath gone through several editions. But his principal publications are, *The Microscope made Easy*, and *Employment for the Microscope*. The first of these, which was originally published in 1742 or 1743, hath gone through six editions. The second edition of the other, which, to say the least of it, is equally pleasing and instructive, appeared in 1764. These treatises, and especially the latter, contain the most curious and important of the observations and experiments which Mr Baker either laid before the Royal Society or published separately. It has been said of Mr Baker, that *he was a philosopher in little things*. If it was intended by this language to lessen his reputation, there is no propriety in the stricture. He was an intelligent, upright, and benevolent man, much respected by those who knew him best. His friends were the friends of science and virtue: and it will always be remembered by his contemporaries, that no one was more ready than himself to assist those with whom he was conversant in their various researches and endeavours for the advancement of knowledge and the benefit of society.

Baker.

BAKER, *David Erskine*, son to the former, was a young man of genius and learning. Having been adopted by an uncle, who was a silk-throwster in Spitalfields, he succeeded him in the business; but wanted the prudence and attention which are necessary to secure prosperity in trade. He married the daughter of Mr Clendon, a reverend empiric. Like his father, he was both a philosopher and a poet; and wrote several occasional poems in the periodical collections, some of which were much admired at the time; but so violent was his turn for dramatic performance, that he repeatedly engaged with the lowest strolling companies, in spite of every effort of his father to reclaim him. The public was indebted to him for "The Companion to the Play-house," in two volumes, 1764, 12mo; a work which, though imperfect, had considerable merit, and showed that he possessed a very extensive knowledge of our dramatic authors; and which has since (under the title of "Biographia Dramatica") been considerably improved by the attention of a gentleman in every respect well qualified for the undertaking.

BAKER, a person whose occupation or business is to bake bread. See the articles BAKING and BREAD.

The learned are in great doubt about the time when baking first became a particular profession, and bakers were introduced. It is however generally agreed, that they had their rise in the east, and passed from Greece

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to Italy after the war with Pyrrhus, about the year of Rome 583. Till which time every housewife was her own baker; for the word *pistor*, which we find in Roman authors before that time, signified a person who ground or pounded the grain in a mill or mortar to prepare it for baking, as Varro observes. According to Athenæus, the Cappadocians were the most applauded bakers, after them the Lydians, then the Phœnicians.—To the foreign bakers brought into Rome, were added a number of freedmen, who were incorporated into a body, or, as they called it, a *college;* from which neither they nor their children were allowed to withdraw. They held their effects in common, and could not dispose of any part of them. Each bake-house had a patronus, who had the superintendency thereof; and these patroni elected one out of their number each year, who had superintendence over all the rest, and the care of the college. Out of the body of the bakers every now and then one was admitted among the senators.—To preserve honour and honesty in the college of bakers, they were expressly prohibited all alliance with comedians and gladiators; each had his shop or bake-house, and they were distributed into fourteen regions of the city. They were excused from guardianships and other offices, which might divert them from their employment.—By our own statutes, bakers are declared not to be handicrafts. No man for using the mysteries or sciences of baking, brewing, surgery, or writing, shall be interpreted a handicraft. The bakers were a brotherhood in England before the year 1155, in the reign of King Henry II. though the white bakers were not incorporated till 1407, by King Edward III. and the brown bakers not till 1621, in King James I.'s time. Their hall is in Harp-lane, Thames-street; and their court-day on the first Monday of the month.—They make the 19th company; and consist of a warden, 4 masters, 30 assistants, and 140 men on the livery, besides the commonalty.—The French had formerly a great baker, *grand panetier de France*, who had the superintendency of all the bakers of Paris. But since the beginning of this century, they have been put under the jurisdiction of the lieutenant-general *de police*. In some provinces of France, the lord is the only baker in his seigneury; keeping a public oven, to which all the tenants are obliged to bring their bread. This right is called *furnagium*, or *furnaticum*, and makes part of the *bannalite*.

BAKEWELL, a pretty large town of Derbyshire in England, seated on the river Wye, on the north side of the Peak. It has a considerable trade in lead. W. Long. 2. 30. N. Lat. 55. 15.

BAKING, the art of preparing bread, or reducing meals of any kind, whether simple or compound, into bread. See the article BREAD.

The various forms of baking among us may be reduced into two, the one for unleavened, the other for leavened bread. For the first the chief is manchet-baking; and the process whereof is as follows: The meal, ground and boulted, is put into a trough; and to every bushel are poured in about three pints of warm ale, with barm and salt to season it. This is kneaded well together with the hands through the brake; or, for want thereof, with the feet, through a cloth; after which, having lain an hour to swell, it is moulded into manchets; which, scotched in the middle, and pricked up at top, to give room to rise, are baked in the oven by a gentle fire.—For the second, sometimes called *cheat-bread baking*, it is thus: Some leaven (saved from a former batch) filled with salt, laid up to sour, and at length dissolved in water, is strained through a cloth into a hole made in the middle of the heap of meal in the trough; then it is worked with some of the flour into a moderate consistence; this is covered up with meal, where it lies all night; and in the morning the whole heap is stirred up, and mixed with a little warm water, barm, and salt, by which it is seasoned, softened, and brought to an even leaven: it is then kneaded, moulded, and baked, as before.

Method of raising a bushel of flour with a tea-spoonful of barm; by James Stone, of Amport, in Hampshire.—Suppose you want to bake a bushel of flour, and have but one tea-spoonful of barm.—Put your flour into your kneading-trough or trendle; then take about three quarters of a pint of warm water, and take the tea-spoonful of thick steady barm and put it into the water; stir it until it is thoroughly mixed with the water: then make a hole in the middle of the flour large enough to contain two gallons of water; pour in your small quantity; then take a stick about two feet long, (which you may keep for that purpose), and stir in some of the flour, until it is as thick as you would make batter for a pudding; then strew some of the dry flour over it, and go about your usual business for about an hour: then take about a quart of warm water more, and pour in; for in one hour you will find that small quantity raised so, that it will break through the dry flour which you shook over it; and when you have poured in the quart of warm water, take your stick as before, and stir in some more flour, until it is as thick as before; then shake some more dry flour over it, and leave it for two hours more, and then you will find it rise and break through the dry flour again; then you may add three quarts or a gallon of water more, and stir in the flour and make it as thick as at first, and cover it with dry flour again; in about three or four hours more you may mix up your dough, and then cover it up warm; and in four or five hours more you may put it into the oven, and you will have as light bread as though you had put a pint of barm. It does not take above a quarter of an hour more time than the usual way of baking, for there is no time lost but that of adding water three or four times.

The author of this method assures us, that he constantly bakes this way in the morning about six or seven o'clock, puts the flour out, and puts this small quantity of barm into the before-mentioned quantity of water, in an hour's time some more, in two hours more a greater quantity, about noon makes up the dough, and about six in the evening it is put into the oven, and he has always good bread, never heavy nor bitter.

When you find, he says, your body of flour spunged large enough, before you put in the rest of your water, you should, with both your hands, mix that which is spunged and the dry flour altogether, and then add the remainder of warm water, and your dough will rise the better and easier.

The reason he assigns why people make heavy bread is, not because they have not barm enough, but because they do not know that barm is the same to flour as

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as fire is to fuel; that as a spark of fire will kindle a large body by only blowing of it up, so will a thimblefull of barm, by adding of warm water, raise or spunge any body of flour; for warm water gives fresh life to to that which is before at work; so that the reason of making bread heavy is, because the body spunged is not large enough, but was made up and put into the oven before it was ripe.

In regard to the difference of seasons, he prescribes, that in the summer you should put your water bloodwarm; and in winter, in cold frosty weather, as warm as you can bear your hand in it without making it smart; being sure you cover up your dough very warm in the winter, and your covering of it with dry flour every time you add warm water, will keep in the heat; when you have added six or eight quarts of warm water, as before mentioned, in such a gradual way, you will find all the body of flour which is mixed with the warm water, by virtue of that one tea-spoonful of barm, brought into great agitation, waxing or fermenting; for it is to the flour what the spirit is to the body. See BAKING, SUPPLEMENT.

BAKOU, or BAKU, a town of Persia, in the province of Shirvan, situated at the extremity of the gulf of Ghilan on the Caspian sea. It is esteemed the most commodious haven in this sea, as vessels may there ride securely at anchor in seven fathom water; but the number of shoals, islands, and sand-banks, render the entrance in some places extremely difficult and dangerous, particularly to the Russians, who are not very expert sailors. Baku is a fortress surrounded with high brick walls; its inhabitants, like those of Derbent, are Persians, Tartars, and a few Armenian merchants. The principal articles of exportation which support the trade of this place are naphtha, and the finest rock salt, of both which there are mines on the east side of the bay. The inhabitants cultivate saffron and the cotton tree, but not to any considerable advantage. The trade of Baku, though more valuable than that of Derbent, is still inconsiderable, and chiefly carried on with Shamakee, from whence it draws raw silk and silken stuffs. A Russian consul is resident at this place. In 1777 Baku belonged to Melik-Mehmed, who was tributary to Feth Ali khan of Kuba: the latter possessed the whole province of Shirvan, and was the most powerful prince, next to the khan of Ghilan, upon the coast of the Caspian. Before we quit the province of Shirvan, it may not be improper to mention its capital, the inland town of Shamakee, which is only 66 miles from Baku, and supplies that port with raw silk and silken stuffs. It owed its former commercial importance to the silk which is cultivated in the neighbouring district; this rich production still preserves the town from ruin; though its traffic is greatly reduced by the exorbitant exactions of the khan of Kuba. Formerly the Russians had a factory at this place; and it was also crowded with Turkish and Greek merchants; but at present there are only a few Armenian and Indian traders. The inhabitants manufacture silk and cotton stuffs, but far inferior to those made at this place in the beginning of the present century. The silk of this province is exported into the interior part of Persia, Turkey, Georgia, and Russia. E. Long. 51. 30. N. Lat. 40. 20.

BALAAM, a prophet and diviner of the city of Pethor upon the Euphrates, whose practices with Balak king of the Moabites are recorded in the book of Numbers, chap. xxii. It is a question much debated among divines, whether Balaam was a true prophet of God, or no more than a magician or fortune-teller. The Jews indeed are generally of opinion, that he was a busy and pretending astrologer, who, observing when men were under a bad aspect of the stars, pronounced a curse upon them; which sometimes coming to pass, gained him in some neighbouring nations a reputation in his way. Several of the ancient fathers suppose him to be no more than a common soothsayer, who undertook to tell future events, and discover secrets, and by no very justifiable arts. Origen will needs have it, that he was no prophet, but only one of the devil's sorcerers, and that of him he went to inquire; but that God was pleased to prevent him, and put what answers he pleased into his mouth. It cannot be denied, however, that the scripture expressly calls him a prophet (Pet. ii. 5.); and therefore some later writers have imagined that he had once been a good man and true prophet, till loving the wages of iniquity, and prostituting the honour of his office to covetousness, he apostatized from God, and betaking himself to idolatrous practices, fell under the delusion of the devil, of whom he learned all his magical enchantments, though at this juncture, when the preservation of his people was concerned, it might be consistent with God's wisdom to appear to him, and vouchsafe his revelations. As to what passed between him and his ass, when that animal was miraculously enabled to speak to its master, commentators are divided in their opinions concerning this fact, whether it really and literally happened as Moses relates it; or whether it be an allegory only, or the mere imagination or vision of Balaam. This indeed is so wonderful an instance, that several of the Jewish doctors, who upon other occasions are fond enough of miracles, seem as if they would hardly be induced to assent to this. Philo, in his *Life of Moses*, passes it over in silence; and Maimonides pretends that it happened to Balaam in a prophetic vision only. But St Peter (2 Pet. ii. 16.) speaks of this fact as literal and certain, and so all interpreters explain it. St Austin, who understands it exactly according to the letter, finds nothing in the whole account more surprising than the stupidity of Balaam, who heard his ass speak to him, and answered it as if he talked with a reasonable person. He is of opinion, that this diviner was accustomed to prodigies like this, or that he was strangely blinded by his avarice not to be stopped by an event of so extraordinary a nature. Le Clerc thinks, that Balaam might probably have imbibed the doctrine of transmigration of souls, which was certainly very common in the east; and from thence he might be the less astonished at hearing a brute speak. And Dr Patrick thinks that Balaam was in such a rage and fury at the supposed perverseness of his beast crushing his foot, that for the present he could think of nothing else; though the conciseness of Moses's relation, who must be presumed to have omitted many circumstances, which if rightly known would dispel this and many more difficulties that may be imagined in this transaction, does certainly furnish us with a better and more satisfactory answer. St Austin is of opinion, that God had not given the ass a reasonable soul; but permitted it to pronounce

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nounce certain words, in order to reprove the prophet's covetousness. Gregory of Nyssa seems to think that the ass did not utter any word articulately or distinctly; but that, having brayed as usual, the diviner, whose practice it had been to draw presages from the cries of beasts and singing of birds, comprehended easily the ass's meaning by its noise; Moses, designing to ridicule this superstitious art of augurs and soothsayers, as if the ass really spoke in words articulate.

We must own, says Calmet, that this is a miraculous fact related by an inspired writer, whose authority we are not allowed to call in question in the least particular: but we should study such ways of explaining it as are most conformable to reason, and most proper to solve the difficulties of it, without attacking the truth of the history. Now it is very possible for God to make an ass speak articulately; it is indeed miraculous, and above the ordinary faculty of this animal, but not against the laws of nature.

BALADAN, the scripture name for a king of Babylon (Is. xxxix. 1. 2 Kings xx. 12.), called by profane authors *Belesus*, or *Belesis*, *Nabonassar*, or *Nanybrus*. Baladan at first was no more than governor of Babylon; but entering into a confederacy with Arbaces governor of Media, and rebelling against Sardanapalus king of Assyria, these two generals marched against him with an army of 400,000 men, and were beat in three different battles. But the Bactrians deserting the king, and coming over to Baladan and Arbaces, the rebels attacked the enemy in the night, and made themselves masters of his camp. After this misfortune, Sardanapalus retreated to Nineveh, and left the command of his army to his brother-in-law Salamenes. The conspirators attacked Salamenes, and defeated him in two great battles; after which they laid siege to Nineveh. Sardanapalus sustained the siege for three years; but the Tigris, in the third year, overflowing its banks, beat down 20 furlongs of the walls; whereupon the conspirators entered the city and took possession of it, after Sardanapalus had burnt himself and all his most valuable effects upon a funeral pile erected for that purpose in his palace. Baladan was acknowledged king of Babylon as Arbaces was of Media. Berodach-baladan, who sent ambassadors to Hezekiah (2 Kings xx.), was the son of Baladan.

BALA, a town of Merionethshire in Wales. W. Long. 3. 37. N. Lat. 52. 54.

BALÆNA, or WHALE. See CETOLOGY *Index*.

BALAGATE, a province of Hindostan, and the largest of the three that compose the kingdom of Dekkan. It has Kandish and Barar to the north, Tellinga to the east, Baglana with part of Guzerat to the west, and Visiapour to the south. It is a fruitful and pleasant country, abounding with cotton and sugar. Here they have sheep without horns; but so strong, that when bridled and saddled they will carry boys of ten years of age. Its present capital is Aurengabad, but formerly was Dowlet-Abad; and from the latter the whole province is sometimes called *Dowlet-Abad*.

BALAGATE Mountains, a chain of mountains which divides the coast of Malabar from that of Coromandel, running almost the whole length of the peninsula on this side the Ganges. Some parts of them are covered with fine red earth, which is blown by the strong west winds as far as the island of Ceylon; and when the rays of the sun are reflected from these mountains, they seem to be all on fire. They make surprising alterations in the seasons; for on the north side of Cape Comorin, it is winter in May, June, July, August, and September, in which months it is summer on the south side of the cape; on one side there are continual tempests, thunder, and lightning, while the other enjoys a constant serenity. When black clouds are gathered about the mountains, they are followed by sudden rain, which causes the overflowing of the rivers, and chokes them up with sand, insomuch that they are unnavigable, for some time afterwards. The buildings and clothes of the inhabitants are scarcely sufficient to defend them from the weather. They live upon rice, milk, roots, and herbs, with very little meat; they have likewise a sort of small arrack, but are never given to drunkenness; nor do they import foreign vices, for they never travel abroad.

BALAGNIA, a town of Muscovy, in the province of Saratow, seated on the Wolga. E. Long. 45. 5. N. Lat. 50. 36.

BALAGUER, a city of Catalonia in Spain, seated on the north bank of the river Segra, at the foot of a high mountain, on which there was formerly a fortress. E. Long. 0. 48. N. Lat. 41. 38.

BALAMBUAN, or PADAMBUAN, a strong town of Asia, in the Indies, on the east end of the island of Java, and capital of a territory of the same name. E. Long. 114. 10. S. Lat. 7. 50.

BALANCE, one of the six simple powers, in mechanics, principally used in determining the equality or difference of weights in heavy bodies, and consequently their masses or quantities of matter.

The balance is of two kinds: the ancient and the modern. The ancient or Roman, called also the *statera Romana*, or steel-yard, consists of a lever or beam, moveable on a centre, and suspended near one of its extremities: the bodies to be weighed are applied on one side of the centre; and their weight is shewn by the division marked on the beam, where the weight, which is moveable along the lever, keeps the steel-yard *in equilibrio*. This balance is still frequently used in weighing heavy bodies.

The modern balance now generally used consists of a lever or beam suspended exactly in the middle, having scales or basons hung to each extremity. The lever is called the *jugum* or *beam*; and the two moieties thereof on each side the axis, the *brachia* or *arms*. The line on which the beam turns, or which divides its brachia, is called the *axis*; and when considered with regard to the length of the brachia, is esteemed a point only, and called the *centre of the balance*; the handle whereby it is held, or by which the whole apparatus is suspended, is called *trutina*; and the slender part perpendicular to the beam, whereby either the equilibrium or preponderancy of bodies is indicated, is called the *tongue* of the balance. Thus in fig. 1. Plate LXXXIV. *a b* is the beam, divided into two equal brachia or arms by the white spot in the centre, which is the axis or centre of the balance, and *c* is the tongue. The trutina, on which the axis is suspended, is not represented in this figure, in order to render the other parts more conspicuous.

It follows, from what has been observed, therefore, that

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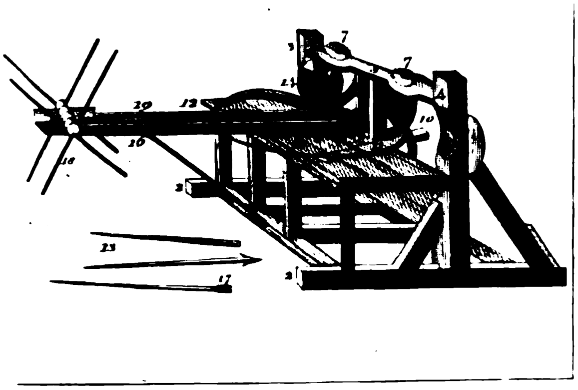
BALANCE. PLATE LXXXIV.

BALISTA. *Fig. 6.*



COMMON BALANCE.
Fig. 3.

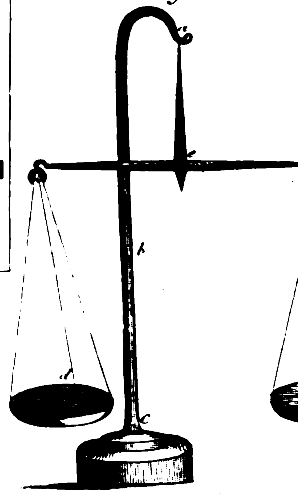
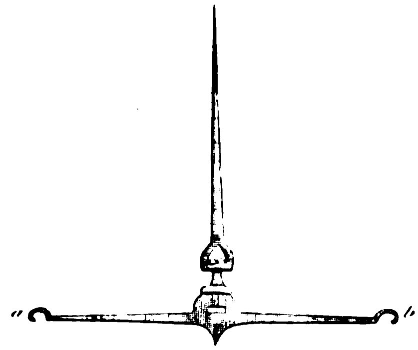
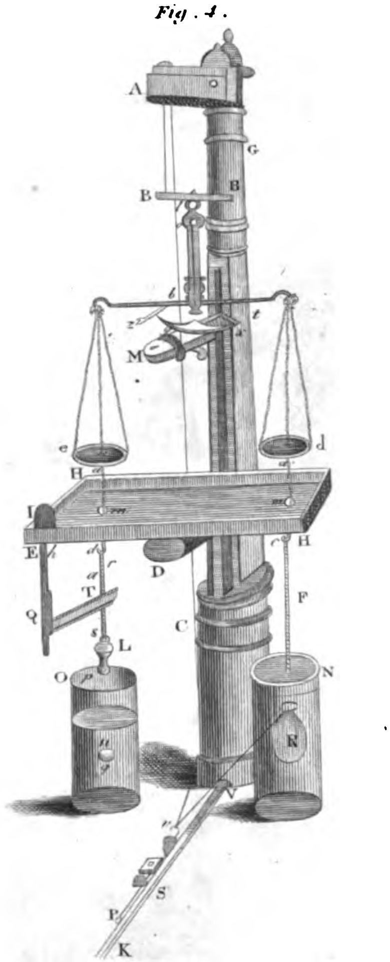


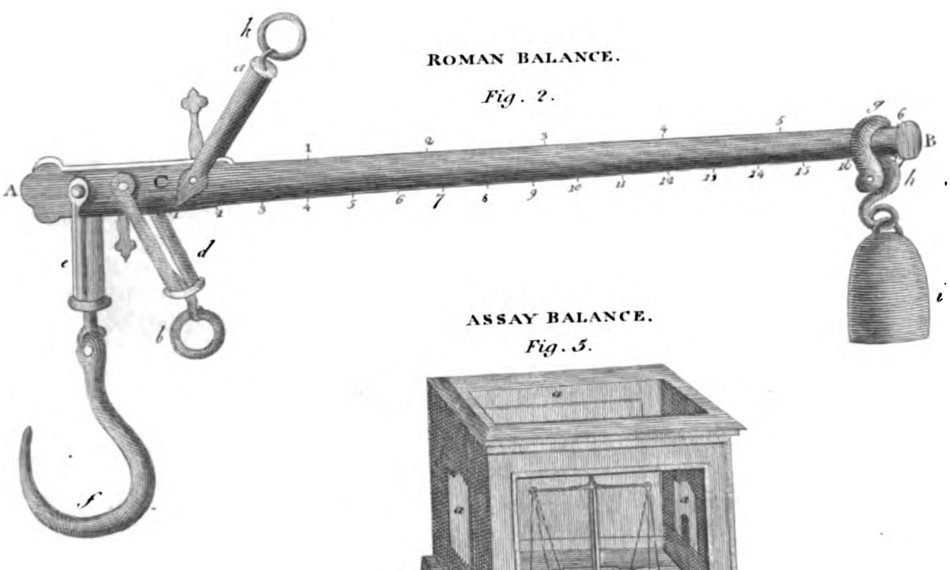
Fig. 1.



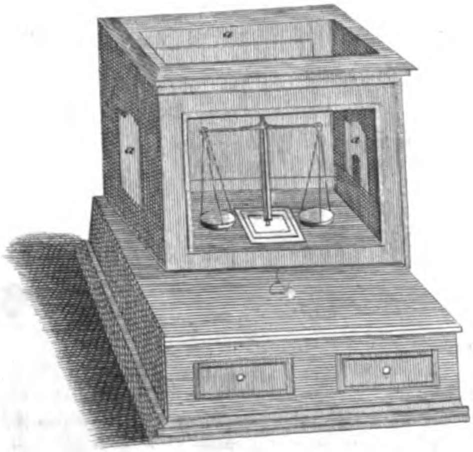
HYDROSTATIC BALANCE.
Fig. 4.



ROMAN BALANCE.
Fig. 2.



ASSAY BALANCE.
Fig. 5.



F. Mitchell sculp.

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that in the Roman balance, the weight used for a counterpoise is the same, but the point of application varies; in the common balance the counterpoise is various, and the point of application the same. The principle on which each is founded, may be very easily understood from the following observations, and the general properties of the lever. See LEVER.

The beam AB (fig. 2.), is a lever of the first kind; but instead of resting on a fulcrum, is suspended by something fastened to its centre of motion: consequently the mechanism of the balance depends on the same theorems as the lever.

Hence as the quantity of matter in a known weight is to its distance from the centre of motion, so is the distance of the unknown weight to its quantity of matter. Hence the nature and use of the steel-yard is easily known. Let AB (fig. 2.) represent an instrument of this kind; *a*, the trutina, or handle on which the beam turns; *k*, a ring on which the balance may be suspended on a nail or hook; *f*, the hook on which the body to be weighed is hung; *c*, a collar or guard by which the hook *f* is fastened to the beam; *g*, a moveable collar; *h*, a swivel; *i*, the counterpoise. From what has been said it evidently follows, that if the body to be weighed is fastened to the hook *f*, and the whole suspended by the ring *k*, the division on which the counterpoise is placed to maintain an equilibrium in the balance, will show the weight of the body required; provided the weight of the counterpoise *i* be known, and the large divisions, 1, 2, 3, &c. be equal to the distance between the centre of the balance and the screw which fastens the guard *c* to the shorter arm of the balance. It will also be necessary that the steelyard itself, with its whole apparatus, exclusive of the counterpoise, be *in equilibrio*, when suspended on the ring *k*. If the body to be weighed be heavier than the divisions on the longer arm will indicate, the balance is turned the lower side upwards, and suspended on the other ring *b*; by which means the divisions become shorter, because the distance between the trutina *d*, and the screw on which the guard *c* moves, is less: the divisions in the figure on this side extending to 17, whereas they extend only to 6 on the other. It will be unnecessary perhaps to observe, that the same precaution, with regard to the centre of gravity when the balance is suspended, is also necessary when this side of the balance is used, as we before mentioned with regard to the other.

We have already observed, that in the common scales the two brachia or arms of the balance, *e f*, *e g*, fig. 3. are equal to each other, and consequently equal weights placed in the scales *d*, *d*, will be *in equilibrio*, when the balance is suspended on its centre *e*, as in the figure, where the ring at the extremity of the trutina is hung on the tapering rod *a b*, fixed in the foot or basis *c*.

The Deceitful BALANCE, or that which cheats by the inequality of its brachia, is founded on the same principle as the steel-yard. Let there be, for example, a balance so constructed, that both the brachia with their scales shall equiponderate, but that the length of the one arm shall be to that of the other as 10 to 9. In this case, a weight of nine pounds put into the longest arm, will counterpoise one of ten pounds put into the shorter one: but the cheat is immediately discovered by shifting the weight from one scale to the other; in which case, the balance will no longer remain *in equilibrio*.

Assay-BALANCE, a very nice balance used in docimastical operations, to determine exactly the weight of minute bodies; see fig. 4. This balance should be made of the best steel, and of the hardest kind; because that metal is not so easily spoiled with rust as iron; and it is more apt than any other to take a perfect polish, which at the same time prevents the rust.

The structure of the assayer's scale is little different from that of common scales, otherwise than by its nicety and smallness. The longer the beam of it is, the more exact may the weight of a body be found; however, 10 or 12 inches are sufficient length. Let the thickness of it be so little, that two drachms may hardly be hung at either of its extremities without its bending; for the largest weight put upon it seldom exceeds one drachm. The whole surface of this beam must be altogether without ornaments, which only increase the weight and gather dust, &c. The beam is suspended in a fork, the two legs of which are steel springs joined at top, but kept together below with a brass pliant clasp, parallel, and two lines and a half distant from each other. This clasp being taken off, and the legs of the fork being stretched out, the axis of the beam may be put into two holes made for that purpose at the ends of the legs, or be taken away from them. Let a very sharp needle be fixed in the head of the fork, standing perpendicularly downwards, if the fork is suspended, and so long, as that it may almost touch the top of the tongue of the beam put into the fork when in equilibrio. This needle is the mark of the equilibrium; and that the artist may be able to observe this, the legs of the fork must be broader in that place, and have an opening two or three lines wide; this fork may be adorned at pleasure, provided the motion of the balance is not hindered by such ornaments: then take two scales made of thin plate of silver, one inch and a half in diameter, hanging on three small silk strings, almost as long as the beam, tied together at top, with a silver hook in form of an S, and hang them to the extremities of the beam: a smaller silver dish or blued steel, somewhat less than one inch in diameter, belongs to each of these scales. You first put into these dishes, with a pair of pincers, the bodies to be weighed, or with a spoon or a small shovel, when they are pounded, and then you put them into the scales; therefore the small dishes must be perfectly equal in weight. We use them, that bodies may be more conveniently put into and taken out of the scales, and that these which are vastly thin may not be bent or soiled, and thence rendered false by wiping.

This balance is suspended on a moveable brass or copper support, which consists of a pedestal, and of a column set upon it about 20 inches high, at the top of which comes out at right angles an arm one inch long. At the extremity of this arm, put a small pulley three lines in diameter, another at the top of the column, and a third near the bottom of it; all which pulleys must turn very easily on their axes. At the distance of one inch and a half below the upper arm, let another arm one inch and a half long come out of the column at right angles, having a hole through it two lines long, a quarter of a line broad, and placed perpendicularly,

pendicularly below the pulley of the upper arm, to receive a small plate, one inch and a half long; and of such breadth and thickness, as that it may freely move up and down, and yet not have too much play within the hole. This plate must also have a small hook at each extremity.

And as such a balance will hardly stand still in the open air, and becomes false when soiled with dust, it must be put, together with its support, into a small case as represented in fig. 4. having glasses, *a*, *a*, *a*, at top, and all round it, that you may see what is within.

Manner of using the Assay-Balance.—Pass a silk string over the three pulleys of the support, and tie it at its upper extremity to the small hook introduced into the hole of the inferior arm; then put the support in the middle of the small case, and pass the other extremity of the silk string below, through a hole bored in the middle of the lower part of the frame, containing the window in the fore-part of the case, and fasten it to a small weight of a cubic form. Suspend the fork of the balance on the inferior hook of the plate. By this means if you move backwards and forwards the weight fastened to the string, placed upon the top of the drawer jutting out beyond the fore-part of the case, the balance within is either lifted up or let down. But you must put the bodies to be weighed, and the weights themselves, into the small silver dishes; and these, when loaded, into the scales, through the side-windows, which must be opened for that purpose. When any thing is to be added or taken out of them, you do it with the small pincers; or, if it is powder, with the small shovel or spoon: but you must let the balance down every time any thing is to be added or taken away, that the scales may rest upon the bottom of the case; and shut the windows before the balance is lifted up again, especially if the air is not perfectly calm.

Hydrostatic Balance, an instrument contrived to determine accurately the specific gravity of both solid and fluid bodies. It is constructed in various forms; but we shall content ourselves here with describing that which appears of all others the most accurate.

VCG (fig. 5.) is the stand or pillar of this hydrostatic balance, which is to be fixed in a table. From the top A hangs, by two silk strings, the horizontal bar BB, from which is suspended, by a ring *i*, the fine beam of a balance *b*; which is prevented from descending too low on either side by the gently springing piece *t x y z*, fixed on the support M. The harness is annulated at *o*, to show distinctly the perpendicular position of the examen, by the small pointed index fixed above it.

The strings by which the balance is suspended, passing over two pulleys, one on each side the piece at A, go down to the bottom on the other side, and are hung over the hook at *v*; which hook, by means of a screw P, is moveable about one inch and a quarter, backward and forward, and therefore the balance may be raised or depressed so much. But if a greater elevation or depression be required, the sliding piece S, which carries the screw P, is readily moved to any part of the square brass rod VK, and fixed by means of a screw.

The motion of the balance being thus adjusted, the rest of the apparatus is as follows. HH is a small board, fixed upon the piece D, under the scales *d* and *e*, and is moveable up and down in a low slit in the pillar above C, and fastened at any part by a screw behind. From the point in the middle of the bottom of each scale hangs, by a fine hook, a brass wire *a d* and *a c*. These pass through two holes *m m* in the table. To the wire *a d* is suspended a curious cylindric wire *r s*, perforated at each end for that purpose: this wire *r s* is covered with paper, graduated by equal divisions, and is about five inches long.

In the corner of the board at E, is fixed a brass tube, on which a round wire *h l* is so adapted as to move neither too tight nor too free, by its flat head I. Upon the lower part of this moves another tube Q, which has sufficient friction to make it remain in any position required: to this is fixed an index T, moving horizontally when the wire *h l* is turned about, and therefore may be easily set to the graduated wire *r s*. To the lower end of the wire *r s* hangs a weight L; and to that a wire *p n*, with a small brass ball *g* about one-fourth of an inch diameter. On the other side, to the wire *a c*, hangs a large glass bubble R, by a horse hair.

Let us first suppose the weight L taken away, and the wire *p n* suspended from S: and, on the other side, let the bubble R be taken away, and the weight F, suspended at *c*, in its room. This weight F we suppose to be sufficient to keep the several parts hanging to the other scale in equilibrium; at the same time that the middle point of the wire *p n* is at the surface of the water in the vessel N. The wire *p n* is to be of such a size, that the length of one inch shall weigh four grains.

Now it is evident, since brass is eight times heavier than water, that for every inch the wire sinks in the water it will become half a grain lighter, and half a grain heavier for every inch it rises out of the water: consequently, by sinking two inches below the middle point, or rising two inches above it, the wire will become one grain lighter or heavier. Therefore, if, when the middle point is at the surface of the water in equilibrium, the index T be set to the middle point *a* of the graduated wire *r s*, and the distance on each side *a r* and *a s* contains 100 equal parts: then, if in weighing bodies the weight is required to the hundredth part of a grain, it may be easily had by proceeding in the following manner.

Let the body to be weighed be placed in the scale d. Put the weight X in the scale e; and let this be so determined, that one grain more shall be too much, and one grain less too little. Then the balance being moved gently up or down, by the screw P, till the equilibrium be nicely shown at *o*; if the index T be at the middle point *a* of the wire *r s*, it shows that the weights put into the scale e are just equal to the weight of the body. By this method we find the absolute weight of the body; the relative weight is found by weighing it hydrostatically in water, as follows.

Instead of putting the body into the scale e, as before, let it hang with the weight F, at the hook *c*, by a horse hair, as at R, supposing the vessel O of water were away. The equilibrium being then made, the index T standing between *a* and *r*, at the 36 division,

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sion, shows the weight of the body put in to be 1095.36 grains. As it thus hangs, let it be immersed in the water of the vessel O, and it will become much lighter: the scale e will descend till the beam of the balance rest on the support z. Then suppose 100 grains put into the scale d restore the equilibrium precisely, so that the index T stand at the 36 division above *a*; it is evident that the weight of an equal bulk of water would, in this case, be exactly 100 grains.

Balance of Power, a principle admitted in the modern policy of Europe, the object of which is to prevent any single state from acquiring such a preponderance as to endanger the independence of the others. See Balance of Power in the Supplement.

Balance of Trade. What is commonly meant by the balance of trade, is the equal importing of foreign commodities with the exporting of the native. A favourable balance is when the exports exceed the imports; because in this case the balance of the account must be made up in bullion or money; and the nation grows so much richer. This idea is, however, now regarded as entirely fallacious by all sound political economists.

Balance of a Clock, or *Watch*, is that part which regulates the beats. See *Clock-Making*.

Balance-Fish. See Squalus, Ichthyology *Index*.

BALANCER, in the history of insects, a style, or oblong body, ending in a protuberance or head, found under each wing of the two-winged flies; these, it is supposed, serve to poise the body of the fly.

BALANCING, among seamen, the contracting a sail into a narrower compass, in a storm, by retrenching, or folding up a part of it at one corner: this method is used in contradistinction to reefing, which is common to all the principal sails; whereas balancing is peculiar to few, such as the mizen of a ship, and the main sail of those vessels wherein it is extended by a boom. See Boom and Reef.—The balance of the mizen is thus performed: the mizen yard is lowered a little, then a small portion of the sail is rolled up at the peek or upper corner, and fastened to the yard about one fifth inward from the outer end or yard-arm toward the mast. See Mizen.—A boom main-sail is balanced, after all its reefs are taken in, by rolling up a similar portion of the hindmost or aftmost lower corner called the *clue*, and fastening it strongly to the boom, having previously wrapped a piece of old canvas round the part (which is done in both cases) to prevent the sail from being fretted by the cord which fastens it.

BALANUS, the trivial name of a species of lepas. See Lepas, Conchology *Index*.

BALAUSTINES, in *Botany*. See Punica, Botany *Index*.

BALAYAN, a province of the island of Manilla in the East Indies, belonging to the Spaniards.—It lies next to the city of Manilla, and extends along the coast on the east side of the island, a little beyond the bay of Batangas. There were formerly gold mines in it, but they have been long since abandoned. It is inhabited by about 2500 tributary Indians, and abounds in cotton, rice, and palm-trees. The province is well cultivated; and the Spaniards, generally speaking, have country-houses in it.

BALBASTRO, an episcopal town of Spain, in the kingdom of Arragon, and capital of a district of the same name. E. Long. 0. 20. N. Lat. 41. 50.

BALBEC, a city of Asia, in Syria, anciently called *Heliopolis*, and by the Arabians *The wonder of Syria*. It is situated at the foot of Anti-Lebanon, precisely on the last rising ground where the mountain terminates in the plain. As we arrive from the south we discover the city only at the distance of a league and a half, behind a hedge of trees, over the verdant tops of which appears a white edging of domes and minarets. After an hour's journey we reach these trees, which are very fine walnuts; and soon after, crossing some ill cultivated gardens, by winding paths, arrive at the entrance of the city. We there perceive a ruined wall, flanked with square towers, which ascends the declivity to the right, and traces the precincts of the ancient city. This wall, which is only ten or twelve feet high, permits us to have a view of those void spaces and heaps of ruins which are the invariable appendage of every Turkish city; but what principally attracts our attention is a large edifice on the left, which, by its lofty walls and rich columns, manifestly appears to be one of those temples which antiquity has left for our admiration. These ruins, which are some of the most beautiful and best preserved of any in Asia, merit a particular description.

To give a just idea of them, we must suppose ourselves descending from the interior of the town. After having crossed the rubbish and huts with which it is filled, we arrive at a vacant place which appears to have been a square; there in front, towards the west, we perceive a grand ruin, which consists of two pavilions ornamented with pilasters, joined at their bottom angle by a wall 160 feet in length. This front commands the open country from a sort of terrace, on the edge of which we distinguish with difficulty the bases of twelve columns, which formerly extended from one pavilion to the other, and formed a portico. The principal gate is obstructed by heaps of stones; but, that obstacle surmounted, we enter an empty space, which is a hexagonal court of 180 feet diameter. This court is strewed with broken columns, mutilated capitals, and the remains of pilasters, entablatures, and cornices; around it is a row of ruined edifices, which display all the ornaments of the richest architecture. At the end of this court, opposite the west, is an outlet, which formerly was a gate, through which we perceive a still more extensive range of ruins, whose magnificence strongly excites curiosity. To have a full prospect of these, we must ascend a slope, up which were the steps to this gate; and then we arrive at the entrance of a square court, much more spacious than the former, being 350 feet wide and 336 in length. The eye is first attracted by the end of this court, where six enormous and majestic columns render the scene astonishingly grand and picturesque. Another object not less interesting is a second range of columns to the left, which appear to have been part of the peristyle of a temple; but before we pass thither, we cannot refuse particular attention to the edifices which enclose this court on each side. They form a sort of gallery

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Balbec. gallery which contains various chambers, seven of which may be reckoned in each of the principal wings, viz. two in a semicircle, and five in an oblong square. The bottom of these apartments still retains pediments of niches and tabernacles, the supporters of which are destroyed. On the side of the court they are open, and present only four and six columns totally destroyed. It is not easy to conceive the use of these apartments; but this does not diminish our admiration at the beauty of their pilasters and the richness of the frize of the entablature. Neither is it possible to avoid remarking the singular effect which results from the mixture of the garlands, the large foliage of the capitals, and the sculpture of wild plants with which they are everywhere ornamented. In traversing the length of the court, we find in the middle a little square esplanade, where was a pavilion, of which nothing remains but the foundation. At length we arrive at the foot of the six columns; and then first conceive all the boldness of their elevation and the richness of their workmanship. Their shafts are 21 feet eight inches in circumference, and 58 high; so that the total height, including the entablature, is from 71 to 72 feet. The sight of this superb ruin, thus solitary and unaccompanied, at first strikes us with astonishment; but, on a more attentive examination, we discover a series of foundations, which mark an oblong square of 268 feet in length and 146 wide, and which, it seems probable, was the peristyle of a grand temple, the primary purpose of this whole structure. It presented to the great court, that is to the east, a front of ten columns, with 19 on each side, which, with the other six, make in all 54. The ground on which it stood was an oblong square, on a level with this court, but narrower than it, so that there was only a terrace of 27 feet wide round the colonnade; the esplanade this produces fronts the open country towards the west, by a sloping wall of about 30 feet. This descent, as you approach the city, becomes less steep, so that the foundation of the pavilion is on a level with the termination of the hill; whence it is evident that the whole ground of the courts has been artificially raised. Such was the former state of this edifice; but the southern side of the grand temple was afterwards blocked up to build a smaller one, the peristyle and walls of which are still remaining. This temple, situated somewhat lower than the other, presents a side of 13 columns by eight in front (in all 34), which are likewise of the Corinthian order; their shafts are 15 feet eight inches in circumference, and 44 in height. The building they surround is an oblong square, the front of which, turned towards the east, is out of the line of the left wing of the great court. To reach it you must cross trunks of columns, heaps of stone, and a ruinous wall by which it is now hid. After surmounting these obstacles you arrive at the gate, where you may survey the enclosure which was once the habitation of a god; but instead of the awful scene of a prostrate people and sacrifices offered by a multitude of priests, the sky is seen through the open roof, which lets in light to show a chaos of ruins covered with dust and weeds. The walls, formerly enriched with all the ornaments of the Corinthian order, now present nothing but pediments of niches and tabernacles, of which almost all the supporters are fallen to the ground. Between these niches is a range of fluted pilasters, whose capitals support a broken entablature; but what remains of it displays a rich frize of foliage resting on the heads of satyrs, horses, bulls, &c. Over this entablature was the ancient roof, which was 57 feet wide and 110 in length. The walls which supported it are 31 feet high, and without a window. It is impossible to form any idea of the ornaments of this roof, except from the fragments lying on the ground; but it could not have been richer than the gallery of the peristyle: the principal remaining parts contain tablets in the form of lozenges, on which are represented Jupiter seated on his eagle; Leda caressed by the swan; Diana with her bow and crescent; and several busts which seem to be figures of emperors and empresses. It would lead us too far to enter more minutely into the description of this astonishing edifice. The lovers of the arts will find it described with the greatest truth and accuracy in a work published at London in 1757, under the title of *Ruins of Balbec*. This work, compiled by Mr Robert Wood, the world owes to the attention and liberality of Mr Dawkins, who in 1751 visited Balbec and Palmyra. But several changes, however, have taken place since their journey; for example, they found nine large columns standing, and in 1784 Mr Volney found but six. They reckoned 29 at the lesser temple, but there now remain but 20; the others having been overthrown by the earthquake of 1759. It has likewise so shaken the walls of the lesser temple, that the stone of the soffit, or cross stone at the top of the gate, has slid between the two adjoining ones, and descended eight inches; by which means the body of the bird sculptured on that stone is suspended, detached from its wings and the two garlands which hung from its beak, and terminated in two genii. Nature alone has not effected this devastation; the Turks have had their share in the destruction of the columns. Their motive is to procure the iron cramps, which serve to join the several blocks of which each column is composed. These cramps answer so well the end intended, that several of the columns are not even disjointed by their fall; one, among others, as Mr Wood observes, has penetrated a stone of the temple wall without giving way. Nothing can surpass the workmanship of these columns; they are joined without any cement, yet there is not room for the blade of a knife between their interstices. After so many ages, they in general still retain their original whiteness. But what is still more astonishing, is the enormous stones which compose the sloping wall. To the west the second layer is formed of stones which are from 28 to 35 feet long, by about nine in height. Over this layer, at the north-west angle, there are three stones which alone occupy a space of 175½ feet; viz. the first 58 feet seven inches, the second 58 feet 11, and the third exactly 58 feet; and each of these is 12 feet thick. These stones are of a white granite, with large shining flakes like gypsum; there is a quarry of this kind of stone under the whole city and in the adjacent mountain, which is open in several places, and among others on the right, as we approach the city. There is still lying there a stone, hewn on three sides, which is 69 feet two inches long, 12 feet 10 inches broad, and 13 feet three in thickness. By what means could the ancients move these enormous masses? This is doubtless

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less a problem in mechanics curious to resolve. The inhabitants of Balbec have a very commodious manner of explaining it, by supposing these edifices to have been constructed by *Djenoun*, or genii, who obeyed the orders of King Solomon; adding, that the motive of such immense works was to conceal in subterraneous caverns vast treasures, which still remain there. To discover these, many have descended into the vaults which range under the whole edifice: but the inutility of their researches, added to the oppressions and extortions of the governors, who have made their supposed discoveries a pretext, have at length disheartened them; but they imagine the Europeans would be more successful, nor would it be possible to persuade them but that we are possessed of the magic art of destroying talismans. It is in vain to oppose reason to ignorance and prejudice: and it would be no less ridiculous to attempt to prove to them that Solomon never was acquainted with the Corinthian order, which was only in use under the Roman emperors. But their tradition on the subject of this prince may suggest three important observations. First, That all tradition relative to high antiquity is as false among the Orientals as the Europeans. With them, as with us, facts which happened 100 years before, when not preserved in writing, are altered, mutilated, or forgotten. To expect information from them with respect to events in the time of David or Alexander, would be as absurd as to make inquiries of the Fleming peasants concerning Clovis or Charlemagne. Secondly, That throughout Syria, the Mahometans, as well as the Jews and Christians, attribute every great work to Solomon: not that the memory of him still remains by tradition in those countries, but from certain passages in the Old Testament; which, with the gospel, is the source of almost all their tradition, as these are the only historical books read or known; but as their expounders are very ignorant, their applications of what they are told are generally very remote from truth. By an error of this kind they pretend Balbec is *the house of the forest of Lebanon* built by Solomon: nor do they approach nearer probability, when they attribute to that king the well of Tyre and the buildings of Palmyra. Thirdly, That the belief in hidden treasures has been confirmed by discoveries which have been really made from time to time. It is not many years since a small coffer was found at Hebron full of gold and silver medals, with an ancient Arabic book on medicine. In the country of the Druses an individual discovered likewise, some time since, a jar with gold coin in the form of a crescent; but as the chiefs and governors claim a right to these discoveries, and ruin those who have made them, under pretext of obliging them to make restoration, those who find any thing endeavour carefully to conceal it; they secretly melt the antique coins, nay frequently bury them again in the same place where they found them, from the same fears which caused their first concealment, and which prove the same tyranny formerly existed in these countries.

When we consider the extraordinary magnificence of the temple of Balbec, we cannot but be astonished at the silence of the Greek and Roman authors. Mr Wood, who has carefully examined all the ancient writers, has found no mention of it except in a fragment of John of Antioch, who attributes the construction of this edifice to Antoninus Pius. The inscriptions which remain corroborate this opinion, which perfectly accounts for the constant use of the Corinthian order, since that order was not in general use before the third age of Rome; but we ought by no means to allege as an additional proof the bird sculptured over the gate; for if his crooked beak, large claws, and the caduceus he bears, give him the appearance of an eagle, the tuft of feathers on his head, like that of certain pigeons, proves that he is not the Roman eagle: besides that the same bird is found in the temple of Palmyra; and is therefore evidently an Oriental eagle, consecrated to the sun, who was the divinity adored in both these temples. His worship existed at Balbec in the most remote antiquity. His statue, which resembled that of Osiris, had been transported thither from the Heliopolis of Egypt, and the ceremonies with which he was worshipped there have been described by Macrobius, in his curious work entitled *Saturnalia*. Mr Wood supposes with reason, that the name of Balbec, which in Syriac signifies *City of Bal*, or of the sun, originated in this worship. The Greeks, by naming it *Heliopolis*, have in this instance only given a literal translation of the oriental word: a practice to which they have not always adhered. We are ignorant of the state of this city in remote antiquity; but it is to be presumed, that its situation on the road from Tyre to Palmyra, gave it some part of the commerce of these opulent capitals. Under the Romans, in the time of Augustus, it is mentioned as a garrison town: and there is still remaining, on the wall of the southern gate, on the right, as we enter, an inscription which proves the truth of this, the words KENTURIA PRIMA, in Greek characters, being very legible. One hundred and forty years after, Antoninus built there the present temple, instead of the ancient one, which was doubtless falling into ruins: but Christianity having gained the ascendency under Constantine, the modern temple was neglected, and afterwards converted into a church; a wall of which is now remaining, that hid the sanctuary of the idols. It continued thus until the invasion of the Arabs, when it is probable they envied the Christians so beautiful a building. The church being less frequented fell to decay; wars succeeded; and it was converted into a place of defence; battlements were built on the wall which surrounded it, on the pavilions and at the angles which still subsist; and from that time, the temple, exposed to the fate of war, fell rapidly to ruin. The state of the city is not less deplorable. The wretched government of the emirs of the house of Harfoushe had already greatly impaired it, and the earthquake of 1759 completed its destruction. The wars of the Emir Yousef and Djezzar have rendered it still more deserted and ruinous. Of 5000 inhabitants, at which number they were estimated in 1751, not 1200 are now remaining; and all these poor, without industry or commerce, and cultivating nothing but a little cotton, some maize, and water-melons.

BALBINUS, Decimus Coelius, the Roman emperor, being chosen by the senate in 237, was massacred by the soldiers, who had a dislike to such emperors as were elected only by the senators. This prince was eloquent, and wrote pretty good verses.

BALBOA, Vasco Nugnes de, a Castilian; a

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celebrated navigator, and one of the first discoverers of South America. He was beheaded by the Spanish governor of St Mary, through jealousy of his growing reputation, in 1517, aged 42.

BALBUS, Lucius Cornelius Theophanes, was born at Cadiz, and distinguished himself by his valour in the war carried on by the Romans in Spain against Sertorius and the Lusitanians, on which account Pompey gave him the privileges of a Roman citizen. He was consul in the 714th year of Rome, and was the first foreigner on whom that dignity was conferred. He was the friend of Pompey, Cæsar, Crassus, and Cicero.—There were many other illustrious Romans of the name of *Balbus*.

BALCONY, in *Architecture*, a projecture in the front of a house, or other building, supported by pillars or consoles, and encompassed with a balustrade.

BALDACHIN, or Baldaquin, in *Architecture*, a building in form of a canopy, supported by pillars, and frequently used as a covering to insulated altars. Some also use the term *balduchin* for the shell over a door.

BALDINUCCI, Philip, of Florence; a connoisseur in the polite arts, and the continuator of Vasari's Lives of the Painters. He died in 1696, aged 72.

BALDIVIA, or Valdivia, a sea-port town of Chili, in America, belonging to the Spaniards. It is situated between the rivers Callaculles and Portero, where they fall into the South sea. W. Long. 74. 2. S. Lat. 39. 55. It was built in 1551 by the Spanish general Baldivia, from whom it takes its name. We may judge of its importance from the sum granted annually by the king for maintaining the garrisons and keeping the fortifications in repair, being no less than 300,000 pieces of eight. It is defended by four strong castles, mounting 100 pieces of fine brass cannon. Notwithstanding which, however, as the garrison is composed mostly of transported criminals, on whom no dependence can be placed, and generally ill supplied with ammunition, &c. it could make but a poor defence. In 1643 it was easily taken by the Dutch, who would probably have maintained their conquest against all the power of the Spanish viceroy, had they not been obliged to relinquish it through sickness and famine. The inhabitants of Baldivia amount to about 2000. The trade is less considerable than formerly, because the gold mines in the neighbourhood are shut up. It formerly carried on a considerable trade with Lima, in corn, hides, salt provisions, &c.; but this must now have ceased, since Baldivia, with all the other parts of Chili, has fallen into the hands of the independent party.

BALDINJER, Ernest G. a German physician. See Supplement.

BALDNESS, a defect of hair, chiefly on the sinciput. It differs from *alopecia*, *area*, *ophiasis*, and *tinea*, as these all arise from some vice in the nutritious humour; *baldness*, from the defect of it. When the eyelids shed their hair, it is called a *ptilosis*. Among the causes of baldness, immoderate venery is reputed one of the chief; old age usually brings it on of course. Some will have the proximate cause of baldness to be the dryness of the brain, and its shrinking from the cranium; it having been observed, that in bald persons there is always a vacuity or empty space between the skull and the brain.—*Calvus*, *bald-pate*, was a frequent term of reproach among the Romans; among whom this defect was in great discredit. Hence divers arts to conceal it, as false hair, a *galericulus* contrived on purpose. The later Romans, however, seem to have been reconciled to baldness; for we find among them a kind of officers, or servants, called *glabratores* or *glabrarii*, whose business was to take off the hair from all parts, even from the head. In an ancient inscription, there is mention of one Diophantus, TI, CÆSARIS, ornator glabr, that is, *Ornator Glabrarius*.

BALDOC, a town of Hertfordshire, in England, chiefly noted for its trading in malt. Population 1438. W. Long. 0. 10. N. Lat. 51. 55.

BALDOCK, Ralph de, bishop of London in the reigns of Edward I. and II. was educated at Merton-college, in Oxford; became dean of St Paul's; was afterwards promoted to the see of London; and at last was made lord high chancellor of England. He had a very amiable character both for morals and learning; and wrote *Historia Anglica*, or a History of the British Affairs down to his own time; and, A Collection of the Statutes and Constitutions of the church of St Paul. Bishop Baldock died at Stepney, July 24. 1313.

BALDWIN, archbishop of Canterbury, was born of obscure parents at Exeter, where, in the early part of his life, he taught a grammar school; after which he took orders, and was made archdeacon of Exeter; but he resigned that dignity, and became a Cistertian monk in the monastery of Ford in Devonshire, of which in a few years he was made abbot. In the year 1180, he was consecrated bishop of Worcester. In 1184, he was promoted to the see of Canterbury by Pope Lucius III. and by his successor Urban III. was appointed legate for that diocese. He laid the foundation of a church and monastery in honour of Thomas Becket, at Hackington, near Canterbury, for secular priests; but, being opposed by the monks of Canterbury and the pope, was obliged to desist. In 1190 he crowned King Richard I. at Westminster; and soon after followed that prince to the Holy Land, where he died at the siege of Ptolemais. Giraldus Cambrensis, who accompanied him in this expedition, says, he was of a mild disposition, and of great abstinence. He wrote various tracts on religious subjects, which were collected and published by Bertrand Tissier in 1662.

BALE, John, bishop of Ossory in Ireland, was born at Cove, near Dunwich in Suffolk, in the year 1495. At 12 years of age he was entered in the monastery of Carmelites at Norwich, and was thence sent to Jesus college in Oxford. He was educated a Roman Catholic, but was converted to the Protestant religion by Thomas Lord Wentworth. On the death of Lord Cromwell, favourite of Henry VIII. who protected him from the persecutions of the Romish clergy, he was obliged to fly into the Low Countries, where he continued eight years. Soon after the accession of Edward VI. he was recalled; and being first presented to the living of Bishop's Stocke in Hampshire, in 1552, he was nominated to the see of Ossory. During his residence in Ireland he was remarkably assiduous in propagating the Protestant doctrines; but to very little purpose, and frequently at the hazard of his life. Once, in particular, they murdered five of his domestics, who were making hay in a meadow near his

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his house; and would probably have done the same by him, if the sovereign of Kilkenny had not come to his assistance with 100 horse and 300 foot. On the accession of Queen Mary, the tide of opposition became so powerful, that, to avoid assassination, he embarked for Holland, but was very unfortunate in his escape. First he was taken by a Dutch man of war, and robbed by the captain of all his effects. Then, being forced by stress of weather into St Ive's in Cornwall, he was confined on suspicion of treason. Being, however, released after a few days confinement, the ship anchored in Dover road, where he was again seized on a false accusation. After his arrival in Holland, he was kept prisoner for three weeks, and at length obtained his liberty on paying 30l. From Holland he travelled to Basil in Switzerland, where he continued till Queen Elizabeth ascended the throne. After his return to England he was in 1560 made prebendary of Canterbury, probably not choosing to return to his former flock of wolves. He died in November 1563, at Canterbury, in the 68th year of his age. He was so severe a writer against the church of Rome, that his books are particularly prohibited in the expurgatory index published at Madrid, in folio, in the year 1667. He is the earliest dramatic writer in the English language, or at least author of the first pieces of that kind that we find in print. Of his writings in that way no fewer than 21 have been enumerated: only three of them, however, have been seen in print, viz. 1. God's Promises, an interlude; 2. St John Baptist, an interlude; 3. Concerning the Laws of Nature corrupted: the first of which has been reprinted by Dodsley, in the first volume of his collection of old plays; and the only copy extant of the last is preserved in St Sepulchre's library in Dublin. As to the rest, they are mentioned by himself as his own, in his account of the writers of Britain before mentioned. He also translated the tragedies of Pammachius. His other works are very numerous; but the chief is his catalogue of British Authors: a book of some merit, as it contains some information which is not elsewhere to be found; but he has destroyed his credit by his intemperate Billingsgate abuse of all those who differed from him in religion. The authentic part of his work is transcribed from Leland. The title of it is, *Illustrium Majoris Britanniæ scriptorum catalogus, à Japheto sanctissimi Noa filio ad an. Dom.* 1557.

BALE, in commerce. Any goods packed up in cloth, and corded round very tight, in order to keep them from breaking, or preserve them from the weather, is called a *bale*.—A bale of cotton yarn is from 300 to 400 weight; of raw silk, is from 100 to 400; of lockram or dowlas, either three, three and a half, or four pieces.

BALE Goods, among the English merchants, are all such as are imported or exported in bales; but the French give that name to certain hardwares and other sorts of merchandise which come to Paris, and are commonly made by bad workmen of different materials.

BALEARES INSULÆ, or the *Balearic Islands*. The appellation is commonly derived from Βαλλειν, because the inhabitants were excellent slingers. But Bochart makes the name of Punic or Phœnician original, as were the people: *Baal-jare*, a master, or skilful at throwing; the Phœnicians and Hebrews being dexterous at the use of the sling. The Greeks called these islands *Gymnesiæ* (Strabo); because in summer the inhabitants went naked (Diodorus, Livy), or rather because only armed with a sling in war (Hesychius). They are two in number, the Greater and the Less, or Major and Minor; and hence the modern names *Majorca* and *Minorca*. The Major is distant from the Minor 30 miles to the west, in length 40 miles, and in circuit 150 (Pliny). They were subdued by Quintus Metellus, thence surnamed *Balearicus*, in the year 120 B. C. The Baleares, together with the adjacent islands, were a part of the Provincia Citerior or Tarraconensis, and of the resort of the Conventus Carthaginiensis or New Carthage. These islands are called *Choearades* by Apollonius, and *Choeradades* by Strabo, i. e. "rocky." See MAJORCA and MINORCA.

BALEARIC ISLANDS. See the preceding article.

BALECHOU, JOHN JOSEPH, a very celebrated and well known French engraver, flourished about 1750. He died, according to Basan, some few years since, at Avignon. This extraordinary artist worked entirely with the graver; and he was perfectly master of that instrument. The clearness of his strokes, and the depth of colour which he produced, are far beyond any production prior to his own. The two large plates which he did from Vernet, one representing a *storm*, the other a *calm*, must ever be considered as very astonishing exertions of the artist. They are too well known, and too much admired, to need any further eulogium; and were never equalled until they were perhaps surpassed by our countryman Woollet.

BALEN, HENDRICK VAN, history and portrait painter, was born at Antwerp in 1560, and was a disciple of Adam Van Oort; but he quitted that master to acquire a better taste of design and composition, by pursuing his studies at Rome, where he resided for a considerable time. He copied the antiques; he attended to the works of the most memorable modern artists; and at his return to his own country, the visible improvement of his taste recommended him to the favour and esteem of the ablest judges of the art. He distinguished himself by a good manner of designing, and his works are admitted into the cabinets of the curious among those of the principal painters. He particularly excelled in the naked, and gave to his figures so much truth, roundness, and correctness of outline, that few of his cotemporaries could enter into competition with him. Several fine portraits of his hand are at the Hague; among which there is one adorned with allegorical figures of Wisdom and Justice, which extorts commendation from all who attentively consider it. He died in 1632. All the historical subjects painted by Van Balen have abundant merit. His designs of the Deluge, of Moses striking the Rock, and the drowning of Pharaoh, are grand and noble compositions. Houbraken observes, that Van Balen with great judgment, hath introduced the Israelites in a clear light in the back-ground, but the Egyptians in a strong shadow in the fore-ground, which had a very fine effect; the figures being well designed, the attitudes and draperies well chosen, and the number of the figures being very considerable. Of this painter's hand also, the Judgment of Paris is accounted a masterly performance;

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performance; in which the figure of Venus is so elegantly designed, so full of life, and so round, that it seems to stand forth from the surface. The landscapes and back grounds of the pictures composed by Van Balen were generally painted by the Velvet Breughel.

BALEN, *John Van*, painter of history, landscapes, and boys, was born at Antwerp in 1611; and derived his knowledge of the art, and his fine taste of drawing and design, from his father Hendrick Van Balen; but as soon as he had made a competent progress, he travelled to Rome, and lived for several years in that and other cities of Italy. There he acquired a good gusto of design, though he was sometimes incorrect; and his particular merit was shown in his naked figures of boys, cupids, nymphs bathing or hunting, of which subjects he painted a considerable number; and he procured both praise and riches by his landscapes and histories. His pictures were well handled, his trees touched with spirit, and his herbage and verdure looked natural and lively. The carnations of his figures were clear and fresh; his colouring in general was transparent; and the airs of his heads were in the manner of Albano.

BALES, PETER, a famous master in the art of penmanship, or fair writing; and one of the first inventors of short-hand writing. He was born in 1547, and is styled by Anthony Wood "a most dexterous person in his profession, to the great wonder of scholars and others;" who adds, that "he spent several years in sciences among Oxonians, particularly as it seems in Gloucester-hall: but that study, which he used for a diversion only, proved at length an employment of profit." He is recorded for his skill in micrography, or miniature-writing, in Hollingshed's Chronicle, anno 1575; and Mr Evelyn also has celebrated his wonderful skill in this delicate operation of the hand. "Hadrian Junius, speaking as a miracle of somebody, who wrote the Apostles Creed, and the beginning of St John's Gospel, within the compass of a farthing: what would he have said," says Mr Evelyn, "of our famous Peter Bales; who, in the year 1575, wrote the Lord's Prayer, the Creed, Decalogue, with two short prayers in Latin, his own name, motto, day of the month, year of the Lord, and reign of the Queen, to whom he presented it at Hampton Court, all of it written within the circle of a single penny, inchaced in a ring and borders of gold; and covered with a crystal so accurately wrought, as to be very plainly legible, to the great admiration of her Majesty, the whole Privy-Council, and several ambassadors then at Court?" He was farther very dexterous in imitating hand-writing, and about 1586, was employed by Secretary Walsingham in certain political manœuvres. We find him at the head of a school, near the Old Bailey, London, in 1590; in which year he published his "Writing Schoolmaster, in three parts: the first teaching swift writing; the second, true writing; the third, fair writing." In 1595, he had a great trial of skill in the Blackfriars with one Daniel Johnson, for a golden pen of 20l. value, and won it; and a contemporary author farther relates, that he had also the arms of Calligraphy given him, which are Azure, a Pen, Or, as a prize, at a trial of skill in this art among the best penmen in London. In 1597, he republished his "Writing Schoolmaster;" which was in such high reputation, that no less than eighteen copies of commendatory verses composed by learned and ingenious men of that time, were printed before it. Wood says, that he was engaged in Essex's treasons in 1600; but Wood was mistaken: he was only engaged, and very innocently so, in serving the treacherous purposes of one of that earl's mercenary dependants. We know little more of this curious person, but that he seems to have died about the year 1610.

BALESTRA, ANTONIO, an excellent historical painter, was born at Verona in 1666. At the age of 21 he went to Venice, where he entered himself in the school of Antonio Bellucci, and continued for three years under his direction; but from thence he visited Bologna and Rome, and at the latter became the disciple of Carlo Maratti. Under the tuition of so eminent a genius, he made a very great proficiency, and exerted himself for some hours of each day in designing after the antiques, after Raphael, Correggio, Hannibal Carracci, and other admired painters; by which conduct he so effectually confirmed his taste and freedom of hand, that he obtained the prize of merit in the Academy of St Luke, in the year 1694, when he was only 28 years of age. From that time his reputation was established, and he received sufficient encouragement; being engaged to work for most of the churches, and in the palaces of the nobility; and his paintings were admired in every part of Europe. His style is sweet and agreeable, not unlike that of Maratti; and the judicious observe in the works of Balestra, a certain mixture of the several manners of Raphael, Correggio, and Carracci. He died in 1740. In the church of Santa Maria Mater Domini at Venice, there is one of the most capital performances of Balestra, representing the nativity of our Saviour. It is designed in a grand style, the composition is excellent, and has a great deal of grace. The heads are peculiarly fine; and the whole has a noble effect, with remarkable harmony. In a chapel belonging to the church of S. Geminiano, in the same city, there is a dead Christ in the arms of the Virgin, painted by this master in a grand taste; and although the composition consists but of a few figures, they are finely designed; and in every part of it there is sufficient merit to claim and justify applause.

BALEY, WALTER, the son of Henry Baley of Warnwell in Dorsetshire, was born at Potsham in the same county, and educated at Westminster school. From thence he was sent to Oxford; and, after two years probation, was admitted perpetual fellow of New College in the year 1550. Having taken his degrees in arts, he practised physic, and in 1558 was proctor of the university. About this time he obtained a prebend of Wells, which he resigned in 1579. In the year 1561 he was appointed queen's professor of physic, in 1563 proceeded doctor in that faculty, and afterwards became one of her majesty's physicians in ordinary. He was thought skilful in his profession, and had considerable practice. He died in 1592, aged 63; and was buried in the inner chapel of New College. His works are, 1. *A discourse of three kinds of paper in common use*, 1588, 8vo. 2. *Brief treatise of the preservation of the eye sight;* first printed in the reign of Elizabeth, in 12mo; afterwards at Oxford in 1616 and 1654, 8vo. 3. *Directions for health natural and artificial;*

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tificial; with medicines for all diseases of the eyes, 1626, 4to. 4. *Explicatio Galeni de potu convalescentium et senum*, &c. manuscript, formerly in Lord Aylesbury's library.

BALI, an island of Asia, in the East Indies, forming the north side of the straits of Java, through which the East India ships sometimes return from China to Europe: but the passage is commonly difficult on account of contrary winds. The island is extremely populous, and abounds in rice and other productions peculiar to that climate. The inhabitants are Pagans, and very warlike. E. Long. 115. 30. S. Lat. 9. 0.

BALIOL, or BALLIOL, SIR JOHN DE, founder of Baliol-college in Oxford, was the son of Hugh Baliol, of Bernard's castle, in the diocese of Durham; and was a person very eminent for his power and riches. During the contests and wars between King Henry III. and his barons, he firmly adhered to the king. In 1263, he began the foundation and endowment of Baliol college, which was afterwards perfected by his widow. He died in the year 1269.

BALIOL, BALLIOL, or BOILLIOL, *John*, the competitor with Robert Bruce for the crown of Scotland, was the great grandson of David earl of Huntington, third son of King David I. See SCOTLAND.

BALISORE, a sea port town of Asia, in the East Indies, to the north-west of the bay of Bengal. It is about four miles from the sea by land, but 20 by the river; seated in a very fruitful soil, producing rice, wheat, aromatic seeds, tobacco, &c. The inhabitants make several sorts of stuffs of cotton, silk, and a kind of grass. The place was given up to the English by the Nagpore rajah at the peace in 1803. E. Long. 86. 50. N. Lat. 21. 30.

BALISTES. See ICHTHYOLOGY *Index*.

BALIVO AMOVENDO, in *Law*, was a writ for removing a bailiff from his office, for want of having sufficient land in his bailiwick to answer the king and his people, according to the statute of Westminster, 2 reg. Orig. 78.

BALK, among builders, is sometimes used for the summer beam of a house; sometimes for the poles and rafters, which support the roofs of barns, &c.; and sometimes for the beams used in making sea-holds.

BALK, or *Balkh*, a province of Great Bukharia in Asia, about 360 miles long and 250 broad, situated to the south of the province of Samarkand, and to the east of Bukharia Proper. It is the least of the three provinces that make up what is called *Great Bukharia;* but being extremely fertile and well cultivated, the prince draws a great revenue from it. The country particularly abounds with silk, of which the inhabitants make pretty manufactures. The Uzbecks subject to the khan of Balkh are the most civilized of all the Tartars inhabiting Great Bukharia, owing probably to their commerce with the Persians: they are likewise more industrious, and more honest, than the rest; but in other respects have the same customs with the rest of the Tartars. The province is subdivided into several countries; the most remarkable of which are Khotlan or Katlan, Tokharestan, and Badagshan. It was formerly subject to Persia, but is now a dependency on the kingdom of Cabul.

BALK, the capital of the above-mentioned province, situated on the frontiers of Persia, in E. Long. 65. 20. N. Lat. 36. 45. It is probably the ancient Bactra, capital of the kingdom of Bactria; and is said by the Persians to have been founded by Kay-umaraz the first king of Persia, because he met his brother upon the spot where it stood, after he had been lost for a long time; *balkhiden*, or *balghiden*, in the Persic language, signifying to receive and embrace a friend. The first kings of Persia, who resided in the province of Media or *Aderbijan*, considered this city as one of their principal frontiers on the side of Scythia. In the 27th year of the Hegira, of Christ 647, Balk was reduced by the Arabs, under the command of Abdallah Ebn Amer. It continued subject to Arab princes till the year of the Hegira 432, of Christ 1041; when it was reduced by Togrol Beg, the Tangrolipix of the Greeks, and prince of the Seljukian dynasty. It was taken by Jenghiz Khan, A. D. 1221, who with his usual and unparalleled cruelty caused all the inhabitants to be brought without the walls, and massacred without mercy. In 1369, Sultan Hosein, the last of the race of Jenghiz Khan, was driven from Balk by Tamerlane, whose successors were driven out by the Uzbecks in the 15th century. It was afterwards redeemed by Shah Ismael Sufi; but finally wrested out of his hands by the Uzbeck Tartars, between whom and the Persians it is the occasion of almost continual wars. It was not long since the residence of a khan of Tartars. It is the most considerable city possessed in these parts by the Mahometan Tartars, is large, well built, and populous, the houses consisting for the most part of stone or brick. The fortifications consist of bulwarks of earth, fenced without with a strong wall, high enough to cover the soldiers employed in defence of those fortifications. As this place is the resort of all the business transacted between the Indies and Great Bukharia, trade flourishes extremely at Balk; especially as it has a fine river passing through its suburbs, which is of vast service to the town. This river falls into the Amu, in N. Lat. 38. 30. upon the confines of Great Bukharia and Kowarazm. The khan's palace, or castle, is a large edifice built after the oriental manner; and consists almost entirely of marble, of which there are fine quarries in the neighbourhood. The khan of Balk was obliged in 1739 to submit to the Persians under Khouli Kan; but since that time the country has been separated from Persia, and is now subject to the kingdom of Cabul.

BALKERS, in the fishery, persons placed on rocks and eminences at sea to spy the herring droves, and give notice to the fishermen, by waving boughs, what way they go, and where they may be found.

BALL, in a general sense, a spherical and round body, whether naturally so, or formed into that figure by art.

BALL, in the military art, comprehends all sorts of bullets for fire-arms, from the cannon to the pistol. Cannon-balls are of iron; musket-balls, pistol-balls, &c. are of lead. The experiment has been tried of iron balls for pistols and fusees; but they are justly rejected, not only on account of their lightness, which prevents them from flying straight, but because they are apt to furrow the barrel of the pistol, &c.

BALL *of a Pendulum*, the weight at the bottom. In shorter pendulums this is called the *bob*.

BALL, in *Pyrotechnics*, is also a composition of various

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Balls. rious combustible ingredients, serving to burn, smoke, give light, &c. In this sense we read of fire-balls, light-balls, smoke-balls, stink-balls, sky-balls, water-balls, land-balls.

Ball, among the Cornish miners, signifies a tin-mine.

Ball, among printers, a kind of wooden tunnel stuffed with wool, contained in a leather cover, which is nailed to the wood, with which the ink is applied on the forms to be wrought off. See Printing.

Horse-Balls, among farriers. Horses have a very nice taste; it is therefore proper to give the more disagreeable drugs in the form of balls, and to make drenches of the more palatable. Balls should be of an oval shape, not exceeding the size of a pullet's egg; and should be dipped in sweet oil to make them slip down the easier. Some horses have a strait gullet, which makes them very averse to a ball being thrust down their throats; such horses had better have drenches given them, or their medicines may be mixed with bran, or in their mashes. See Farriery, *passim*.

Ball-Vein, in *Mineralogy*, a name given by the miners of Sussex to a sort of iron ore common there, and wrought to considerable advantage. It yields not any great quantity of metal, but what it has runs freely in the fire; it is usually found in loose masses, not in the form of a stratum, and is often covered with one or more crusts. It generally contains some sparkling particles; and is usually of a circular form in the perfect masses, thickest in the middle, and gradually thinner as it approaches the sides. The ores of Sussex in general are poor, but they require very little trouble in the working; so that a considerable profit is made annually from them.

Ball and Socket, an instrument made of brass, with a perpetual screw, so as to move horizontally, vertically, and obliquely; and is generally used for the managing of surveying or astronomical instruments.

Puff-Ball, the English name of the lycoperdon. See Lycoperdon, Botany *Index*.

Martial Balls, in *Pharmacy*, are a mixture of filings of iron and cream of tartar, formed into a solid consistence and form of a ball, which is used to impregnate water or other liquids with iron dissolved by the tartareous acid. To make these balls, one part of filings of iron and two parts powdered cream of tartar are mixed well together, and put into an earthen or iron vessel with some water. This mixture is to be stirred from time to time, till it becomes almost dry; and then it is to receive more water, and to be stirred as before. This treatment is to be continued till it acquires, when nearly dry, somewhat of the consistence and tenacity of softened rosin. Then it is to be rolled up in the form of a ball, which is generally kept tied up in a rag; and when intended to be used, it is to be infused in water, till it gives some colour to that liquid. The infusion of martial balls is tonic, vulnerary, discutient, and aperitive; and is employed both internally and externally. Iron being soluble in all acids, is attacked in this preparation by the tartareous acid, which reduces it to a kind of neutral salt not crystallizable. This salt would remain liquid, and would form a soluble martial tartar, called *tartarised tincture of Mars*. If proper proportions of filings of iron and cream of tartar be used, and treated long enough for an entire and complete combination, nothing would be obtained but a liquor or magma, which could not be preserved in a solid form, but would be continually moist. Therefore, in the martial ball there is a good deal of the cream of tartar and filings of iron not combined together, by which its solidity is preserved.

Mercurial Balls, in *Pharmacy*, are an amalgam of mercury and tin, sufficiently solid to be moulded, and to preserve a given form. The method of making them is by adding mercury to melted tin, and pouring the fluid mass into a round hollow mould. These balls are employed to purify water, in which they are boiled; for which purpose travellers often carry some along with them. Nothing, however, can be more pernicious than such a practice, should the water contain any nitrous acid, which it very often does.

Balls of Silk-worms and Spiders, are little cases or cones of silk, wherein those insects deposite their eggs. Spiders are extremely tender of their balls, which they carry about with them, adhering to the papillæ about their anus. Grew mentions balls or bags of a species of silk-worms in Virginia as big as hens eggs, and containing each four aurelias.

Zoologists speak of a sort of balls of hair covered over with a smooth shining coat or shell, found in the stomachs of oxen, cows, calves, horses, sheep, and goats. See the article Bezoar.

Balls of Fire, in *Meteorology*. See Fire, *Balls of*.

Balls, in *Electricity*, are two pieces of cork, or pith of elder, nicely turned in a lathe to the size of a small pea, and suspended by fine linen threads; intended as electrometers, and of excellent use to discover small degrees of electricity, to observe the changes of it from positive to negative, and *vice versa;* and to estimate the force of a shock before the discharge, so that the operator should always be able to tell very nearly before the discharge, by knowing how high he has charged his jars, what the explosion will be.

Fire-Balls, are bags of canvas filled with gunpowder, sulphur, saltpetre, pitch, &c. to be thrown by the soldiers, or out of mortars, in order to fire the houses incommoding trenches, advanced posts, or the like.—The Greeks had divers kinds of fire-balls, or Πυροβολοι λιθοι; one kind called, more particularly, σκυταλια, or σκυταλιδες, made of wood, sometimes a foot or even a cubit long; their heads being armed with spikes of iron, beneath which were hemp, pitch, and other combustibles, which being set on fire, they were cast among the enemy. The preparations of fire-balls, among the moderns, consist of several operations, viz. making the bag, preparing the composition, tying, and, lastly, dipping the ball. 1. The bags for this purpose are either oval or round. 2. The composition wherewith fire-balls are filled is various: To ten pounds of meal-gunpowder add two of saltpetre, one of sulphur, and one of colophony; or to six pounds of gunpowder, add four of saltpetre, four of sulphur, one of powdered glass, half a pound of antimony, as much camphor, an ounce of sal-ammoniac, and four of common salt, all pulverised. Sometimes they even fill fire-balls with hand grenades. 3. For tying the fire-balls, they prepare two iron rings, one fitted round the aperture,

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aperture, where the ball is to be lighted, the other near its base. A cord is tied to these rings in such a manner, as that the several turns represent semicircles of the sphere cutting the globe through the poles: over the cords, extended according to the length of the ball, others are tied, cutting the former at right angles, and parallel to each other, making a knot at each intersection: lastly, after putting in a leaden bullet, the rest of the space is filled with tow or paper. 4. Thus completed, the fire-ball remains to be dipped in a composition of melted pitch four pounds, colophony two, and linseed oil or oil of turpentine two; after dipping, they cover it round with tow, and dip again, till it be brought to the just diameter required.

Light-Balls, are such as diffuse an intense light around; or they are balls which, being cast out of the hand or a mortar, burn for some time, and illuminate the adjacent parts. 1. Luminous or light-balls for the hand are made of ground powder, saltpetre, brimstone, camphor, and borax, all sprinkled with oil, and moulded into a mass with suet; and this is wrapped up in tow, with a sheet of strong paper over it. To fire it, they make a hole into it with a bodkin, into which they put some priming, that will burn slow. Its use is to be cast into any works they would discover in the night-time. 2. For the larger light-balls, or those to be thrown to a greater distance, they melt equal quantities of sulphur, turpentine, and pitch; and therein dip an earthen or stone ball, of a diameter much less than that of the mortar out of which the fire-ball is to be cast: then rolling it in gunpowder, and covering it round with gauze, they dip it again, and repeat the rest till it come to fit the cavity of the mortar: lastly, they sprinkle it round with gunpowder. This, being once kindled, will strongly illuminate all around the place where it is thrown, and give opportunity to examine the state and condition thereof.

Smoke or *Dark-Balls*, those which fill the air with smoke, and thus darken a place to prevent discoveries. To prepare a darkening ball, make an oval or spherical bag; melt rosin over the coals, and add an equal part of saltpetre not purified, also of sulphur, and a fifth part of charcoal. The whole being well incorporated, put in tow first shred, and fill the bags with this composition, and dip it after the same manner as a fire-ball.

Stink-Balls, those which yield a great stench where fired to annoy the enemy. Their preparation is thus: Melt ten pounds of pitch, six of rosin, twenty of saltpetre, eight of gunpowder, and four of colophony; to these add two of charcoal, six of horse-hoofs cut small, three of asafœtida, one of stinking-saracen, and any other offensive ingredients. The rest as in the former.

Sky-Balls, those cast on high out of mortars, and which, when arrived at their height, bursting like rockets, afford a spectacle of decoration. Sky-balls are made of a wooden shell, filled with various compositions, particularly that of the stars of rockets. These are sometimes intermixed with crackers and other combustibles, making rains of fire, &c.

Water-Balls, those which swim and burn a considerable time in the water, and at length burst therein. These are made in a wooden shell, the cavity of which is filled with refined saltpetre, sulphur, saw-dust boiled in water of saltpetre, and dried; to which sometimes other ingredients are added, as iron filings, Greek pitch, amber dust, powdered glass, and camphor. The ingredients are to be ground, mixed up, and moistened with linseed oil, nut oil, olive oil, hempseed oil, or petrol. At the bottom is placed an iron coffin, filled with whole gunpowder, that the ball may at last burst with a greater noise: and, lastly, the ball is by the addition of lead or otherwise, made of the same specific gravity with water.

Land-Balls are those which, being thrown out of a mortar, fall to the ground, burn, and burst there. The ingredients are much the same as in the *water-balls*, only the specific gravity is not attended to.

BALLAD, a kind of song, adapted to the capacity of the lower class of people; who, being mightily taken with this species of poetry, are thereby not a little influenced in the conduct of their lives. Hence we find, that seditious and designing men never fail to spread ballads among the people, with a view to gain them over to their side.

BALLAGHAN, a town of Ireland, in the county of Sligo, and province of Connaught. W. Long. 9. 50. N. Lat. 53, 48.

BALLAN, or BALLON, a town of France, in the department of Sarthe, seated on the river Orne. E. Long. 0. 20. N. Lat. 48. 10.

BALLAST, any heavy matter, as stone, gravel, iron, &c. thrown into the hold of a ship, in order to make her sink a proper depth in the water, that she may be capable of carrying a sufficient quantity of sail without oversetting.

There is often great difference in the proportion of ballast required to prepare ships of equal burden for a voyage; the quantity being always more or less according to the sharpness or flatness of the ship's bottom, which seamen call the *floor*.

The knowledge of ballasting a ship with propriety, is certainly an article that deserves the attention of the skilful mariner: for though it is known, that ships in general will not carry a sufficient quantity of sail till they are laden so deep that the surface of the water will nearly glance on the extreme breadth amidships, yet there is more than this general knowledge required; since, if she has a great weight of heavy ballast, as lead, iron, &c. in the bottom, it will place the centre of gravity too low in the hold; and although this will enable her to carry a great sail, she will nevertheless sail very heavily, and run the risk of being dismasted by her violent rolling.

To ballast a ship, therefore, is the art of disposing those materials so that she may be duly poised, and maintain a proper equilibrium on the water, so as neither to be too *stiff* nor too *crank*, qualities equally pernicious: as in the first, although the ship may be fitted to carry a great sail, yet her velocity will not be proportionably increased; whilst her masts are more endangered by her sudden jerks and excessive labouring: and in the last, she will be incapable of carrying sail, without the risk of oversetting.

Stiffness, in ballasting, is occasioned by disposing a great quantity of heavy ballast, as lead, iron, &c. in the bottom, which naturally places the centre of gravity very near the keel; and that being the centre about which

which the vibrations are made, the lower it is placed, the more violent will be the motion of rolling.

Crankness, on the other hand, is occasioned by having too little ballast, or by disposing the ship's lading so as to raise the centre of gravity too high, which also endangers the mast in carrying sail when it blows hard: for when the masts lose their perpendicular height, they strain on the shrouds in the nature of a lever, which increases as the sine of their obliquity; and a ship that loses her masts is in great danger of being lost.

The whole art of ballasting, therefore, consists in placing the centre of gravity to correspond with the trim and shape of the vessel, so as neither to be too high nor too low, neither too far forwards nor too far aft; and to lade the ship so deep, that the surface of the water may nearly rise to the extreme breadth, amidships; and thus she will be enabled to carry a good sail, incline but little, and ply well to the windward.

Ships are said to be *in ballast* when they have no other loading. Masters of vessels are obliged to declare the quantity of ballast they bear, and to unload it at certain places. They are prohibited unloading their ballast in havens, roads, &c. the neglect of which has ruined many excellent ports.—Ships and vessels taking in ballast in the river Thames are to pay so much a ton to Trinity-house, Deptford; who shall employ ballast-men, and regulate them; and their lighters to be marked, &c. on pain of 10l.

BALLATOONS, large heavy luggage-boats used for carrying wood by the river from Astracan and the Caspian sea to Moscow. These will carry from 100 to 200 tons, and have from 100 to 120 men employed to row and tow them along.

BALLENDEN, Sir John, a Scottish poet, in the reign of James V. of Scotland, was descended from an ancient family in that kingdom. His father, Mr Thomas Ballenden of Auchinoul, was director to the chancery in the year 1540, and clerk register in 1541. Where our poet was educated, we are not informed; but from one of his poems we learn, that in his youth he had some employment at the court of King James V. and that he was in great favour with that prince. Having taken orders, and being created doctor of divinity at the Sorbonne, he was made canon of Ross, and archdeacon of Moray. He likewise obtained the place of clerk-register, but was afterwards deprived of that employment by the factions of the times; however, in the succeeding reign of Mary, he recovered that office, and was one of the lords of session. Being a zealous Papist, he, in conjunction with Dr Laing, was extremely assiduous in retarding the progress of the reformation; till at last, finding the opposition too powerful, he quitted Scotland, and went to Rome, where he died in the year 1550. He is generally esteemed one of the best Scottish poets of that age. His works are, 1. *The History and Chronicles of Scotland of Hector Boëis* (Boethius), *translated by Mr John Ballenden*, Edinb. 1536. This is not a mere translation, Ballenden having corrected several mistakes of his author, and made large additions. It is in folio, and black letter. 2. *Cosmography to the History of Scotland*, with a poetical poem. 3. *A Description of Albany*. 4. *Translation of Boethius's Description of Scotland*. 5. *Epistles to King James V.* Bale says he had seen these letters. 6. Several poems in Carmichael's collection of Scottish poems; besides many others in manuscript, in private libraries in Scotland. 7. *Virtue and Vyce*, a poem addressed to King James V.

BALLET, Balet, or Balletto, a kind of dramatic poem, representing some fabulous action or subject divided into several entries; wherein several persons appear, and recite things under the name of some deity, or other illustrious character.

Ballet is more particularly used for a kind of comic dance, consisting of a series of several airs of different kinds of movements, which together represent some subject or action. They are performed chiefly by masks representing sylvans, tritons, nymphs, shepherds, and the like; and consist of three parts, the entry, figure, and the retreat. The word is of Greek origin, formed from βαλλειν, *jacere*, to cast, throw, or toss; whence also in writers of the middle age, we find *ballationes* for *saltationes*, dancings; and *ballare* for *saltare*, to dance.

BALLIAGE, or Bailiage, in *Commerce*, a small duty paid to the city of London by aliens, and even denizens, for certain commodities exported by them.

BALLICONNEL, a town of Ireland in the county of Cavan, and province of Ulster. W. Long. 7. 45. N. Lat. 54. 6.

BALLISHANNON, a large town of Ireland in the county of Donegal, or Tyrconnel, with a good haven. W. Long. 8. 25. N. Lat. 54. 25.

BALLISTA, a machine used by the ancients for shooting darts; it resembled in some measure our cross-bow. The word is Latin, signifying a cross-bow; and is derived from the Greek βαλλω, to *shoot*, or *throw*.

Vegetius informs us, that the ballista discharged darts with such rapidity and violence that nothing could resist their force: and Athenæus adds, that Agistratus made one of little more than two feet in length, which shot darts 500 paces.

In Plate LXXXIV. is represented the balista used in sieges, according to the chevalier Folard: 2, 2, the base of the ballista; 3, 4, upright beams; 5, 6, transverse beams; 7, 7, the two capitals in the upper transverse beam, (the lower transverse beam has also two similar capitals, which cannot be seen in this transverse figure); 9, 9, two posts or supports for strengthening the transverse beams; 10, 10, two skains of cords fastened to the capitals; 11, 11, two arms inserted between the two stands, or parts of the skains; 12, a cord fastened to the two arms; 13, darts which are shot by the ballista; 14, 14, curves in the upright beams, and in the concavity of which cushions are fastened, in order to break the force of the arms, which strike against them with great force when the dart is discharged; 16, the arbor of the machine, in which a groove or canal perfectly straight is formed, and in which the darts are placed in order to their being shot by the ballista; 17, the nut of the trigger; 18, the roll or windlass, about which the cord is wound; 19, a hook, by which the cord is drawn towards the centre, and the ballista cocked; 20, a stage or table on which the arbor is in part sustained.

BALLISTEUM, or Ballistræa, in antiquity, a military song or dance used on occasions of victory. Vopiscus has preserved the *balisteum* sung in honour of Aurelian, who, in the Sarmatian war, was said to have

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have killed 48 of the enemy in one day with his own hand. *Mille, mille, mille, mille, mille, mille decollavimus: Unus homo mille, mille, mille, mille decollavit; mille, mille, mille vivat, qui mille, mille occidit. Tantum vini habet nemo, quantum fudit sanguinis.* The same writer subjoins another popular song of the same kind: *Mille Francos, mille Sarmatas, semel occidimus; mille, mille, mille, mille, mille, Persas, quærimus.* It took the denomination *ballisteum* from the Greek Βαλλω, *jacio*, or *jacto*, to cast or toss, on account of the motions used in this dance, which was attended with great elevations and swingings of the hands. The *ballistea* were a kind of popular ballads, composed by poets of the lower class, without much regard to the laws of metre.

BALLISTIC PENDULUM, an ingenious machine invented by Benjamin Robbins for ascertaining the velocity of military projectiles, and consequently the force of fired gunpowder. It consists of a large block of wood, annexed to the end of a strong iron stem, having a cross steel axis at the other end, placed horizontally, about which the whole vibrates together like the pendulum of a clock. The machine being at rest, a piece of ordnance is pointed straight towards the wooden block, or ball of this pendulum, and then discharged: the consequence is this; the ball discharged from the gun strikes and enters the block, and causes the pendulum to vibrate more or less according to the velocity of the projectile, or the force of the blow; and by observing the extent of the vibration, the force of that blow becomes known, or the greatest velocity with which the block is moved out of its place, and consequently the velocity of the projectile itself which struck the blow and urged the pendulum. *Hutton's Mathemat. Dict.*

BALLOON, or BALON, in a general sense, signifies any spherical hollow body, of whatever matter it be composed, or for whatever purposes it be designed. Thus, with chemists, balloon denotes a round short-necked vessel, used to receive what is distilled by means of fire; in architecture, a round globe on the top of a pillar; and among engineers, a kind of bomb made of pasteboard, and played off, in fire-works, either in the air or on the water, in imitation of a real bomb.

Air-BALLOON. See AEROSTATION.

BALLOON also denotes a kind of game something resembling tennis. The balloon is played in the open field, with a great round ball of double leather blown up with wind, and thus driven to and fro with the strength of a man's arm, fortified with a brace of wood.

BALLOON, or BALLOEN, is more particularly used among voyagers for the state-barges of Siam. The balloons are a kind of brigantine, managed with oars, of very odd figures, as serpents, sea-horses, &c. but by their sharpness and number of oars, of incredible swiftness. The balloons are said to be made of a single piece of timber, of uncommon length; they are raised high, and much decorated with carving at head and stern: some are gilt over, and carry 120 or even 150 rowers on each side. The oars are either plated over with silver, or gilt, or radiated with gold; and the dome or canopy in the middle, where the company is placed, is ornamented with some rich stuff, and furnished with a ballustrade of ivory, or other costly matter, enriched with gilding. The edges of the balloon just touch the water, but the extremities rise with a sweep to a great height. Some are adorned with a variety of figures, made of pieces of mother-of-pearl inlaid: the richer sort, instead of a dome, carry a kind of steeple in the middle; so that, considering the slenderness of the vessel, which is usually 100 or 120 feet long, and scarce six broad, the height of the two ends, and of the steeple with the load of decorations, it is a kind of miracle they are not overset.

BALLOON, in the French paper trade, is a term for a quantity of paper, containing 24 reams.

BALLOON, BALLON, or BALLOT, in the French glass-trade, signifies a certain quantity of glass-plates, smaller or greater according to their quality. The ballon of white glass contains 25 bundles, of six plates per bundle; but the ballon of coloured glass is only of 12½ bundles, and of three plates to a bundle.

BALLOTA, WHITE HOREHOUND. See BOTANY *Index*.

BALLOTADE, in the manege, the leap of a horse between two pillars, or upon a straight line, made with justness of time, with the aid of the hand and the calves of the legs: and in such a manner, that when his fore-feet are in the air, he shows nothing but the shoes of his hinder feet without yerking out.

BALLOTING, a method of voting at elections, &c. by means of little balls usually of different colours, by the French called *ballots*; which are put into a box privately.

BALLS, or BALLETS, in *Heraldry*, a frequent bearing in coats of arms, usually denominated, according to their colour, bezantes, plates, hurts, &c.

BALLUSTER, a small kind of pillar used for ballustrades.

BALLUSTRADE, a series or row of ballusters, joined by a rail; serving as well for a rest to the elbows as for a fence or enclosure to balconies, altars, staircases, &c. See ARCHITECTURE, N° 74.

BALM. See MELISSA, BOTANY *Index*.

BALM, or BALSAM. See BALSAM.

BALM of Gilead. See SUPPLEMENT.

BALNAVES, HENRY, a Scottish Protestant divine, born in the shire of Fife, in the reign of James V. and educated at the university of St Andrew's. He went afterwards to France in order to finish his studies; and returning to Scotland, was admitted into the family of the earl of Arran, who at that time governed the kingdom: but in the year 1542 the earl dismissed him for having embraced the Protestant religion. In 1564, he joined, says Mackenzie, the murderers of Cardinal Beaton; for which he was declared a traitor, and excommunicated. Whilst that party were besieged in the castle of St Andrew's, they sent Balnaves to England, who returned with a considerable supply of provisions and money; but being at last obliged to surrender to the French, he was sent with the rest of the garrison to France. He returned to Scotland, about the year 1559; and having joined the Congregation, he was appointed one of the commissioners to treat with the duke of Norfolk on the part of Queen Elizabeth. In 1563 he was made one of the lords of session, and appointed by the general assembly, with other learned men, to revise the book of Discipline. Knox, his cotemporary, and fellow-labourer, gives him the character of a very learned and pious divine. He died

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died at Edinburgh in the year 1579. He wrote, 1. A Treatise concerning Justification. Edinb. 1550, 8vo. 2. A Catechism, or Confession of Faith. Edinb. 1584, 8vo.

BALNEARII SERVI, in antiquity, servants or attendants belonging to the baths. Some were appointed to heat them, called *fornicatores;* others were denominated *capsarii*, who kept the clothes of those that went into them; others *alliptæ*, whose care it was to pull off the hair; others *unctuarii*, who anointed and perfumed the body.

BALNEARIUS FUR, in antiquity, a kind of thief who practised stealing the clothes of persons in the baths; sometimes also called *fur balnearum*. The crime of those thieves was a kind of sacrilege; for the hot baths were sacred: hence they were more severely punished than common thieves who stole out of private houses. The latter were acquitted with paying double the value of the thing stolen; whereas the former were punished with death.

BALNEUM, a term used by chemists to signify a vessel filled with some matter, as sand, water, or the like, in which another is placed that requires a more gentle heat than the naked fire.

BALSA, an ancient town of Lusitania, in the Ager Cunæus; now *Tavira*, capital of Algarva.

BALSAM, or NATIVE BALSAM, an oily, resinous, liquid substance, flowing either spontaneously, or by means of incision, from certain plants. There are a great variety of balsams, generally denominated from the substances from which they are obtained; and which are explained under their names as they occur.

BALSAMICS. *Balsamica* is a Latin word which signifies *mitigating*. The term *balsamic* is a very lax one; it includes medicines of very different qualities, as emollients, detergents, restoratives, &c. but in medicines of all these kinds there seems to be this requisite in them, viz. that they be soft, yielding, and adhesive, also that by their smallness they have a ready disposition to motion. Medicines of this tribe are generally required for complaints whose seat is in the viscera; and as they cannot be conveyed there but by the common road of the circulation, it follows, that no great effects can be expected from them but by their long continuation. Hoffman calls by the name of *balsamics* those medicines which are hot and acrid, also the natural balsams, gums, &c. by which the vital heat is increased.

Motherby's Med. Dict.

BALSORA. See BASSORA.

BALTAGI, among the Turks, porters and hewers of wood, in the court of the grand signior; who also mount on horseback when the emperor rides out. Part of them also, who, for that purpose, must be castrated, keep watch at the gates of the first and second courts of the seraglio. The first are called *capigi*, and their commander *capigi pascha*.

BALTIC SEA, a great gulf surrounded by Sweden, Russia, Courland, Prussia, Pomerania, and Denmark. The king of Denmark levies a tax at Elsineur on every ship that enters the Baltic sea. It is remarkable that this sea neither ebbs nor flows, and there is always a current sets through the Sound into the ocean. It is generally frozen over three or four months in the year. See BALTIC, SUPPLEMENT.

BALTIMORA. See BOTANY *Index*.

BALTIMORE, a town of Ireland in the county of Cork, a province of Munster, with the title of a barony. It is seated on a headland which runs into the sea, five miles north-east of Cape Clear. W. Long. 9. 10. N. Lat. 51. 15.

BALTIMORE, a town of Maryland, in North America. It is situated round the head of a small bay, which is an arm of the Chesapeake, and near the mouth of the river Patapsco. The bason which forms the harbour is of a circular form, with a narrow entrance guarded by a fort, and is large enough to contain 2000 merchant vessels. Baltimore is now the third port in point of trade in the United States, New York and Philadelphia only being superior. Its progress has been rapid beyond example. In 1750 it was a village of 10 or 12 houses, and in 1818 it contained 60,000 inhabitants. The merchants here are rated as being among the most enterprising in the United States. The tonnage belonging to the port in 1815 amounted to 107,137 tons. A British force attacked Baltimore in September 1814; but the ships of war being unable to force the entrance to the harbour, the attack by land proved unsuccessful, and the troops withdrew, with the loss of the commander, General Ross, and 200 men. The houses in Baltimore are generally well built, and many of the public edifices are extremely handsome. The Roman Catholics are the most numerous class; the other considerable sects are the Episcopalians, Presbyterians, Baptists, and Quakers. The democratic party have a more decided superiority in Baltimore than in any other great city in the United States. W. Long. 76. 40. N. Lat. 39. 10.

BALTIMORE-Bird. See ORIOLUS, ORNITHOLOGY *Index*.

BALTZAR, THOMAS, a native of Lubec, was an eminent musical composer, and esteemed the finest performer on the violin of his time. He came into England in the year 1658, and lived about two years in the house of Sir Anthony Cope of Hanwel in Oxfordshire. He was the great competitor of Davis Mell, who, though a clockmaker by trade, was, till Baltzar came hither, allowed to be the finest performer on the violin in England; and after his arrival he divided with him the public applause, it being agreed that Mell excelled in the fineness of his tone and the sweetness of his manner, and Baltzar in the power of execution and command of the instrument. Moreover, it is said of the latter, that he first taught the English the practice of shifting, and the use of the upper part of the finger-board. Baltzar was given to intemperance, and is said to have shortened his days by excessive drinking: he was buried in Westminster-abbey on the 27th day of July 1663.

BALUCLAVO, or JAMBOL, a sea-port town of the Crimea on the Black sea, where they build ships for the grand signior. E. Long. 35. 15. N. Lat. 44. 50.

BALUZE, STEPHEN, a French writer, born in 1651, and some time librarian to M. Colbert. In 1693 he obtained a pension, with the post of director of the Royal College, for writing the lives of the popes of Avignon; both which advantages he soon lost in the fluctuation of court parties. M. Baluze is much more noted for collecting ancient MSS. and illustrasing them by notes, than famed for his own compositions.

BALYUR, or BALIUR, a sea-port of Africa in the kingdom

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kingdom of Dancali, about 14 hours journey west from Babel-Mandel. It is remarkable only for being the landing place of the Abyssinian patriarch Alphonsus Mendez, with his Jesuits and Portuguese, on April 3d 1724. The royal palace they found to consist of about half a dozen of tents, and a score of huts, fenced about with a thorn hedge, and shaded by some wild kinds of trees. The hall of audience was only a large tent about a musket-shot from the rest. At the upper end was a kind of throne made of stones and clay, covered with a carpet, and two velvet cushions. At the other end was his majesty's horse, with the saddle and other accoutrements hanging one side.

BALZAC, John Lewis Guez de, born at Angouleme in 1595. Voltaire allows him the merit of having given numbers and harmony to the French prose, but censures his style as somewhat bombastic. The critics of his own time gave him no little disquiet; and he gave them no little advantage over him by his sallies of vanity, and some particular propositions which were a little dangerous. M. Balzac, getting rid of these disputes by his moderation, settled at his country-seat; refined his style and genius; and got by his letters and other writings which he published from time to time, the reputation of being the first writer in France. He was at length drawn from his retirement by the hopes of making his fortune under Cardinal Richlieu, who had formerly courted his friendship: but in a few years he retired again, disgusted with the slavish dependence of a court life. All he obtained from the court was a pension of 2000 livres, with the titles of counsellor of state and historiographer of France. He died in 1654; and was buried in the hospital of Notre Dame des Anges, to which he bequeathed 12,000 livres. He left an estate of 100 franks per annum, for a gold medal to be bestowed every two years for the best discourse on some moral subject. Besides his letters he wrote a work called *Oeuvres Diverses*, i. e. on various subjects; The Prince; The Christian Socrates, &c. and many other pieces; all of which have been published in two vols folio.

BAMBA, a province of the kingdom of Congo in Africa.—It is situated between the rivers of Ambrisi and Lose; the last of which parts it from Pemba on the east, as the Ambrisi does from the province of Sogno on the north. Along the sea-coast it extends itself northward to the river Lelunda; and on the south to that of Danda, which parts it from the kingdom of Angola. The governors of this province bear the title of *dukes*, and are always some of the princes of the royal family. They are as despotic and arbitrary as if they were really kings, notwithstanding the care and pains their monarchs have taken to keep them within due bounds. The soil of this province is very fertile; and would produce all the necessaries of life in great plenty, were the inhabitants but industrious in its cultivation. The sea coasts produce a vast quantity of salt, which could be purified with little trouble, and would yield an extraordinary revenue if the duties were duly paid: but these the governors find means to sink mostly into their own coffers.—Here is also the fishery of the zimbis, or little sea-snail, whose shell is the current coin not only in this and the neighbouring kingdoms, but also in the most distant parts of Africa. Here are also said to be mines of gold, silver, quicksilver, copper, tin, and iron; but none except the iron mines are allowed to be worked.

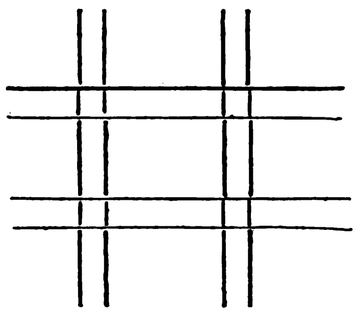
BAMBERG, a large handsome town of Franconia in Germany, and capital of a bishopric of the same name. It was formerly imperial, but is now subject to Bavaria. The country about it produces plenty of corn, fruits, and liquorice. It has an university, founded in 1585; and is situated at the confluence of the rivers Main and Regnitz. E. Long. 10. 15. N. Lat. 50. 10.

Bamberg, a town of Bohemia, situated at the foot of a mountain. E. Long. 16. 50. N. Lat. 49. 53.

BAMBOCCIO, a celebrated painter of conversations, landscapes, cattle, &c. was born at Laeren near Narden in 1613. His name was Peter Van Laer; but in Italy they gave him the name of Bamboccio, on account of the uncommon shape of his body, the lower part being one-third longer than the upper, and his neck so short that it was buried between his shoulders. He had, however, an ample amends for the unseemliness of his limbs, in the superior beauties of his mind: he was endowed with an extensive genius; and, indeed, had an universal taste for every part of painting. He resided at Rome for sixteen years successively; every day studying to improve himself by those beautiful models which were continually open to his observation, and by the lovely scenery in the environs of that city. He was held in the highest esteem by all ranks of men, as well as by those of his own profession; not only on account of his extraordinary abilities, but also for the amiable qualities of his mind. He studied nature incessantly; observing with a curious exactness every effect of light on different objects, at different hours of the day; and whatsoever incident afforded pleasure to his imagination, his memory for ever perfectly retained. His style of painting is sweet and true; and his touch delicate, with great transparency of colouring. His figures are always of a small size, well proportioned, and correctly designed; and although his subjects are taken but from the lower kind of nature, such as plunderings, playing at bowls, inns, farriers shops, cattle, or conversations; yet whatever he painted was so excellently designed, so happily executed, and so highly finished, that his manner was adopted by many of the Italian painters of his time. His works are still universally admired, and he is justly ranked among the first class of the eminent masters. His hand was as quick as his imagination, so that he rarely made sketches or designs for any of his works; he only marked the subject with a crayon on the canvas, and finished it without more delay. His memory was amazing: for whatever objects he saw, if he considered them with any intention to insert them in his compositions, the idea of them was so strongly impressed on his mind, that he could represent them with as much truth as if they were placed before his eyes. Sandrart observes, that although painters who are accustomed to a small size are frequently inaccurate in the disposition of the different parts of their subject, seeming content if the whole appears natural; yet Bamboccio was as minutely exact in having his figures, trees, grounds, and distances, determined with the utmost precision and perspective truth, as the best masters usually are in pictures of the largest size; which is is one circumstance that causes the eye to be so agreeably deluded by the paintings of Bamboccio. In the latter part of his life, he was severely tormented with an asthmatic complaint, which he endured with much impatience; and it is reported, that as the disorder seemed to him insupportable, he threw himself into a canal to shorten his misery, and was drowned. His death happened in 1673.

BAMBOE, in *Botany*, the trivial name of a species of arundo. See ARUNDO, BOTANY *Index*.

Bamboe-Habit; a Chinese contrivance by which a person who cannot swim may easily keep himself above water. The following account of it is from a letter to the author of the *Seaman's Preservative*. "In the year 1730, I was passenger in a ship from Batavia to China, burden about 400 tons, called the *Pridae*, Francisco Xavier commander, freighted by English, Chinese, and Portuguese. Near the coast of China we met one of those storms called a *tuftoon* (*tau-fong*), or a great wind, which carried away all our masts, bowsprit and rudder; and in our hold we had six feet of water, expecting every moment the ship would founder.—We consequently were consulting our preservation: the English and Portuguese stood in their shirts only, ready to be thrown off; but the Chinese merchants came upon deck, not in a cork-jacket, but I will call it a *bamboe-habit*, which had lain ready in their chests against such dangers; and it was thus constructed; four bamboes, two before and two behind their bodies, were placed horizontally, and projected about 28 inches. These were crossed on each side by two others, and the whole properly secured, leaving a space for their body; so that they had only to put it over their heads, and tie the same securely, which was done in two minutes, and we were satisfied they could not possibly sink." The shape is here subjoined.



BAMBOROUGH, an inconsiderable village in Northumberland, on the sea coast, 14 miles north of Alnwick, was once a royal borough, and sent two members to parliament: it even gave name to a large tract extending southward, which was called *Bamboroughshire*. It had also three religious foundations; a house of friars preachers founded by Henry III. a cell of canons regular of St Austin, and an hospital. Its very ancient castle stands on an almost perpendicular rock close to the sea, and accessible only on the south-east side, on a spot where, according to the monkish historians, there stood the castle or palace of the kings of Northumberland; built, as it is said, by King Ida, who began his reign about the year 559. Part of the present ruins are by some supposed to be the remains of King Ida's work. The ancient name of this place was, it is said, *Bebbanborough;* which name Camden, from the authority of Bede, imagines borrowed from Bebba, Ida's queen: but the author of the additions to that writer is of a contrary opinion, as in the Saxon copy it is called *Cynclicanberg*, or the "royal mansion." According to Florilegus, King Ida at first fenced it only with a wooden enclosure, but afterwards surrounded it with a wall. It is thus described by Roger Hoveden, who wrote in the year 1192: "Bebba is a very strong city, but not exceeding large; containing not more than two or three acres of ground. It has but one hollow entrance into it, which is admirably raised by steps. On the top of a hill stands a fair church; and in the western point is a well curiously adorned, and of sweet clean water." This castle was besieged anno 642 by Penda, the Pagan king of the Mercians, who, as the story goes, attempted to burn it: for which purpose he laid vast quantities of wood under the walls, and set fire to it as soon as the wind was favourable; but no sooner was it kindled, than by the prayers of St Adian, the wind changed and carried the flames into his camp, so that he was obliged to raise the siege. In 710, King Osred, on the death of Alfred his father, took shelter in this castle with Brithric his tutor or guardian; one Edulph having seized the crown, by whom, with his partizans, they were unsuccessfully besieged. Brithric made so gallant a defence, that the siege was turned into a blockade, which gave the royal subjects time to arm in defence of their young king. On their marching hither to his relief, Edulph fled: but was followed, taken, and put to death by Brithric, who thereby securely seated Osred on the throne, when this castle became his palace. In the reign of Egbert, Kenulph bishop of Lindisfarne was confined here 30 years, from 750 to 780. In 933, it was plundered and totally ruined by the Danes; but being of great importance in defending the northern parts against the continual incursions of the Scots, it was soon after repaired, and made a place of considerable strength. It is said to have been in good repair at the time of the Conquest, when it was probably put into the custody of some trusty Norman, and had in all likelihood some additions made to its works; and this is the more probable, as the present area, contained within its walls, measures upwards of 80 acres, instead of three, as when described by Hoveden. About the year 1095 it was in possession of Robert de Mowbray earl of Northumberland, who engaging in some treasonable practices against William Rufus, that king laid siege to it and obliged it to surrender. In the next reign it was entrusted by Henry I. to Eustace Fitz-John, who was dispossessed of it and his other employments by King Stephen, that king being jealous of his attachment to Maud, daughter of Henry I. Irritated at this, Fitz-John delivered the castle of Alnwick to David king of Scotland, and brought to his aid all the forces he could raise; he was, however, afterwards reconciled to King Stephen, and held the manors of Burg and Knaresborough in Yorkshire, but never recovered the government of this castle.

In the 16th of Henry II. some great repairs seem to have been done here, as in Madox's history of the exchequer, under the article of Amercements, it appears one William, son of Waldef, was fined five marks for refusing his assistance in the king's works at Baenburg castle.

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castle. Its keep is supposed to have been the work of this reign.

Edward I. summoned Baliol to meet him here 1296; and on his refusal invaded Scotland and took him prisoner. Edward II. sheltered Gaveston here 1310. It was taken by the Yorkists after the battle of Hexham. In the reign of Elizabeth, Sir John Forester, warden of the marches, was governor of it, and made a knight banneret after the battle of Musselburgh; and his grandson John obtained a grant of both castle and manor from James I. His descendant Thomas forfeited it in 1715; but his maternal uncle, Nathaniel Crew bishop of Durham, purchased and bequeathed them to unconfined charitable uses. The ruins are still considerable; but many of them are now filled with sand, caught up by the winds which rage here with great violence, and carried to very distant places. The remains of a great hall are very singular; it had been warmed by two fire-places of a vast size, and from the top of every window ran a flue like that of a chimney, which reached the summits of the battlements. These flues seem designed as so many supernumerary chimneys to give vent to the smoke that the immense fires of those hospitable times filled the rooms with; for halls smoky, but filled with good cheer, were in those days thought no inconvenience. In the year 1757, the trustees for Lord Crew's charity began the repairs of the keep or great tower; the direction and management being committed to Dr Sharp archdeacon of Durham, one of their number; who has made a most judicious and humane application of his lordship's generous bequest. The walls are from 9 to 12 feet thick. The upper parts of the building have been formed into granaries; whence, in times of scarcity, corn is sold to the indigent without any distinction at four shillings per bushel. A hall and some small apartments are reserved by the Doctor, who frequently resides here to see that this noble plan is properly executed.—Among the variety of distressed who find relief from the judicious disposition of this charity, are the mariners navigating this dangerous coast, for whose benefit a constant watch is kept on the top of the tower; from whence signals are given to the fishermen of Holy Island when any ship is discovered in distress, these fishermen by their situation being able to put off their boats when none from the land can get over the breakers. The signals are so regulated as to point out the particular place where the distressed vessel lies. Besides which, in every great storm, two men on horseback patrole the adjacent coast from sunset to sunrise; who, in case of any shipwreck, are to give immediate notice at the castle. Premiums are likewise paid for the earliest information of any such misfortune. By these means the lives of many seamen have been, and will be, preserved, who would otherwise have perished for want of timely assistance. Nor does this benevolent arrangement stop here. The shipwrecked mariner finds an hospitable reception in this castle; and is here maintained for a week or longer, as circumstances may require. Here, likewise, are store-houses for depositing the goods which may be saved; instruments and tackle for weighing and raising the sunken and stranded vessels; and, to complete the whole, at the expence of this fund, the last offices are decently performed to the bodies of such drowned sailors as are cast on shore.

BAMBUCK, a country of Africa, of which the following account is given by the Abbé Raynal, on the credit of a modern traveller whom he does not name. "In the interior part of Africa, under the 12th or 13th degree of north latitude, there is (says a modern traveller) a pretty large country, known by the name of *Bambuck*. It is not subject to a particular king; but governed by village lords, called *farims*. These hereditary and independent chiefs are all obliged to unite for the defence of the state, when it is either attacked as a community, or only in one of its branches.

"The territory of this aristocratical state is dry and barren. It produces neither maize, rice, nor pulse. The insupportable heat it is subject to, proceeds in part from its being surrounded by high mountains, which prevent the wind from refreshing the air. The climate is as unwholesome as it is disagreeable: vapours, which continually issue from the bowels of a soil replete with minerals, render this country unfit to live in, especially to strangers.

"It is gold that hath made this miserable country an object worthy of notice; gold, which in the eyes of the covetous man seems to compensate for all the evils of nature, though in reality it increases them all. This metal is so common in this country, that it is found almost indiscriminately everywhere. To obtain it, sometimes it is sufficient to scrape the surface of the earth, which is clayish, light, and mixed with sand. When the mine is very rich, it is digged only to the depth of a few feet, and never deeper; though it has been observed, that the lower it was digged, the more gold the soil afforded. The miners are too indolent to pursue a toil which constantly becomes more tedious, and too ignorant to perceive the inconveniences it would be attended with. Their negligence and their folly are in this instance so extraordinary, that in washing the gold, in order to separate it from the earth, they only preserve the larger pieces: the light parts pass away with the water, which flows down an inclined plane.

"The inhabitants of Bambuck do not work these mines at all times, nor are they at liberty to do it when they please. They are obliged to wait till private or public wants determine the farims to grant this permission. When it is proclaimed, all who are able to avail themselves of this advantage meet at the appointed place. When their work is finished, a division is made. Half of the gold goes to the lord, and the remainder is equally distributed among the labourers. Those who want gold at any other time than that of the general digging, search for it in the beds of the rivers, where it is very common.

"The French and English have successively been desirous of appropriating to themselves those real or imaginary riches. Some thought they could reach this country by the Niger, others by the Salum. Far from having succeeded in their attempts of becoming masters of this country, they have not yet ascertained its existence. The unsuccessfulness of past efforts hath redoubled the activity of sanguine minds; sensible and judicious merchants have chosen to limit themselves to a commerce much more important, which is that of slaves."

BAMFF,

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BAMFF, a shise of Scotland, comprehending part of Buchan, with the districts of Strathdevron, Boyn, Enzie, Strathaven, and Balvenie, extends 52 miles in length, with a breadth varying from 8 to 25, and has an area of 622 square miles. On the south and east it is bounded by Aberdeenshire; on the north it is watered by the German ocean; on the west it is bounded by the county of Elgin; and on the south-west, it borders on Inverness-shire. The face of the country is agreeably diversified with hill and dale, not without woods, well watered with rivers, and exhibiting many seats and plantations. The air is pure and keen, the climate healthy, and the soil fertile, producing plentiful crops of corn. The district of Buchan, extending northwards from the river Ugie to the sea, and westward as far as Devron, comprehending a tract of 20 miles in length and nine in breadth, is more free from hills and mountains than any other district of the same extent in the kingdom of Scotland. It is inhabited chiefly by Lowlanders, and gives the title of *earl* to the family of Erskine; of which family, however, Erskine of Mar is the chief. The county of Bamff abounds with the necessaries and comforts of life. The pasture-grounds yield sheep, cattle, and horses: the arable lands produce plenty of corn; while the rivers and sea supply great quantities of fish. Various minerals have been found in different parts of the shire; and a piece of amber, as large as a horse, was once cast ashore on the beach. In the mountainous district of Balvenie on the western side of the shire, watered by the Spey, there is a noted rock, which produces hones and whetstones sufficient to supply the whole island. Here are also veins of alum stone, and springs of alum water. Strathallan, another district to the north-east of Balvenie, abounds with such plenty of limestone, that the inhabitants use it as common stone in building their houses; and moreover burn a great quantity of it into lime, which they sell to good advantage in the village of Keith, on the river Devron. Along this whole coast, there are ancient Danish monuments, such as cairns, tumuli, and huge stones standing erect. In Strathaven, a hilly country, lying along the limpid river Aven, which falls into the Spey, we meet with Gordon castle, belonging to the duke of Gordon, the most princely edifice in the north of Scotland, environed with fine gardens and parks well stored with fallow deer. The valued rent is 79,200l. Scots; and in 1811 the real gross rent of lands was 79,396l. 3s. 4d. as ascertained by the property-tax returns.

The following is the population of the different parishes of this county at different periods:

	Parishes.	Population in 1755.	Population in 1790—98.
1	Aberlour	1010	920
	Alva	1161	1070
	Bamff	3000	3510
	Bellie	1730	1919
5	Boharm	835	1294
	Botriphnie	953	630
	Boyndie	994	1260
	Cullen	900	1214
	Deskford	940	752
10	Fordyce	3212	3425
	Forglen	607	600
	Gamrie	2083	3000
	Grange	1797	1572
	Inveraven	2460	2244
15	Inverkiethnie	571	460
	Keith	2683	3057
	Kirkmichael	1288	1276
	Marnoch	1894	1960
	Mortlich	2374	1918
20	Ordiquhill	666	517
	Rathven	2898	3524
	Rothiemay	1190	1125
23	St Fergus	1271	1240
		36,521	38,487

Population in 1811, 36,668. See BANFFSHIRE, SUPPLEMENT.

BAMFF, the capital of the shire of that name in Scotland, is pleasantly situated on the side of a hill, at the mouth of the river Devron. It has several streets, of which that with the town-house in it, adorned with a new spire, is very handsome. This place was erected into a borough by virtue of a charter from Robert II. dated October 7. 1372, endowing it with the same privileges, and putting it on the same footing, with the burgh of Aberdeen; but tradition says it was founded in the reign of Malcolm Canmore. The number of inhabitants in 1811 was 2860. The harbour is very bad, as the entrance of the mouth of the Devron is very uncertain, being often stopped by the shifting of the sands, which are continually changing in great storms; the pier is therefore placed on the outside. Much salmon is exported from hence. About Troophead some kelp is made; and the adventurers pay the lord of the manor 50l. per annum for the liberty of collecting the materials. Near the town is a most magnificent seat lately built by the earl of Fife. It lies in a beautiful plain washed by the Devron, the lofty banks of which, clothed with wood on the opposite side, afford a delightful contrast to the soft vale beneath. W. Long. 2. 5. N. Lat. 57. 40.

BAMIER, the name of a plant common in Egypt. It produces a pyramidal husk, with several compartments, of the colour of a lemon, and filled with musky seeds. This husk dressed with meat is a wholesome food, and has a very agreeable flavour. The Egyptians make great use of it in their ragouts.

BAMIYAN, a city of Asia, situated in the province of Zablestan, 10 days journey from Balkh, and eight from Gazna. It is remarkable only for its dreadful catastrophe when taken by Jenghiz Khan in 1221. At that time the city belonged to Sultan Jalalladin, the last of the famous Mahmud Gazni's race. Jenghiz Khan was at that time about to attack Gazna, that prince's capital; but was stopped by the garrison of Bamiyan, which he had hoped would give him no trouble. In this, however, he was disappointed. The people had for a long time expected an attack; and had therefore ruined the country for five or six leagues round, while the peasants had carried away the stones, and every thing that could be of use to the besiegers,

Accordingly,

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Accordingly, Jenghiz Khan having erected wooden towers, and planted his engines upon them, was in a short time obliged to give over his attacks till millstones and other materials could be brought from a great distance. The walls of the city were very strong, so that the engines of the Moguls made but little impression; and the garrison making frequent and furious sallies, cut off whole squadrons of their enemies, and frequently overthrew their towers and engines. This exceedingly chagrined Jenghiz Khan; who one day returning from a fruitless attack, and hearing of the defeat of one of his generals by Jalallodin, swore to be revenged on Bamiyan. This fury cost the life of one of his grandchildren; who exposing himself too much, to please his grandfather, was slain with an arrow.—At last, however, by the numberless multitude of the Moguls, who continued the attacks without intermission, the city was taken, after its walls had been ruined in many places, and the bravest soldiers and officers of the garrison slain in its defence. The mother of the young prince who had been killed entering with the troops, and more deserving the name of a fiend than a woman, caused the throats of all the inhabitants to be cut, without excepting one. She even gave orders to rip up the bellies of all the women with child, that not an infant might be left alive. In short, to gratify the rage of this inhuman monster, the buildings were all levelled with the ground; the cattle, and every living creature, destroyed; insomuch that the hardened Moguls themselves gave this place the name of *Maubalig*, which in their language signifies *the unfortunate city*. A strong castle has since been built out of its ruins.

BAMOTH-BAAL, in *Ancient Geography*, one of the towns of the tribe of Reuben, which seems also to have had a temple of Baal on an eminence; lying eastwards, and not far from the river Arnon, and the territory of Moab. Jerome calls it *Bamoth*, a city of the Amorites, beyond Jordan, in the possession of the sons of Reuben. Whether the same with that mentioned Numb. xxi. is doubtful, from the disagreement of interpreters; and yet we may admit it to be the place of encampment of the Israelites, and of Balaam's first station, or where he had the first view of the rear of the people.

BAMPTON, a town of Devonshire, situated in a bottom surrounded with high hills, and containing 1232 inhabitants in 1811. W. Long. 4. 25. N. Lat. 51. 5.

BAN, or BANS. See BANN.

BAN, in commerce, a sort of fine smooth muslin, which the English import from the East Indies. The piece is almost a yard broad, and runs about 20 yards and a half.

BANANA TREE, a species of the musa or plantain. See MUSA, BOTANY *Index*.

BANARES, or BENARES, a town of Hindostan, greatly celebrated for its sanctity, and being the university of the Indian Bramins. It is seated on the north side of the river Ganges, and contains nearly 600,000 inhabitants. E. Long. 82. 30. N. Lat. 26. 20. See OBSERVATORY.

BANBURY, a town of Oxfordshire in England, situated on the river Charwell, in W. Long. 1. 20. N. Lat. 52. 0. It sends one member to parliament.

BANC, or BENCH, in *Law*, denotes a tribunal, or judgment-seat; hence *king's banc* is the same with the *court of king's bench*, and *common banc* with that of *common pleas*.

BANCI JUS, or the privilege of having a bench, was anciently only allowed to the king's judges, *qui summam administrant justitiam*. Inferior courts, as courts-baron, hundred courts, &c. were not allowed that prerogative; and even at this day the hundred-court at Freibridge in Norfolk is held under an oak at Gey-wood; and that of Woolfry in Herefordshire, under an oak near Ashton in that county, called *Hundred oak*.

BANCA, an island of Asia in the East Indies, between Sumatra and Borneo; from the first of which it is separated only by a narrow channel. This island is famous on account of its tin mines. The prince of the island, who is also possessor of the territory of Palambang on the river of the same name in Sumatra, where he has his constant residence, had a contract with the Dutch, by whose troops his authority and independence are preserved, for the tin which he compels his subjects to deliver to him at a low price. Their profit, it is said, was not less than 150,000l. annually. In consequence of the perfection which the miners had arrived at in the reduction of the ore, the tin of this island was preferred to the tin from Europe at the Canton market. E. Long. 105. 10. N. Lat. 13. 25.

BANCALIS, a sea-port town on the east coast of the island of Sumatra, where the Dutch have a settlement. E. Long. 99. 7. N. Lat. 1. 5.

BANCK, PETER VANDER, an engraver of considerable repute, was born at Paris, and received his instructions in the art from the celebrated François de Poilly. He came over into England with Gascar the painter, about the year 1674; and married the sister of a gentleman of estate in Hertfordshire, named Forester. He was a laborious artist: but the pay he received for his plates being by no means adequate to the time he bestowed upon them, he was reduced to want; and, retiring from business, sought an asylum in the house of his brother-in-law. He died at Bradfield, and was buried in the church there, in 1674; leaving his widow in possession of the chief part of his plates, which she disposed of to Brown, a printseller, to great advantage, and left an easy fortune.—His chief employment was engraving of portraits; and, according to Virtue's account of this artist published by the Hon. Mr Walpole, he was the first in England who engraved them on so large a scale. But even their novelty, it seems, added to their merit, could not sufficiently recommend them to support the artist. Like many of Poilly's disciples, his great merit, according to Mr Strutt, consists in the laboured neatness and management of the mechanical part of the art. Freedom, harmony, and chasteness of outline, are by no means the characteristic of his prints. However, though they cannot rank with the superior productions of Edelink or Nanteuil, &c. they have their share of merit; and doubtless will be always esteemed in England, as preserving the best resemblance of many eminent persons who were living at that time.

BANCO, an Italian word which signifies *bank*. It is commonly used to signify the bank of Venice.

BANCOCK, a town of the kingdom of Siam in Asia,

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Asia, with a fort, which was once in the possession of the French, but they were driven from it in 1688. E. Long. 101. 5. N. Lat. 13. 25.

BAND, in a general sense, some small narrow ligament, wherewith any thing is bound, tied, or fastened.

BAND, in *Architecture*, a general name for any flat low member, or moulding, that is broad but not very deep.

BAND of Soldiers, in military affairs, those who fight under the same flag or ensign.

BAND of Pensioners, a company of 120 gentlemen, who receive a yearly allowance of 100l. for attending on his majesty on solemn occasions.

BAND is also the denomination of a military order in Spain, instituted by Alphonsus XI. king of Castile, for the younger sons of the nobility; who, before their admission, must serve 10 years at least, either in the army or at court; and are bound to take up arms for the catholic faith against the infidels.

BAND, in *Surgery*. See BANDAGE.

BANDA ISLANDS, the general name of five islands in the East Indies, belonging to the Dutch. Two of them are uncultivated, and almost entirely uninhabited; the other three claim the distinction of being the only islands in the world that produce the nutmeg.

If we except this valuable spice, the islands of Banda, like all the Moluccas, are barren to a dreadful degree. What they produce in superfluities they want in necessaries. The land will not bring forth any kind of corn; and the pith of the sago serves the natives of the country instead of bread.

As this food is not sufficient for the Europeans who settle in the Moluccas, they are allowed to fetch provisions from Java, Macassar, or the extremely fertile island of Bali. The company itself carries some merchandise to Banda.

This is the only settlement in the East Indies that can be considered as an European colony; because it is the only one where the Europeans are proprietors of lands. The company finding that the inhabitants of Banda were savage, cruel, and treacherous, because they were impatient under their yoke, resolved to exterminate them. Their possessions were divided among the white people, who got slaves from some of the neighbouring islands to cultivate the lands. These white people are for the most part Creoles, or malecontents who have quitted the service of the country. In the small island of Rosinging, there are likewise several banditti, whom the laws have branded with disgrace; and young men of abandoned principles, whose families wanted to get rid of them: so that Banda is called the *island of Correction*. The climate is so unhealthy, that these unhappy men live but a short time. It is on account of the loss of so great a number of hands, that attempts have been made to transfer the culture of the nutmeg to Amboyna; and the company were likewise probably influenced by two other strong motives of interest, as their trade would be carried on with less expence and greater safety. But the experiments that have been made have proved unsuccessful, and matters remain in their former state.

BANDAGE, in *Surgery*, a fillet, roller, or swath, used in dressing and binding up wounds, restraining dangerous hemorrhagies, and in joining fractured and dislocated bones.

BANDALEER, or BANDELEER, in military affairs, a large leathern belt, thrown over the right shoulder, and hanging under the left arm; worn by the ancient musqueteers, both for the sustaining of their fire-arms, and for the carriage of their musket charges, which being put up in little wooden cases, coated with leather, were hung, to the number of twelve, to each bandaleer.

BANDELET, or BANDLET, in *Architecture*, any little band, or flat moulding, as that which crowns the Doric architrave.

BANDER CONGO, a small sea-port town in Asia, seated on the Persian gulf. E. Long. 54. 10. N. Lat. 19. 0.

BANDERET, a general, or one of the commanders in chief of the forces. This appellation is given to the principal commanders of the troops of the canton of Bern in Switzerland, where there are four banderets, who command all the forces of that canton.

BANDEROLL, a little flag, in form of a guidon, extended more in length than in breadth, used to be hung out on the masts of vessels, &c.

BANDITTI, from the Italian *bandito;* persons proscribed, or, as we call it, outlawed: sometimes denominated *banniti* or *foris banniti*. It is also a denomination given to highwaymen or robbers who infest the roads in troops, especially in Italy, France, and Sicily. Mr Brydone, in his tour through Sicily, informs us, that in the eastern part, called *Val Demoni* from the devils that are supposed to inhabit Mount Ætna, it has ever been found altogether impracticable to extirpate the banditti; there being numberless caverns and subterraneous passages round that mountain, where no troops could possibly pursue them: besides, they are known to be perfectly determined and resolute, never failing to take a dreadful revenge on all who have offended them. Hence the prince of Villa Franca has embraced it, not only as the safest, but likewise as the wisest and most political scheme, to become their declared patron and protector: and such of them as think proper to leave the mountains and forests, though perhaps only for a time, are sure to meet with good encouragement and a certain protection in his service, where they enjoy the most unbounded confidence, which, in no instance, they have ever yet been found to make an improper or a dishonest use of. They are clothed in the prince's livery, yellow and green, with silver lace; and wear likewise a badge of their honourable order, which entitles them to universal fear and respect from the people.

In some circumstances, these banditti are the most respectable people of the island, and have by much the highest and most romantic notions of what they call their point of honour. However criminal they may be with regard to society in general; yet with respect to one another, and to every person to whom they have once professed it, they have ever maintained the most unshaken fidelity. The magistrates have often been obliged to protect them, and pay them court, as they are known to be perfectly determined and desperate, and so extremely vindictive, that they will certainly put any person to death that has ever given

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given them just cause of provocation. On the other hand, it never was known that any person who had put himself under their protection, and showed that he had confidence in them, had cause to repent of it, or was injured by any of them in the most minute trifle; but, on the contrary, they will protect him from impositions of every kind, and scorn to go halves with the landlord, like most other conductors and travelling servants, and will defend him with their lives if there is occasion. Those of their number who have thus enlisted themselves in the service of society, are known and respected by the other banditti all over the island; and the persons of those they accompany are ever held sacred. For these reasons, most travellers choose to hire a couple of them from town to town: and may thus travel over the whole island in safety.

BANDORA, the capital of the island of Salset, on the west coast of the peninsula on this side the Ganges. It is separated from the island of Bombay by a narrow channel, and subject to the Portuguese. E. Long. 72. 30. N. Lat. 19. 0.

BANDORE, the name of a musical instrument with strings, resembling a lute, and said to be invented in the fourth year of Queen Elizabeth, by John Rose, a citizen of London.

BANDY-LEGS, from the French *bander*, 'to bend,' a distortion of the legs, when they turn either inward or outward on either side; arising from some defect in the birth, or imprudence in the nurse, endeavouring to make a child stand or walk before his legs were strong enough to sustain the weight of his body. See VALGUS.

BANE (from the Saxon *bana*, a murderer), signifies destruction or overthrow. Thus, "I will be the *bane* of such a man," is a common saying. So, when a person receives a mortal injury by any thing, we say, "it was his *bane*:" and he who is the cause of another man's death, is said to be *le bane*, i. e. a malefactor.

BANFF. See BAMFF.

BANGHIR, a town of Ireland, in King's county in the province of Leinster, seated on the river Shannon. W. Long. 8. 5. N. Lat. 53. 10.

BANGLE EARS, an imperfection in a horse, remedied in the following manner. Place his ears in such a manner as you would have them stand; bind them with two little boards so fast that they cannot stir, and then clip away all the empty wrinkled skin close by the head.

BANGIUS, THOMAS, a Danish divine, and an elegant Latin writer on the origin of languages and a variety of other subjects. He died in 1661.

BANGOR, an episcopal city of Caernarvonshire in North Wales. In ancient times it was so considerable, that it was called *Bangor the Great*, and defended by a strong castle; but it is now a very mean place; the principal buildings being the cathedral, the bishop's palace, and free school. The see is of very great antiquity, and its founder unknown. The church is dedicated to St Daniel, who was bishop here about the year 516; but for near 500 years afterwards, there is no certainty of the names of his successors. Owen Glendower greatly defaced the cathedral church; but Bishop Dean repaired it again. This see met a still more cruel ravager than Owen Glendower, in the person of Bishop Bulkeley; who not only alienated many of the lands belonging to it, but even sold the bells of the church. This diocese contains the whole of Caernarvonshire except three parishes, the shire of Anglesey, and part of the shires of Denbigh, Merioneth, and Montgomery; in which are 107 parishes, whereof 36 are impropriated. It has three archdeaconries, viz. Bangor, Anglesey, and Merioneth; of which the two first are commonly annexed to the bishopric for its better support. This see is valued in the king's books at 131l. 16s. 4d. and is computed to be worth annually 1200l. The tenths of the clergy are 151l. 14s. 3½d. To the cathedral there belong a bishop, a dean, an archdeacon, a treasurer, and two prebendaries, endowed; a precentor, a chancellor, and three canons, not endowed; three vicars choral, an organist, lay-clerks, choristers, and two officers. W. Long. 4. 10. N. Lat. 53. 20.

BANGOR, a town of Ireland, in the county of Down and province of Ulster. It is seated on the south shore of the bay of Carrick Fergus, opposite to the town of that name; and has a considerable fishery for soles, turbot, &c. W. Long. 6. N. Lat. 54. 42.

BANGUE, a species of opiate, in great use throughout the east, for drowning cares and inspiring joy.—This by the Persians is called *beng*; by the Arabs, *essrar*, corruptly *asseral*, and *assarth*; by the Turks, *bengitie*, and vulgarly called *mastack*; by the European naturalists, *bangue* or *bang*.—It is the leaf of a kind of wild hemp, growing in the countries of the Levant; it differs little, either as to leaf or seed, from our hemp, except in size. Some have mistaken it for a species of althæa.

There are divers manners of preparing it, in different countries. Olearius describes the method used in Persia. Mr Sale tells us, that, among the Arabs, the leaf is made into pills, or conserves. But the most distinct account is that given by Alexander Maurocordato, counsellor and physician of the Ottoman Porte, in a letter to Wedelius. According to this author, bangue is made of the leaves of wild hemp, dried in the shade, then ground to powder; put into a pot wherein butter has been kept; set in an oven till it begin to torrify: then taken out, and pulverized again; thus to be used occasionally, as much at a time as will lie on the point of a knife. Such is the Turkish bangue.—The effects of this drug are, To confound the understanding; set the imagination loose; induce a kind of folly and forgetfulness, wherein all cares are lost, and joy and gaiety take place thereof. Bangue, in reality, is a succedaneum to wine, and obtains in those countries where Mahometanism is established; which prohibiting the use of that liquor absolutely, the poor Mussulmans are forced to have recourse to succedanea, to rouse their spirits. The principal are *opium* and this bangue. As to the opinion among Europeans, that the Turks prepare themselves for battle by a dose of bangue, which rouses their courage, and drives them, with eagerness, to certain death; Dr Maurocordato assures us, that it is a popular error: the Turks think they are then going assuredly to receive the crown of martyrdom; and would not, for any consideration, lose the merit of it, which they would do, by eating the bangue, as being held unlawful by their apostle, among other things which intoxicate.

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BANIALUCH, or BAGNALUCH, a city of European Turkey, the capital of Bosnia, upon the frontiers of Dalmatia, near the river Setina. E. Long. 18. 20. N. Lat. 44. 20.

BANIAN-TREE. See FICUS, BOTANY *Index*.

BANIANS, a religious sect in the empire of the Mogul, who believe a metempsychosis; and will therefore eat no living creature, nor kill even noxious animals, but endeavour to release them when in the hands of others.—The name of *Banian* is used with some diversity, which has occasioned much confusion, and many mistakes. Sometimes it is taken in a less proper sense, and extended to all the idolaters of India, as contradistinguished from the Mahometans: in which sense, Banians includes the Bramins and other casts. *Banians*, in a more proper sense, is restrained to a peculiar cast, or tribe of Indians, whose office or profession is trade and merchandise: in which sense, *Banians* stand contradistinguished from *Bramins*, *Cuttery*, and *Wyse*, the three other casts into which the Indians are divided. The four casts are absolutely separate as to occupation, relation, marriage, &c. though all of the same religion; which is more properly denominated the religion of the Bramins, who make the ecclesiastical tribe, than of the *Banians*, who make the mercantile. The proper *Banians* are called, in the *Shaster*, or book of their law, by the name of *Shuddery;* under which are comprehended all who live after the manner of merchants, or that deal and transact for others, as brokers; exclusive of the mechanics or artificers, who make another cast, called *Wyse*. These *Banians* have no peculiar sect or religion, unless it be, that two of the eight general precepts given by their legislator Brama to the Indian nation, are, on account of the profession of the Banians, supposed more immediately to relate to them, viz. those which enjoin veracity in their word and dealings, and avoiding all practices of circumvention in buying and selling. Some of the Banians, quitting their profession, and retiring from the world, commence religious, assume a peculiar habit, and devote themselves more immediately to God, under the denomination of *Vertea*. These, though, they do not hereby change their cast, are commonly reckoned as bramins of a more devout kind; much as monks in the Romish church, though frequently not in orders, are reputed as a more sacred order than the regular clergy. The name *Banian* imports as much, in the Bramin language (wherein their law is written), as a people innocent and harmless; void of all guile; so gentle, that they cannot endure to see either a fly or a worm injured; and who, when struck, will patiently bear it, without resisting or returning the blow.—Their mien and appearance is described by Lord *, in terms a little precise, but very significant: "A people presented themselves to my eyes clothed in linen garments, somewhat low descending; of a gesture and garb, as I may say, maidenly, and well nigh effeminate; of a countenance shy and somewhat estranged." Gemelli Careri divides the Banians into 22 tribes, all distinct, and not allowed to marry with each other. Lord assures us they are divided into 82 casts or tribes, correspondent to the casts or divisions of the Bramins or priests, under whose discipline they are as to religious matters; though the generality of the Banians choose to be under the direction of the two Bramin tribes, the Visalnagranaugers and Volnagranaugers.

* *Discov. Relig. Banian.*

The Banians are the great factors, by whom most of the trade of India is managed; in this respect, comparable to the Jews and Armenians, and not behind either, in point of skill and experience, in whatever relates to commerce. Nothing is bought but by their mediation. They seem to claim a kind of *jus divinum* to the administration of the traffic of the nation, grounded on their sacred books, as the Bramins do that of religion. They are dispersed, for this purpose, through all parts of Asia, and abound in Persia, particularly at Ispahan and Gombroon, where many of them are extremely rich, yet not above acting as brokers, where a penny is to be got. The chief agents of the English, Dutch, and French East India Companies, are of this nation: they are faithful, and are generally trusted with the cash of those companies in their keeping. They act also as bankers, and can give bills of exchange for most cities in the East Indies. Their form of contract in buying and selling is remarkable; being done without words, in the profoundest silence, only by touching each other's fingers: the buyer loosing his pamerin or girdle, spreads it on his knee, and both he and the seller having their hands underneath, by the intercourse of the fingers, mark the price of pounds, shillings, &c. demanded, offered, and at length agreed on. When the seller takes the buyer's whole hand, it denotes a thousand; and, as many times as he squeezes it, as many thousand pagods, or rupees, according to the species in question, are demanded; when he only takes the five fingers, it denotes five hundred; and when only one, one hundred: taking only half a finger, to the second joint, denotes fifty; the small end of the finger, to the first joint, stands for ten.

BANIE, ANTHONY, licentiate in laws, member of the academy of inscriptions and belles lettres, an ecclesiastic of the diocese of Clermont in Auvergne; died in November 1741, aged 69. He is principally celebrated for his translation of the Metamorphoses of Ovid, with historical remarks and explanations; which was published in 1732, at Amsterdam, in folio, finely ornamented with copperplates, by Picart; and reprinted at Paris 1738, in two vols 4to: and for his Mythology, or Fables of the Ancients, explained by history; a work full of the most important information, which was translated into English, and printed at London in 1741, in 4 vols 8vo.

BANISHMENT, exile, among us is of two kinds: the one voluntary, and upon oath; the other by compulsion, for some offence or crime. The former, properly called *abjuration*, is now ceased; the latter is chiefly enjoined by judgment of parliament. Yet outlawing and transportation may also be considered as species of exile.

BANISTER, JOHN, a physician and surgeon in the reign of Queen Elizabeth, was educated at Oxford, where, says Anthony Wood, he studied logicals for a time; but afterwards applied himself solely to physic and surgery. In 1573 he took the degree of bachelor of physic; and, obtaining a license from the university to practise, settled at Nottingham, where he lived many years in great repute, and wrote several medical treatises.

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Banister ‖ Bank.

treatises. His works were collected and published in 1633, 4to.

BANISTERIA. See BOTANY *Index*.

BANK, in *Commerce*, a common repository, where many persons agree to keep their money, to be always ready at their call or direction: or, certain societies or communities, who take the charge of other people's money, either to improve it, or to keep it secure.

The first institution of banks was in Italy, where the Lombard Jews kept benches in the market-places for the exchange of money and bills; and *banco* being the Italian name for *bench*, banks took their title from this word.

I. Company-banks.

Banks are of two principal kinds. 1. One sort is either *public*, consisting of a company of moneyed men, who being duly established, and incorporated by the laws of their country, agree to deposite a considerable fund, or joint stock, to be employed for the use of the society, as in lending money upon good security, buying and selling bullion, discounting bills of exchange, &c.: or *private*, i. e. set up by private persons, or partnerships, who deal in the same way as the former upon their own single stock and credit.

Bank of England; its establishment, regulations, importance, &c.

The greatest bank of circulation in Europe is the *Bank of England.* The company was incorporated by parliament in the fifth and sixth years of King William and Queen Mary, by the name of *The Governors and Company of the Bank of England:* in consideration of the loan of 1,200,000l. granted to the government; for which the subscribers received almost 8 per cent. By this charter, the company are not to borrow under their common seal, unless by act of parliament; they are not to trade, or suffer any person in trust for them to trade, in any goods or merchandise; but they may deal in bills of exchange, in buying or selling bullion, and foreign gold and silver coin, &c.

By an act of parliament passed in the 8th and 9th years of William III. they were empowered to enlarge their capital stock to 2,201,171l. 10s. It was then also enacted, that bank-stock should be a personal, and not a real estate; that no contract either in word or writing for buying or selling bank-stock, should be good in law, unless registered in the books of the bank within 7 days, and the stock transferred in 14 days; and that it shall be felony, without benefit of clergy, to counterfeit the common seal of the bank, or any sealed bank-bill, or any bank-note, or to alter or erase such bills or notes. By another act passed in the 7th of Queen Anne, the company were empowered to augment their capital to 4,402,343l. and they then advanced 400,000l. more to the government; and in 1714, they advanced another loan of 1,500,000l.

In the third year of the reign of King George I. the interest of their capital stock was reduced to 5 per cent. when the bank agreed to deliver up as many exchequer bills as amounted to 2,000,000l. and to accept an annuity of 100,000l. and it was declared lawful for the bank to call from their members, in proportion to their interests in the capital stock, such sums of money as in a general court should be found necessary. If any member should neglect to pay his share of the moneys so called for, at the time appointed by notice in the London Gazette, and fixed upon the Royal Exchange, it should be lawful for the bank, not only to stop the dividend of such member, and to apply it towards payment of the money in question, but also to stop the transfers of the share of such defaulter, and to charge him with an interest of 5 per cent. per annum, for the money so omitted to be paid; and if the principal and interest should be three months unpaid, the bank should then have power to sell so much of the stock belonging to the defaulter as would satisfy the same. After this, the bank reduced the interest of the 2,000,000l. lent to the government, from 5 to 4 per cent. and purchased several other annuities, which were afterwards redeemed by the government, and the national debt due to the bank reduced to 1,600,000l. But in 1742, the company engaged to supply the government with 1,600,000l. at 3 per cent. which is now called the 3 per cent. annuities; so that the government was now indebted to the company 3,200,000l. the one half carrying 4, and the other 3 per cent.

In the year 1746, the company agreed that the sum of 986,800l. due to them in the exchequer bills unsatisfied, on the duties for licenses to sell spirituous liquors by retail, should be cancelled, and in lieu thereof to accept of an annuity of 39,442l. the interest of that sum at 4 per cent. The company also agreed to advance the further sum of 1,000,000l. into the exchequer, upon the credit of the duties arising by the malt and land tax at 4 per cent. for exchequer bills to be issued for that purpose; in consideration of which, the company were enabled to augment their capital with 986,800l. the interest of which, as well as that of the other annuities, was reduced to $3\frac{1}{2}$ per cent. till the 27th of December 1757, and from that time to carry only 3 per cent.

And in order to enable them to circulate the said exchequer bills, they established what is now called *bank circulation.* The nature of which may be understood from what follows.

The company of the bank are obliged to keep cash sufficient not only to answer the common, but also any extraordinary demand that may be made upon them; and whatever money they have by them, over and above the sum supposed necessary for these purposes, they employ in what may be called the *trade of the company;* that is to say, in discounting bills of exchange, in buying of gold and silver, and in government securities, &c. But when the bank entered into the above-mentioned contract, as they did not keep unemployed a larger sum of money than what they deemed necessary to answer their ordinary and extraordinary demands, they could not conveniently take out of their current cash so large a sum as a million, with which they were obliged to furnish the government, without either lessening that sum they employed in discounting, buying gold and silver, &c. (which would have been very disadvantageous to them), or inventing some method that should answer all the purposes of keeping the million in cash. The method which they chose, and which fully answers their end, was as follows:

They opened a subscription, which they renew annually, for a million of money; wherein the subscribers advance 10 per cent. and enter into a contract to pay the remainder, or any part thereof, whenever the bank shall call upon them, under penalty of forfeiting the 10 per cent. so advanced: in consideration of which, the bank pays the subscribers 4 per cent. interest for the

Bank.

the money paid in, and ¼ per cent. for the whole sum they agree to furnish; and in case a call shall be made upon them for the whole, or any part thereof, the bank further agrees to pay them at the rate of 5 per cent. per annum for such sum till they repay it, which they are under an obligation to do at the end of the year. By this means the bank obtains all the purposes of keeping a million of money by them; and though the subscribers, if no call is made upon them (which is in general the case), receive 6½ per cent. for the money they advance, yet the company gains the sum of 23,500l. per annum by the contract; as will appear by the following account:

The bank receives from the government for the advance of a million -	L.30,000
The bank pays the subscribers who advance 100,000l. and engage to pay (when called for) 900,000l. more - - -	6,500
The clear gain to the bank therefore is	23,500

This is the state of the case, provided the company should make no call on the subscribers; which they will be very unwilling to do, because it would not only lessen their profit, but affect the public credit in general.

Bank-stock may not improperly be called a *trading stock*, since with this they deal very largely in foreign gold and silver, in discounting bills of exchange, &c. Besides which, they are allowed by the government very considerable sums annually for the management of the annuities paid at their office. All which advantages render a share in their stock very valuable; though it is not equal in value to the East India stock. The company make dividends of the profits half yearly, of which notice is publicly given; when those who have occasion for their money may readily receive it; but private persons, if they judge convenient, are permitted to continue their funds, and to have their interest added to the principal.

This company is under the direction of a governor, deputy-governor, and 24 directors, who are annually elected by the general court, in the same manner as in the East India Company. Thirteen, or more, compose a court of directors for managing the affairs of the company. The officers of this company are very numerous.

The stability of the bank of England is equal to that of the British government. All that it has advanced to the public must be lost before its creditors can sustain any loss. No other banking company in England can be established by act of parliament, or can consist of more than six members. It acts, not only as an ordinary bank, but (as we have already seen) as a great engine of state; receiving and paying the greater part of the annuities which are due to the creditors of the public; circulating exchequer bills; and advancing to government the annual amount of the land and malt taxes, which are frequently not paid up till some years thereafter. It likewise has, upon several different occasions, supported the credit of the principal houses, not only in England, but of Hamburgh and Holland. Upon one occasion it is said to have advanced for this purpose, in one week, about 1,600,000l. a great part of it in bullion.

Bank.

Scotch banks, public and private.

In Scotland there are two public banks, both at Edinburgh. The one, called *The Bank of Scotland*, was established by act of parliament in 1695; the other, called *The Royal Bank*, by royal charter in 1727.

Within these 30 years there have also been erected private banking companies in almost every considerable town, and even in some villages. Hence the business of the country is almost entirely carried on by paper-currency, *i. e.* by the notes of those different banking companies; with which purchases and payments of all kinds are commonly made. Silver very seldom appears, except in the change of a twenty-shilling bank-note, and gold still seldomer. But though the conduct of all those different companies has not been unexceptionable, and has accordingly required an act of parliament to regulate it; the country, notwithstanding, has evidently derived great benefit from their trade. It has been asserted, that the trade of the city of Glasgow doubled in about 15 years after the first erection of the banks there; and that the trade of Scotland has more than quadrupled since the first erection of the two public banks at Edinburgh. Whether the trade, either of Scotland in general, or of the city of Glasgow in particular, has really increased in so great a proportion, during so short a period, we do not pretend to know. If either of them has increased in this proportion, it seems to be an effect too great to be accounted for by the sole operation of this cause. That the trade and industry of Scotland, however, have increased very considerably during this period, and that the banks have contributed a good deal to this increase, cannot be doubted.

Smith's *Wealth of Nations*, Book II. chap. ii.

The value of the silver money which circulated in Scotland before the Union in 1707, and which immediately after it was brought into the bank of Scotland in order to be recoined, amounted to 411,117l. 10s. 9d. sterling. No account has been got of the gold coin: but it appears from the ancient accounts of the mint of Scotland, that the value of the gold annually coined somewhat exceeded that of the silver. There were a good many people too upon this occasion, who, from a diffidence of repayment, did not bring their silver into the bank of Scotland; and there was, besides, some English coin, which was not called in. The whole value of the gold and silver, therefore, which circulated in Scotland before the Union, cannot be estimated at less than a million sterling. It seems to have constituted almost the whole circulation of that country; for though the circulation of the bank of Scotland, which had then no rival, was considerable, it seems to have made but a very small part of the whole. In the present times, the whole circulation of Scotland cannot be estimated at less than two millions, of which that part which consists of gold and silver most probably does not amount to half a million. But though the circulating gold and silver of Scotland have suffered so great a diminution during this period, its real riches and prosperity do not appear to have suffered any. Its agriculture, manufactures, and trade, on the contrary, the annual produce of its land and labour, have evidently been augmented.

Discounting of bills.

It is chiefly by discounting bills of exchange, that is, by advancing money upon them before they are due, that the greater part of banks and bankers issue their promissory notes. They deduct always upon whatever

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ever sum they advance, the legal interest till the bill shall become due. The payment of the bill, when it becomes due, replaces to the bank the value of what had been advanced, together with a clear profit of the interest. The banker, who advances to the merchant whose bill he discounts not gold and silver, but his own promissory notes, has the advantage of being able to discount to a greater amount, by the whole value of his promissory notes, which he finds by experience are commonly in circulation. He is thereby enabled to make his clear gain of interest on so much larger a sum.

The commerce of Scotland, which at present is not very great, was still more inconsiderable when the two first banking companies were established; and those companies would have had but little trade, had they confined their business to the discounting of bills of exchange. They invented, therefore, another method of issuing their promissory notes, by granting what they called *cash accounts;* that is, by giving credit to the extent of a certain sum (2000l. or 3000l. for example), to any individual who could procure two persons of undoubted credit and good landed estate to become surety for him, that whatever money should be advanced to him within the sum for which the credit had been given should be repaid upon demand, together with the legal interest. Credits of this kind are commonly granted by banks and bankers in all different parts of the world. But the easy terms on which the Scots banking companies accept of repayment, are peculiar to them, and have perhaps been the principal cause, both of the great trade of these companies and of the benefit which the country has received from it.

Cash-accounts.

Advantages from these

Whoever has a credit of this kind with one of those companies, and borrows 1000l. upon it, for example, may repay this sum piecemeal, by 20l. and 30l. at a time, the company discounting a proportional part of the interest of the great sum from the day on which each of those small sums is paid in, till the whole be in this manner repaid. All merchants, therefore, and almost all men of business, find it convenient to keep such cash-accounts with them; and are thereby interested to promote the trade of those companies, by readily receiving their notes in all payments, and by encouraging all those with whom they have any influence to do the same. The banks, when their customers apply to them for money, generally advance it to them in their own promissory notes. These the merchants pay away to the manufacturers for goods, the manufacturers to the farmers for materials and provisions, the farmers to their landlords for rent, the landlords repay them to the merchants for the conveniences and luxuries with which they supply them, and the merchants again return them to the banks in order to balance their cash-accounts, or to replace what they may have borrowed of them; and thus almost the whole money business of the country is transacted by means of them. Hence the great trade of those companies.

to the banks, and

By means of those cash-accounts, every merchant can, without imprudence, carry on a greater trade than he otherwise could do. If there are two merchants, one in London, and the other in Edinburgh, who employ equal stocks in the same branch of trade, the Edinburgh merchant can, without imprudence, carry on a greater trade, and give employment to a greater number of people, than the London merchant. The London merchant must always keep by him a considerable sum of money, either in his own coffers, or in those of his banker (who gives him no interest for it), in order to answer the demands continually coming upon him for payment of the goods which he purchases upon credit. Let the ordinary amount of this sum be supposed 500l. The value of the goods in his warehouse must always be less by 500l. than it would have been, had he not been obliged to keep such a sum unemployed. Let us suppose that he generally disposes of his whole stock upon hand, or of goods to the value of his whole stock upon hand, once in the year. By being obliged to keep such a great sum unemployed, he must sell in a year 500l. worth less goods than he might otherwise have done. His annual profits must be less by all that he could have made by the sale of 500l. worth more goods; and the number of people employed in preparing his goods for the market, must be less by all those that 500l. more stock could have employed. The merchant in Edinburgh, on the other hand, keeps no money unemployed for answering such occasional demands. When they actually come upon him, he satisfies them from his cash-account with the bank, and gradually replaces the sum borrowed with the money or paper which comes in from the occasional sales of his goods. With the same stock, therefore, he can, without imprudence, have at all times in his warehouse a larger quantity of goods than the London merchant; and can thereby both make a greater profit himself, and give constant employment to a greater number of industrious people who prepare those goods for the market. Hence the great benefit which the country has derived from this trade.

to the country.

The late multiplication of banking companies in both parts of the united kingdom, an event by which many people have been much alarmed, instead of diminishing, increases the security of the public. It obliges all of them to be more circumspect in their conduct, and, by not extending their currency beyond its due proportion to their cash, to guard themselves against those malicious runs which the rivalship of so many competitors is always ready to bring upon them. It restrains the circulation of each particular company within a narrower circle, and reduces their circulating notes to a smaller number. By dividing the whole circulation into a greater number of parts, the failure of any one company, an accident which, in the course of things, must sometimes happen, becomes of less consequence to the public. This free competition too obliges all bankers to be more liberal in their dealings with their customers, lest their rivals should carry them away. In general, if any branch of trade, or any division of labour, be advantageous to the public, the freer and more general the competition, it will always be the more so. See further, the article *Paper-Money*.

2. The other kind of banks consist of such as are instituted wholly on the public account, and are called *Banks of Deposit;* the nature of which not being generally understood, the following particular explanation may not be unacceptable.

II. Banks of deposit.

The currency of a great state, such as Britain, generally, Bank.

Smith's Wealth of Nations, Book IV. chap. iii.

nerally consists almost entirely of its own coin. Should this currency, therefore, be at any time worn, clipt, or otherwise degraded below its standard value, the state by a reformation of its coin can effectually re-establish its currency. But the currency of a small state, such as Genoa or Hamburgh, can seldom consist altogether in its own coin, but must be made up, in a great measure, of the coins of all the neighbouring states with which its inhabitants have a continual intercourse. Such a state, therefore, by reforming its coin, will not always be able to reform its currency. If foreign bills of exchange are paid in this currency, the uncertain value of any sum, of what is in its own nature so uncertain, must render the exchange always very much against such a state, its currency being, in all foreign states, necessarily valued below even what it is worth. In order to remedy the inconvenience to which this disadvantageous exchange must have subjected their merchants, such small states, when they began to attend to the interest of trade, have frequently enacted, that foreign bills of exchange of a certain value should be paid, not in common currency, but by an order upon, or by a transfer in, the books of a certain bank, established upon the credit and under the protection of the state; this bank being always obliged to pay, in good and true money, exactly according to the standard of the state. The banks of Venice, Genoa, Amsterdam, Hamburgh, and Nuremberg, seem to have been all originally established with this view, though some of them may have afterwards been made subservient to other purposes. The money of such banks, being better than the common currency of the country, necessarily bore an agio, which was greater or smaller, according as the currency was supposed to be more or less degraded below the standard of the state. The agio of the bank of Hamburgh, for example, which is said to be commonly about 14 per cent. is the supposed difference between the good standard money of the state, and the clipt, worn, and diminished currency poured into it from all the neighbouring states.

Before 1609, the great quantity of clipt and worn foreign coin, which the extensive trade of Amsterdam brought from all parts of Europe, reduced the value of its currency about 9 per cent. below that of good money fresh from the mint. Such money no sooner appeared, than it was melted down or carried away, as it always is in such circumstances. The merchants, with plenty of currency, could not always find a sufficient quantity of good money to pay their bills of exchange; and the value of those bills, in spite of several regulations which were made to prevent it, became in a great measure uncertain. In order to remedy these inconveniences, a bank was established in 1609 under the guarantee of the city. The bank received both foreign coin, and the light and worn coin of the country, at its real and intrinsic value in the good standard money of the country, deducting only so much as was necessary for defraying the expence of coinage, and other necessary expence of management. For the value which remained after this small deduction was made, it gave a credit in its books. This credit was called *bank-money*; which, as it represented money exactly according to the standard of the mint, was always of the same real value, and intrinsically worth more

Bank of Amsterdam, one of the most famous. Its institution, regulation, utility, &c.

than current money. It was at the same time enacted, that all bills drawn upon or negotiated at Amsterdam of the value of 600 guilders and upwards should be paid in bank-money, which at once took away all uncertainty in the value of those bills. Every merchant, in consequence of this regulation, was obliged to keep an account with the bank in order to pay his foreign bills of exchange, which necessarily occasioned a certain demand for bank-money.

Bank-money, over and above both its intrinsic superiority to currency, and the additional value which this demand necessarily gives it, has likewise some other advantages. It is secure from fire, robbery, and other accidents; the city of Amsterdam is bound for it; it can be paid away by a simple transfer, without the trouble of counting, or the risk of transporting it from one place to another. In consequence of those different advantages, it seems from the beginning to have born an agio; and it is generally believed that all the money originally deposited in the bank was allowed to remain there, nobody caring to demand payment of a debt which he could sell for a premium in the market. Besides, this money could not be brought from these coffers, as it will appear by and by, without previously paying for the keeping.

Those deposits of coin, or which the bank was bound to restore in coin, constituted the original capital of the bank, or the whole value of what was represented by what is called *bank-money*. At present they are supposed to constitute but a very small part of it. In order to facilitate the trade in bullion, the bank has been for these many years in the practice of giving credit in its books upon deposits of gold and silver bullion. The credit is generally about 5 per cent. below the mint price of such bullion. The bank grants at the same time what is called a *recipice* or receipt, entitling the person who makes the deposit, or the bearer, to take out the bullion again at any time within six months, upon re-transferring to the bank a quantity of bank-money equal to that for which credit had been given in its books when the deposit was made, and upon paying $\frac{1}{4}$ per cent. for the keeping if the deposit was in silver, and $\frac{1}{2}$ per cent. if it was in gold; but at the same time declaring, that in default of such payment, and upon the expiration of this term, the deposit should belong to the bank at the price at which it had been received, or for which credit had been given in the transfer books. What is thus paid for the keeping of the deposit may be considered as a sort of warehouse-rent; and why this warehouse-rent should be so much dearer for gold than for silver, several different reasons have been assigned. The fineness of gold, it has been said, is more difficult to be ascertained than that of silver. Frauds are more easily practised, and occasion a greater loss in the more precious metal. Silver, besides, being the standard metal, the state, it has been said, wishes to encourage more the making of deposits of silver than those of gold.

Deposits of bullion are most commonly made when the price is somewhat lower than ordinary; and they are taken out again when it happens to rise. In Holland the market price of bullion is generally above the mint price, for the same reason that it was so in England before the late reformation of the gold coin. The difference is said to be commonly from about six to sixteen

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Bank. sixteen stivers upon the mark, or eight ounces of silver of eleven parts fine and one part alloy. The bank-price, or the credit which the bank gives for deposits of such silver (when made in foreign coin, of which the fineness is well known and ascertained, such as Mexico dollars), is 22 gilders the mark; the mint-price is about 23 gilders; and the market-price is from 23 gilders six stivers to 23 gilders 16 stivers, or from 2 to 3 per cent. above the mint-price. The proportion between the bank-price, the mint-price, and the market-price, of gold bullion, are nearly the same. A person can generally sell his receipt for the difference between the mint-price of bullion and the market-price. A receipt for bullion is almost always worth something; and it very seldom happens therefore that anybody suffers his receipt to expire, or allows his bullion to fall to the bank at the price at which it had been received, either by not taking it out before the end of the six months, or by neglecting to pay the ¼ or ½ per cent. in order to obtain a new receipt for another six months. This, however, though it seldom happens, is said to happen sometimes, and more frequently with regard to gold than with regard to silver, on account of the higher warehouse-rent which is paid for the keeping of the more precious metal.

The person who by making a deposit of bullion obtains both a bank-credit and a receipt, pays his bills of exchange as they become due with his bank-credit; and either sells or keeps his receipt, according as he judges that the price of bullion is likely to rise or to fall. The receipt and the bank-credit seldom keep long together, and there is no occasion that they should. The person who has a receipt, and who wants to take out bullion, finds always plenty of bank-credits, or bank-money, to buy at the ordinary price; and the person who has bank-money, and wants to take out bullion, finds receipts always in equal abundance.

The owners of bank-credits and the holders of receipts constitute two different sorts of creditors against the bank. The holder of a receipt cannot draw out the bullion for which it is granted, without re-assigning to the bank a sum of bank-money equal to the price at which the bullion had been received. If he has no bank-money of his own, he must purchase it of those who have it. The owner of bank-money cannot draw out bullion without producing to the bank receipts for the quantity which he wants. If he has none of his own, he must buy them of those who have them. The holder of a receipt, when he purchases bank-money, purchases the power of taking out a quantity of bullion, of which the mint-price is 5 per cent. above the bank-price. The agio of 5 per cent. therefore, which he commonly pays for it, is paid not for an imaginary, but for a real value. The owner of bank-money, when he purchases a receipt, purchases the power of taking out a quantity of bullion, of which the market-price is commonly from 2 to 3 per cent. above the mint-price. The price which he pays for it, therefore, is paid likewise for a real value. The price of the receipt, and the price of the bank money, compound or make up between them the full value or price of the bullion.

Upon deposits of the coin current in the country, the bank grants receipts likewise as well as bank-credits; but those receipts are frequently of no value, and will bring no price in the market. Upon ducatoons, for example, which in the currency pass for three gilders three stivers each, the bank gives a credit of three gilders only, or 5 per cent. below their current value. It grants a receipt likewise entitling the bearer to take out the number of ducatoons deposited at any time within six months, upon paying ¼ per cent. for the keeping. This receipt will frequently bring no price in the market. Three gilders bank-money generally sell in the market for three gilders three stivers, the full value of the ducatoons if they were taken out of the bank; and before they can be taken out, ¼ per cent. must be paid for the keeping, which would be mere loss to the holder of the receipt. If the agio of the bank, however, should at any time fall to 3 per cent. such receipts might bring some price in the market, and might sell for 1¾ per cent. But the agio of the bank being now generally about 5 per cent. such receipts are frequently allowed to expire, or, as they express it, to fall to the bank. The 5 per cent. which the bank gains, when deposits either of coin or bullion are allowed to fall to it, may be considered as the warehouse rent for the perpetual keeping of such deposits.

The sum of bank-money for which the receipts are expired must be very considerable. It must comprehend the whole original capital of the bank, which, it is generally supposed, has been allowed to remain there from the time it was first deposited, nobody caring either to renew his receipt or to take out his deposit, as, for the reasons already assigned, neither the one nor the other could be done without loss. But whatever may be the amount of this sum, the proportion which it bears to the whole mass of bank-money is supposed to be very small. The bank of Amsterdam has for these many years past been the great warehouse of Europe for bullion, for which the receipts are very seldom allowed to expire, or, as they express it, to fall to the bank. The far greater part of the bank-money, or of the credits upon the books of the bank, is supposed to have been created, for these many years past, by such deposits which the dealers in bullion are continually both making and withdrawing.

No demand can be made upon the bank but by means of a recipice or receipt. The smaller mass of bank-money, for which the receipts are expired, is mixed and confounded with the much greater mass for which they are still in force; so that, though there may be a considerable sum of bank-money for which there are no receipts, there is no specific sum or portion of it which may not at any time be demanded by one. The bank cannot be debtor to two persons for the same thing; and the owner of bank-money who has no receipt cannot demand payment of the bank till he buys one. In ordinary and quiet times, he can find no difficulty in getting one to buy at the market-price, which generally corresponds with the price at which he can sell the coin or bullion it entitles him to take out of the bank.

It might be otherwise during a public calamity; an invasion, for example, such as that of the French in 1672. The owners of bank-money being then all eager to draw it out of the bank, in order to have it in their own keeping, the demand for receipts might raise their price to an exorbitant height. The holders of them might

Bank

might form extravagant expectations, and instead of 2 or 3 per cent. demand half the bank-money for which credit had been given upon the deposits that the receipts had respectively been granted for. The enemy, informed of the constitution of the bank, might even buy them up in order to prevent the carrying away of the treasure. In such emergencies, the bank, it is supposed, would break through its ordinary rule of making payment only to the holders of receipts. The holders of receipts, who had no bank-money, must have received within 2 or 3 per cent. of the value of the deposit for which their respective receipts had been granted. The bank, therefore, it is said, would in this case make no scruple in paying, either with money or bullion, the full value of what the owners of bank-money who could get no receipts were credited for in its books; paying at the same time 2 or 3 per cent. to such holder of receipts as had no bank-money, that being the whole value which in this state of things could justly be supposed due to them.

Even in ordinary and quiet times it is the interest of the holders of receipts to depress the agio in order either to buy bank-money (and consequently the bullion which their receipts would then enable them to take out of the bank) so much cheaper, or to sell their receipts to those who have bank-money, and who want to take out bullion, so much dearer; the price of a receipt being generally equal to the difference between the market-price of bank-money and that of the coin or bullion for which the receipt had been granted. It is the interest of the owners of bank-money, on the contrary, to raise the agio, in order either to sell their bank-money so much dearer, or to buy a receipt so much cheaper. To prevent the stock-jobbing tricks which those opposite interests might sometimes occasion, the bank has of late years come to a resolution to sell at all times bank-money for currency, at 5 per cent. agio, and to buy it again at 4 per cent. agio. In consequence of this resolution, the agio can never either rise above 5 or sink below 4 per cent. and the proportion between the market-price of the bank and that of current money is kept at all times very near to the proportion between their intrinsic values. Before this resolution was taken, the market-price of money used sometimes to rise so high as 9 per cent. agio, and sometimes to sink so low as par, according as opposite interests happened to influence the market.

The bank of Amsterdam professes to lend out no part of what is deposited with it, but, for every gilder for which it gives credit in its books, to keep in its repositories the value of a gilder either in money or bullion. That it keeps in its repositories all the money or bullion for which there are receipts in force, for which it is at all times liable to be called upon, and which, in reality, is continually going from it and returning to it again, cannot well be doubted. But whether it does so likewise with regard to that part of its capital for which the receipts are long ago expired, for which in ordinary and quiet times it cannot be called upon, and which in reality is very likely to remain with it for ever, or as long as the States of the United Provinces subsist, may appear perhaps more uncertain. At Amsterdam, however, no part of faith is better established, than that for every gilder circulated as bank-money, there is a correspondent gilder in gold and silver to be found in the treasure of the bank. The city is guarantee that it should be so. The bank is under the direction of the four reigning burgomasters, who are changed every year. Each new set of burgomasters visits the treasure, compares it with the books, receives it upon oath and delivers it over, with the same awful solemnity, to the set which succeeds it; and in that sober and religious country oaths are not yet disregarded. A rotation of this kind seems alone a sufficient security against any practices which cannot be avowed. Amidst all the revolutions which faction has ever occasioned in the government of Amsterdam, the prevailing party has at no time accused their predecessors of infidelity in the administration of the bank. No accusation could have affected more deeply the reputation and fortune of the disgraced party; and if such an accusation could have been supported, we may be assured that it would have been brought. In 1672, when the French king was at Utrecht, the bank of Amsterdam paid so readily as left no doubt of the fidelity with which it had observed its engagements. Some of the pieces which were then brought from its repositories appeared to have been scorched with the fire which happened in the town-house soon after the bank was established. Those pieces, therefore, must have lain there from that time.

What may be the amount of the treasure in the bank is a question which has long employed the speculations of the curious. Nothing but conjecture can be offered concerning it. It is generally reckoned, that there are about 2000 people who keep accounts with the bank; and allowing them to have, one with another, the value of 1500l. lying upon their respective accounts (a very large allowance), the whole quantity of bank-money, and consequently of treasure in the bank, will amount to 3,000,000l. or, at 11 gilders the pound sterling, 33,000,000 of gilders; a great sum, and sufficient to carry on a very extensive circulation, but vastly below the extravagant ideas which some people have formed of this treasure.

The city of Amsterdam derives a considerable revenue from the bank. Besides what may be called the *warehouse-rent* above-mentioned, each person, upon first opening an account with the bank, pays a fee of 10 gilders, and for every new account, 3 gilders 3 stivers; for every transfer, 2 stivers; and if the transfer is for less than 300 gilders, 6 stivers; in order to discourage the multiplicity of small transactions. The person who neglects to balance his accounts twice in the year forfeits 25 gilders. The person who orders a transfer for more than is upon his accounts, is obliged to pay 3 per cent. for the sum overdrawn, and his order is set aside into the bargain. The bank is supposed, too, to make a considerable profit by the sale of the foreign coin or bullion which sometimes falls to it by the expiring of receipts, and which is always kept till it can be sold with advantage. It makes a profit likewise by selling bank-money at 5 per cent. agio, and buying it in at 4. These different emoluments amount to a good deal more than what is necessary for paying the salaries of officers, and defraying the expence of management. What is paid for the keeping of bullion upon receipts, is alone supposed to amount to a neat annual revenue of between 150,000 and 200,000 gilders. Public utility, however, and not revenue, was the original object of this

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this institution. Its object was to relieve the merchants from the inconvenience of a disadvantageous exchange. The revenue which has arisen from it was unforeseen. See BANKING, SUPPLEMENT.

BANKS for Savings, a class of institutions lately introduced with the view of encouraging habits of economy among the labouring classes. See the article in the SUPPLEMENT.

BANK, in sea affairs, denotes an elevation of the ground or bottom of the sea, so as sometimes to surmount the surface of the water, or at least to leave the water so shallow as usually not to allow a vessel to remain afloat over it.—In this sense, *bank* amounts to much the same as flat, shoal, &c.

BANKER, a person who traffics and negociates in money; who receives and remits money from place to place by commission from correspondents, or by means of bills or letters of exchange, &c.

The ancient bankers were called *argentarii*, and *nummularii;* by the Greeks, *τραπεζῖται*, *κολλυβισται*, and *αργυραμοιβοι*. Their chief business was to put out the money of private persons to interest; they had their boards and benches, for this purpose, in all the markets and public places, where they took in the money from some to lend it to others.

BANKING, the making of banks to oppose the force of the sea, rivers, or the like, and secure the land from being overflowed thereby. With respect to the water which is to be kept out, this is called *banking;* with respect to the land, which is hereby to be defended, *imbanking*.

BANKING is also applied to the keeping a bank, or the employment of a banker. Banking, in this sense, signifies the trading in money, or remitting it from place to place, by means of bills of exchange. This answers to what the French call *faire la banque*. In France, every body is allowed to bank, whether merchant or not; even foreigners are indulged in this kind of traffic. In Italy, banking does not derogate from nobility, especially in the republican states; whence it is, that most of the younger sons of great families engage in it. In reality, it was the nobility of Venice and Genoa, that, for a long time, were the chief bankers in the other countries of Europe.

BANKISH, a province of the Mogul's dominions, in the north part of the Hither India, lying south-west of the province of Cassimere.

BANKRUPT, (*bancus ruptus*), is so called, because, when the bank or stock is broken or exhausted, the owner is said to be a *bankrupt*. And this word *bankrupt* is derived from the French *banqueroute*, which signifies a breaking or failing in the world: *banque* in French is as much as *mensa* in Latin, and *route* is the same as *vestigium;* and this term is said to have been taken originally from the Roman *mensarii*, which were set in public places; and when a tradesman slipped away, with an intention to deceive his creditors, he left only some *vestigia* or signs of his table or shop behind him. But a bankrupt with us, from the several descriptions given of him in our statute-law, may be defined "a trader, who secrets himself, or does certain other acts tending to defraud his creditors." For the better understanding of this article, it will be proper to consider, 1. *Who* may become a bankrupt. 2. What *acts* make a bankrupt. 3. The *proceedings* on a commission of bankruptcy: and, 4. In what manner an estate in goods and chattels may be *transferred* by bankruptcy.—But of these, the two last being treated under the article *COMMISSION of Bankruptcy*, the two first only belong to this place.

1. A bankrupt was formerly considered merely in the light of a criminal or offender; and in this spirit we are told by Sir Edward Coke, that we have fetched as well the name, as the wickedness of bankrupts from foreign nations. But at present the laws of bankruptcy are considered as laws calculated for the benefit of trade, and founded on the principles of humanity as well as justice; and to that end they confer some privileges not only on the creditors, but also on the bankrupt or debtor himself. On the creditors; by compelling the bankrupt to give up all his effects to their use, without any fraudulent concealment: on the debtor, by exempting him from the rigour of the general law, whereby his person might be confined at the discretion of his creditor, though in reality he has nothing to satisfy the debt; whereas the law of bankrupts, taking into consideration the sudden and unavoidable accidents to which men in trade are liable, has given them the liberty of their persons, and some pecuniary emoluments, upon condition they surrender up their whole estate to be divided among their creditors.

In this respect our legislature seems to have attended to the example of the Roman law. We mean not the terrible law of the twelve tables, whereby the creditors might cut the debtor's body into pieces, and each of them take his proportionable share: if indeed that law, *de debitore in partes secando*, is to be understood in so very butcherly a light; which many learned men have with reason doubted. Nor do we mean those less inhuman laws (if they may be called so, as *their* meaning is indisputably certain), of imprisoning the debtor's person in chains; subjecting him to stripes and hard labour, at the mercy of his rigid creditor; and sometimes selling him, his wife, and children, to perpetual foreign slavery *trans Tiberim* (A): an oppression which produced so many popular insurrections, and secessions to the *mons sacer*. But we mean the law of cession, introduced by the Christian emperors; whereby, if a debtor *ceded*, or yielded up all his fortune to his creditors, he was secured from being dragged to a gaol, "*omni quoque corporali cruciatu semoto.*" For, as the emperor justly observes, "*inhumanum erat spoliatum fortunis suis in solidum damnari.*" Thus far was just and reasonable: but as the departing from one extreme is apt to produce its opposite, we find it afterwards enacted, that if the debtor by any unforeseen accident was reduced to low circumstances, and would swear that he had not sufficient left to pay his debts, he should not be compelled to cede or give up even that

Blackst. Comm. II. 472, &c.

(A) In Pegu, and the adjacent countries in the East Indies, the creditor is entitled to dispose of the debtor himself, and likewise of his wife and children; insomuch that he may even violate with impunity the chastity of the debtor's wife; but then, by so doing, the debt is understood to be discharged.

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Bankrupt. which he had in his possession; a law which, under a false notion of humanity, seems to be fertile of perjury, injustice, and absurdity.

The laws of England, more wisely, have steered in the middle between both extremes: providing at once against the inhumanity of the creditor, who is not suffered to confine an honest bankrupt after his effects are delivered up; and at the same time taking care that all his just debts shall be paid, so far as the effects will extend. But still they are cautious of encouraging prodigality and extravagance by this indulgence to debtors; and therefore they allow the benefit of the laws of bankruptcy to none but actual traders; since that set of men are, generally speaking, the only persons liable to accidental losses, and to an inability of paying their debts, without any fault of their own. If persons in other situations of life run in debt without the power of payment, they must take the consequence of their own indiscretion, even though they meet with sudden accidents that may reduce their fortunes: for the law holds it to be an unjustifiable practice, for any person but a trader to encumber himself with debts of any considerable value. If a gentleman, or one in a liberal profession, at the time of contracting his debts, has a sufficient fund to pay them, the delay of payment is a species of dishonesty, and a temporary injustice to his creditor: and if, at such a time, he has not sufficient fund, the dishonesty and injustice is the greater. He cannot therefore murmur, if he suffers the punishment which he has voluntarily drawn upon himself. But in mercantile transactions the case is far otherwise. Trade cannot be carried on without mutual credit on both sides; the contracting of debts is therefore here not only justifiable but necessary. And if, by accidental calamities, as by the loss of a ship in a tempest, the failure of brother-traders, or by the non-payment of persons out of trade, a merchant or trader becomes incapable of discharging his own debts, it is his misfortune and not his fault. To the misfortunes therefore of debtors, the law has given a compassionate remedy, but denied it to their faults; since, at the same time that it provides for the security of commerce, by enacting that every considerable trader may be declared a bankrupt, for the benefit of his creditors as well as himself, it has also, to discourage extravagance, declared that no one shall be capable of being made a bankrupt, but only a trader; nor capable of receiving the full benefit of the statutes, but only an industrious trader.

In the interpretation of the several statutes made concerning English bankrupts *, it hath been held, that buying only, or selling only, will not qualify a man to be a bankrupt; but it must be both buying and selling, and also getting a livelihood by it; as, by exercising the calling of a merchant, a grocer, a mercer, or, in one general word, a *chapman*, who is one that buys and sells any thing. But no handicraft occupation (where nothing is bought or sold, and therefore an extensive credit, for the stock in trade, is not necessary to be had) will make a man a regular bankrupt: as that of a husbandman, a gardener, and the like, who are paid for their work and labour. Also an innkeeper cannot, as such, be a bankrupt: for his gain or livelihood does not arise from buying and selling in the way of merchandise, but greatly from the use of his rooms and furniture, his attendance, and the like; and though he may buy corn and victuals, to sell again at a profit, yet that no more makes him a trader, than a schoolmaster or other person is, that keeps a boarding-house, and makes considerable gains by buying and selling what he spends in the house, and such a one is clearly not within the statute. But where persons buy goods, and make them up into saleable commodities, as shoemakers, smiths, and the like; here, though part of the gain is by bodily labour, and not by buying and selling, yet they are within the statutes of bankrupts: for the labour is only in melioration of the commodity, and rendering it more fit for sale.

* 34 *Hen.* VIII. c. 4. 13 *Eliz.* c. 21. *Jac.* I. c. 19. 5 *Geo.* II. c. 30.

2. To learn what the acts of bankruptcy are which render a man a bankrupt, we must consult the several statutes, and the resolutions formed by the courts thereon. Among these may therefore be reckoned, 1. Departing from the realm, whereby a man withdraws himself from the jurisdiction and coercion of the law, with an intent to defraud his creditors. 2. Departing from his own house, with an intent to secrete himself and avoid his creditors. 3. Keeping in his own house, privately (except for just and necessary cause), so as not to be seen or spoken with by his creditors; which is likewise construed to be an intention to defraud his creditors, by avoiding the process of the law. 4. Procuring or suffering himself willingly to be arrested, or outlawed, or imprisoned, without just and lawful cause; which is likewise deemed an attempt to defraud his creditors. 5. Procuring his money, goods, chattels, and effects, to be attached or sequestrated by any legal process; which is another plain and direct endeavour to disappoint his creditors of their security. 6. Making any fraudulent conveyance to a friend, or secret trustee, of his lands, tenements, goods, or chattels: which is an act of the same suspicious nature with the last. 7. Procuring any protection, not being himself privileged by parliament, in order to screen his person from arrests; which also is an endeavour to elude the justice of the law. 8. Endeavouring, or desiring, by any petition to the king, or bill exhibited in any of the king's courts against any creditors, to compel them to take less than their just debts; or to procrastinate the time of payment, originally contracted for; which are an acknowledgment of either his poverty or his knavery. 9. Lying in prison for two months, or more, upon arrest or other detention for debt, without finding bail, in order to obtain liberty. For the inability to procure bail argues a strong deficiency in his credit, owing either to his suspected poverty, or ill character; and his neglect to do it, if able, can arise only from a fraudulent intention; in either of which cases, it is high time for his creditors to look to themselves, and compel a distribution of his effects. 10. Escaping from prison after an arrest for a just debt of 100l. or upwards: for no man would break prison, that was able and desirous to procure bail: which brings it within the reason of the last case. 11. Neglecting to make satisfaction for any just debt to the amount of 100l. within two months after service of legal process, for such debt, upon any trader having privilege of parliament.

These are the several acts of bankruptcy expressly defined by the statutes relating to this article; which being

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being so numerous, and the whole law of bankrupts being an innovation on the common law, our courts of justice have been tender of extending or multiplying acts of bankruptcy by any construction or implication. And therefore Sir John Holt held, that a man's removing his goods privately to prevent their being seized in execution, was no act of bankruptcy. For the statutes mention only fraudulent gifts to third persons, and procuring them to be seized by sham process, in order to defraud creditors; but this, though a palpable fraud, yet, falling within neither of those cases, cannot be adjudged an act of bankruptcy. So also it has been determined expressly, that a banker's stopping or refusing payment is no act of bankruptcy: for it is not within the description of any of the statutes; and there may be good reasons for his so doing, as suspicion of forgery, and the like; and if, in consequence of such refusal, he is arrested, and puts in bail, still it is no act of bankruptcy; but if he goes to prison, and lies there two months, then, and not before, is he become a bankrupt.

As to the consequences resulting from the unhappy situation of a bankrupt, see the article *Commission of Bankruptcy*.

BANKS, John, a dramatic writer, was bred to the law, and belonged to the society of Gray's Inn; but this profession not suiting his natural disposition, he quitted it for the service of the muses. Here, however, he found his rewards by no means adequate to his deserts. His emoluments at the best were precarious, and the various successes of his pieces too feelingly convinced him of the error in his choice. This, however, did not prevent him from pursuing with cheerfulness the path he had taken; his thirst of fame, and warmth of poetic enthusiasm, alleviating to his imagination many disagreeable circumstances into which indigence, the too frequent attendant on poetical pursuits, frequently threw him. His turn was entirely to tragedy; his merit in which is of a peculiar kind. For at the same time that his language must be confessed to be extremely unpoetical, and his numbers uncouth and unharmonious; nay, even his characters very far from being strongly marked or distinguished, and his episodes extremely irregular: yet it is impossible to avoid being deeply affected at the representation, and even at the reading, of his tragic pieces. This is owing in the general to a happy choice of his subjects; which are all borrowed from history, either real or romantic; and indeed the most of them from circumstances in the annals of our own country, which, not only from their being familiar to our continual recollection, but even from their having some degree of relation to ourselves, we are apt to receive with a kind of partial prepossession, and a pre-determination to be pleased. He has constantly chosen as the basis of his plays such tales as were in themselves and their well-known catastrophes most truly adapted to the purposes of the drama. He has indeed but little varied from the strictness of historical facts; but he seems to have made it his constant rule to keep the scene perpetually alive, and never suffer his characters to droop. His verse is not poetry, but prose run mad. Yet will the false gem sometimes approach so near in glitter to the true one, at least in the eyes of all but real connoisseurs (and how small a part of an audience are to be ranked in this class it will need no ghost to inform us), that bombast will frequently pass for the true sublime; and where it is rendered the vehicle of incidents in themselves affecting, and in which the heart is apt to interest itself, it will perhaps be found to have a stronger power on the human passions than even that property to which it is in reality no more than a bare succedaneum. And from these principles it is that we must account for Mr Banks's writings having in the general drawn more tears from, and excited more terror in, even judicious audiences, than those of much more correct and more truly poetical authors. The tragedies he has left behind him are, 1. Albion Queens. 2. Cyrus the Great. 3. Destrustion of Troy. 4. Innocent Usurper. 5. Island Queens. This is only the Albion Queens altered. 6. Rival Kings. 7. Virtue Betrayed. 8. Unhappy Favourite. The Albion Queens was rejected by the managers in 1684; but was acted by Queen Anne's command in 1706, with great applause, and has been several times revived. The Unhappy Favourite continued till very lately a stock tragedy at the theatres; but gives way at present to the later tragedies from the same story, by Jones and Brooke.—Neither the time of the birth, nor that of the death, of this author, are ascertained. His remains, however, lie interred in the church of St James's, Westminster.

BANKS'S island, a small island in the South sea, discovered by Captain Cook in 1770, in S. Lat. 53. 32. W. Long. 186. 30. It is of a circular figure, and about 24 leagues in compass: it is sufficiently high to be seen at the distance of 12 or 15 leagues; and the land has a broken irregular surface, with the appearance of barrenness rather than fertility. It is, however, inhabited; as some straggling savages were observed upon it.

BANKSIA. See Botany *Index*.

BANN, or Ban (from the Brit. *ban*, i. e. clamour), is a proclamation or public notice; any public summons or edict, whereby a thing is commanded or forbidden. It is a word ordinary among the feudists; and there is both *banus* and *banum*, which signify two several things.—The word *banns* is particularly used in England in publishing matrimonial contracts; which is done in the church before marriage, to the end that if any persons can speak against the intention of the parties, either in respect of kindred, precontract, or for other just cause, they may take their exception in time before the marriage is consummated; and in the canon law, Bannæ *sunt proclamationes sponsi et sponsæ in ecclesiis fieri solitæ*. But there may be a faculty or license for the marriage, and then this ceremony is omitted: and ministers are not to celebrate matrimony between any persons without a license, except the banns have been first published three several times, upon pain of suspension, &c. Can. 62.

The use of matrimonial banns is said to have been first introduced in the Gallican church, though something like it obtained even in the primitive times; and it is this that Tertullian is supposed to mean by *trinundina promulgatio*. The council of Lateran first extended, and made the usage general. By the ordinance of Blois, no person could validly contract marriage, without a preceding proclamation of three banns; nor could any person whatever be dispensed with, except

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cept for the two last. But the French themselves have abated much of this severity; and only minors are now under an absolute necessity of submitting to the formality of banns. For majors, or those of age, after publication of the first banns, the two latter are easily bought off.

BANN is also used to denote proscription or banishment for a crime proved; because anciently published by sound of trumpet; or, as Vossius thinks, because those who did not appear at the above-mentioned summons, were punished by proscription. Hence *to put a prince under the bann of the empire*, is to declare him divested of all his dignities. The sentence only denotes an interdict of all intercourse, and offices of humanity, with the offender; the form of which seems taken from that of the Romans, who banished persons by forbidding them the use of fire and water. Sometimes also cities are put under the imperial bann; that is, stripped of their rights and privileges.

BANN also denotes a pecuniary mulct, or penalty, laid on a delinquent for offending against a bann.

BANN, or BANNUS, a title anciently given to the governor or viceroy of Croatia, Dalmatia, and Sclavonia.

Episcopal BANN (*Bannus Episcopalis*), a mulct paid to the bishop by those guilty of sacrilege and other crimes.

BANN is also used for a solemn anathema, or excommunication attended with curses, &c. In this sense we read of *papal banns*, &c.

BANN, in military affairs, a proclamation made in the army by beat of drum, sound of trumpet, &c. requiring the strict observance of discipline, either for the declaring a new officer, or punishing an offender.

BANNER denotes either a square flag, or the principal standard belonging to a prince.

We find a multiplicity of opinions concerning the etymology of the word *banner*; some deriving it from the Latin *bandum*, "a band or flag;" others from the word *bann*, "to summons the vassals to appear in arms;" others again from the German *ban*, "a field or tenement," because landed men alone were allowed a banner: and, finally, there are some who think it is a corruption of *panniere*, from *pannus*, "cloth," because banners were originally made of cloth.

The BANNER *of France*, was the largest and richest of all the flags borne by the ancient kings in their great military expeditions. St Martin's cap was in use 600 years as the banner of France; it was made of taffety, painted with the image of that saint, and laid one or two days on his tomb to prepare it for use. About the year 1100 came in a more pompous apparatus. The banner royal was fastened to the top of a mast, or some tall tree, planted on a scaffold; borne on a carriage drawn by oxen, covered with velvet housings, decorated with devices or cyphers of the prince reigning. At the foot of the tree was a priest, who said mass early every morning. Ten knights mounted guard on the scaffold night and day, and as many trumpets at the foot of the tree never ceased flourishing, to animate the troops. This cumbersome machine, the model of which was brought from Italy, continued in use about 130 years. Its post was in the centre of the army. And here it was that the chief feats were performed, to carry off and defend the royal banner; for there was no victory without it, nor was any army reputed vanquished till they had lost their banner.

BANNERETS, an ancient order of knights, or feudal lords; who, possessing several large fees, led their vassals to battle under their own flag or banner, when summoned thereto by the king. The word seems formed from *banner*, "a square flag," or from *band*, which anciently denoted a flag.—Bannerets are also called in ancient writers *milites vexilliferi*, and *vexillarii bannerarii*, *bannarii*, *banderisii*, *&c.*

Anciently there were two kinds of knights, *great* and *little*; the first whereof was called *bannerets*, the second *bachelors*; the first composed the upper, the second the middle, nobility.

The banneret was a dignity allowed to march under his own flag, whereas the *bachelarius eques* followed that of another. To be qualified for a banneret, one must be a gentleman of family, and must have a power to raise a certain number of armed men, with estate enough to subsist at least 28 or 30 men. This must have been very considerable in those days; because each man, besides his servant, had two horsemen to wait on him armed, the one with a cross-bow, the other with a bow and hatchet. As he was not allowed to be a baron who had not above 13 knights fees, so he was not admitted to be a banneret if he had less than 10.

Banneret, according to Spelman, was a middle order between a baron and a simple knight; called sometimes also *vexillarius minor*, to distinguish him from the greater, that is, from the baron, to whom alone properly belonged *jus vexilli*, or privilege of the square flag. Hence the banneret was also called *bannerettus*, *quasi baro minor*; a word frequently used by English writers in the same sense as banneret was by the French, though neither of them occur before the time of Edward II.

Some will have bannerets to have originally been persons who had some portion of a barony assigned them; and enjoyed it under the title of *baro proximus*, and that with the same prerogatives as the baron himself. Some, again, find the origin of bannerets in France, others in Brittany, others in England. These last attribute the institution of bannerets to Conan, lieutenant of Maximus, who commanded the Roman legions in England under the empire of Gratian in 383. This general, say they, revolting, divided England into 40 cantons, and in these cantons distributed 40 knights; to whom he gave a power of assembling, on occasion, under their several banners, as many of the effective men as were found in their respective districts: whence they are called *bannerets*. However this be, it appears from Froissart, &c. that anciently such of the military men as were rich enough to raise and subsist a company of armed men, and had a right to do so, were called *bannerets*. Not, however, that these qualifications rendered them knights, but only bannerets; the appellation of *knight* being only added thereto, because they were simple knights before.

Bannerets were second to none but knights of the Garter. They were reputed the next degree below the nobility; and were allowed to bear arms with supporters, which none else may under the degree of a baron. In France, it is said, the dignity was hereditary; but in England it died with the person that gained

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gained it. The order dwindled on the institution of baronets by King James I. and at length became extinct. The last person created banneret was Sir John Smith, made so after Edgehill fight, for rescuing the standard of King Charles I.

The form of the banneret's creation was this. On a day of battle, the candidate presented his flag to the king or general; who, cutting off the train or skirt thereof, and making it a square, returned it again, the proper banner of bannerets; who are hence sometimes called *knights of the square flag*. There seem to have been bannerets created either in a different manner, or by others than the sovereign; since King James, in the patents of baronets, gives them precedence to all knights bannerets, except such as are created by the king himself in the field; which implies, either that there are some of this order created out of the field, or by inferior persons. See CHIVALRY, SUPPLEMENT.

BANNERET is also the name of an officer or magistrate of Rome towards the close of the 14th century. —The people of that city, and throughout the territory of the church, during the disputes of the antipopes, had formed a kind of republican government; where the whole power was lodged in the hands of a magistrate called *senator*, and twelve heads of quarters called *bannerets*, by reason of the banners which each raised in his district.

BANNOCK, a kind of oat-cake, baked in the embers, or on a stone placed before the fire. It is common in the northern parts of this kingdom.

BANNOCKBURN, a village in Scotland, near Stirling, celebrated as the place of a great battle between the Scots and English. See SUPPLEMENT.

BANNUM, in *Law*, signifies the utmost bounds of a manor or town.

BANQUET, a feast or entertainment where people regale themselves with pleasant foods or fruits.

BANQUET, in the manege, that small part of the branch of a bridle that is under the eye; which gathers and joins the extremities of the bit to the branch.

Banquet-Line, an imaginary line drawn, in making a bit, along the banquet, and prolonged up or down, to adjust the designed force or weakness of the branch, in order to make it stiff or easy.

BANQUET, or *Banquette*, in *Fortification*, a little foot-bank, or elevation of earth, forming a path which runs along the inside of a parapet, upon which the musketeers get up, in order to discover the counterscarp, or to fire on the enemy, in the moat or in the covert-way.

BANQUETING ROOM or HOUSE. See SALOON. The ancient Romans supped in the atrium, or vestibule, of their houses; but, in after times, magnificent saloons, or banqueting-rooms, were built, for the more commodious and splendid entertainment of their guests. Lucullus had several of these, each distinguished by the name of some god; and there was a particular rate of expence appropriated to each. Plutarch relates with what magnificence he entertained Cicero and Pompey, who went with a design to surprise him, by only telling a slave who waited, that the cloth should be laid in the Apollo. The emperor Claudius, among others, had a splendid banqueting-room named *Mercury*. But every thing of this kind was outdone by the lustre of that celebrated banqueting-house of Nero, called *domus aurea*; which, by the circular motion of its partitions and ceilings, imitated the revolution of the heavens, and represented the different seasons of the year, which changed at every service, and showered down flowers, essences, and perfumes, on the guests.

BANSTICKLE. See GASTEROSTEUS, ICHTHYOLOGY *Index*.

BANTAM, a town of the island of Java, in the East Indies, situated in E. Long. 105. 16. S. Lat. 6. 20. It is the capital of a kingdom of the same name, with a harbour and castle; but the harbour is now so choked up that it is inaccessible to vessels of any great burden. It is divided into two towns separated by a river, and one of them inhabited by Chinese. Bantam once enjoyed a flourishing trade. It was a great mart for pepper and other spices; but this trade, as well as the power of its sovereign, has fallen to decay. For its history, &c. see JAVA.

BANTAM-WORK, a kind of painted or carved work, resembling that of Japan, only more gaudy.

There are two sorts of Bantam, as well as of Japan work. As, in the latter, some are flat, lying even with the black, and others high and embossed; so in Bantam-work, some are flat and others in-cut, or carved into the wood, as we find in many large screens: with this difference, that the Japan artists work chiefly in gold and other metals; and those of Bantam generally in colours, with a small sprinkling of gold here and there: for the flat Bantam-work is done in colours, mixed with gum-water, proper for the thing designed to be imitated. For the carved, or in-cut kind, the method of performing it is thus described by an ingenious artist: First, the wood is to be primed with whiting and size, so often till the primer lie near a quarter of an inch thick; then it is to be water-plained, i. e. rubbed with a fine wet cloth, and some time after, rubbed very smooth, the blacks laid on, varnished up with a good body, and polished well, though with a gentle hand. This done, the design is to be traced out with vermilion and gum-water, exactly in the manner wherein it is intended to be cut; the figures, trees, building, &c. in their due proportion: then the graver is applied, with other tools, of proper shapes, differing according to the workman's fancy: with these he cuts deep or shallow, as is found convenient, but never deeper than the whiting lies, the wood being never to feel the edge of the instrument. Lines, or parts of the black, are still to be left for the draperies, and other outlines, and for the distinction of one thing from another; the rule being to cut where the white is, and leave the black untouched. The carving being finished, then take to the pencil, with which the colours are laid into the cut-work: after this, the gold is to be laid in those places which the design requires; for which purpose a strong thick gum-arabic water is taken and laid with a pencil on the work; and, while this remains wet, leaf-gold is cut with a sharp smooth-edged knife, in little pieces, shaped to the bigness and figure of the places where they are to be laid. These being taken up with a little cotton, they daub them with the same close to the gum water, which affords a rich lustre. The work thus finished, they clear up the black with oil, taking care not to touch the colours. The European workmen ordinarily use brass dust, which is less bright and beautiful.

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BANTRY, a town of Ireland, in the county of Cork, and province of Munster. It is seated on a bay of the same name, in W. Long. 9. 15. N. Lat. 51. 30.

BAOBAB, the name given by Prosper Alpinus to the African calabash-tree, since called ADANSONIA. See BOTANY *Index*.

BAPTISM, in matters of religion, the ceremony of washing; or a sacrament, by which a person is initiated into the Christian church.—The word is formed from the Greek βαπτιζω, of βαπτω, *to dip* or *wash*. Baptism is known, in ecclesiastical writers, by divers other names and titles. Sometimes it is called *palingenesia*, or *laver of regeneration;* sometimes *salus*, or *life and salvation;* sometimes σφραγις, *signaculum Domini*, and *signaculum fidei*, or *the seal of faith;* sometimes absolutely *mysterium*, and *sacramentum;* sometimes *the sacrament of faith;* sometimes *viaticum*, from its being administered to departing persons; sometimes *sacerdotium laici*, or *the lay priesthood*, because allowed, in cases of necessity, to be conferred by laymen: sometimes it is called the *great circumcision*, because it was imagined to succeed in the room of circumcision, and to be a seal of the Christian covenant, as that was the seal of the covenant made with Abraham: so, in regard that baptism had Christ for its author, and not man, it was anciently known by the name of Δωρον and χαρισμα Κυριυ, *the gift of the Lord:* sometimes it was simply called δωρον, without any other addition, by way of eminence, because it was both a gratuitous and singular gift of Christ: in reference to the making men complete members of Christ's body, the church, it had the name of Τελειωσις, and Τελεια, the *consecration* and *consummation;* because it gave men the perfection of Christians, and a right to partake of the Το Τελειον, which was *the Lord's Supper:* it had also the name of μυησις and μυσταγωγια, the *initiation*, because it was the admittance of men to all the sacred rites and mysteries of the Christian religion.

Various names given to baptism.

Bingham's Orig. Eccles.

Its origin, &c.

Baptism has been supposed by many learned authors to have had its origin from the Jewish church, in which, as they maintain, it was the practice long before Christ's time, to baptize proselytes or converts to their faith, as part of the ceremony of their admission: a practice which, according to some, obtains among them to this day; a person turning Jew, is first circumcised, and, when healed, is bathed, or baptized in water, in presence of their rabbins; after which he is reputed a good Jew. Others, however, insist that the Jewish proselyte baptism is not by far so ancient, and that John the Baptist was the first administrator of baptism among the Jews. Of this opinion were Deylingius, J. G. Carpzovius, Boernerus, Wernsdorfius, Zeltnerus, Owen, Knatchbull, Jennings, Gill, and others.

Grotius is of opinion, that the rite of baptism had its original from the time of the deluge; immediately after which, he thinks, it was instituted in memory of the world having been purged by water. Some learned men think it was added to circumcision, soon after the Samaritan schism, as a mark of distinction to the orthodox Jews. Spencer, who is fond of deriving the rites of the Jewish religion from the ceremonies of the Pagans, lays it down as a probable supposition, that the Jews received the baptism of proselytes from the neighbouring nations, who were wont to prepare candidates for the more sacred functions of their religion, by a solemn ablution; that by this affinity of sacred rites, they might draw the Gentiles to embrace their religion, and that the proselytes (in gaining of whom they were extremely diligent) might the more easily comply with the transition from Gentilism to Judaism. In confirmation of this opinion, he observes, first, that there is no divine precept for the baptism of proselytes, God having enjoined only the rite of circumcision for the admission of strangers into the Jewish religion. Secondly, that, among foreign nations, the Egyptians, Persians, Greeks, Romans, and others, it was customary that those who were to be initiated into their mysteries, or sacred rites, should be first purified by dipping their whole body in water. That learned writer adds, as a farther confirmation of his opinion, that the cup of blessing likewise, added to the paschal supper, seems plainly to have been derived from a pagan original: for the Greeks, at their feasts, had one cup, called ποτηριον αγαθυ δαιμονος, *the cup of the good dæmon or god*, which they drank at the conclusion of their entertainment, when the table was removed. Since then, a rite of Gentile origin was added to one of the Jewish sacraments, viz. the passover, there can be no absurdity in supposing, that baptism, which was added to the other sacrament, namely circumcision, might be derived from the same source. In the last place, he observes, that Christ, in the institution of his sacraments, paid a peculiar regard to those rites which were borrowed from the Gentiles: for rejecting circumcision and the paschal supper, he adopted into his religion baptism and the sacred cup; thus preparing the way for the conversion and reception of the Gentiles into his church.

The design of the Jewish baptism, if baptism be practised by them, is supposed to be, to import a regeneration, whereby the proselyte is rendered a new man, and of a slave becomes free. The effect of it is, to cancel all former relations; so that those who were before akin to the person, after the ceremony ceased to be so. It is to this ceremony Christ is supposed to have alluded, in his expression to Nicodemus, that it was necessary that he should be born again, in order to become his disciple.—The necessity of baptism to salvation is grounded on those two sayings of our Saviour; *He that believeth, and is baptized, shall be saved;* and *Except a man be born of water and of the Spirit, he cannot enter into the kingdom of God.* The ancients did not generally think the mere want of baptism, where the procuring it was impracticable, excluded men absolutely from the hopes of eternal salvation. Some few of them, indeed, are pretty severe upon infants dying without baptism; and some others seem also, in general terms, to deny eternal life to adult persons dying without it: but when they interpret themselves, and speak more distinctly, they make some allowances, and except several cases, in which the want of baptism may be supplied by other means. Such are, martyrdom, which commonly goes by the name of *second baptism in men's own blood*, in the writings of the ancients; because of the power and efficacy it was thought to have to save men by the invisible baptism of the Spirit, without the external element of water. Faith, and repentance, were also esteemed a supplement to the want of baptism, in such catechumens as died while they were piously preparing themselves for baptism. Constantly

Opinions concerning the effects of baptism.

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communicating with the church, was thought to supply the want of baptism in persons who had been admitted to communion, on a presumption of their being duly baptized, though the contrary afterwards appeared. For infants dying without baptism, the case was thought more dangerous; as here, no personal faith, repentance, or the like, could be pleaded, to supply the defect, and wash away original sin: on this account, they who spoke most favourably of them, as Greg. Nazianzen, and Severus bishop of Antioch, only assigned them a middle state, neither in heaven nor hell. But the Latins, as St Augustin, Fulgentius, Marius Mercator, &c. who never received the opinion of a middle state, concluded, as they could not be received into heaven, they must go to hell. Pelagius, and his followers, who denied original sin, asserted, that they might be admitted to eternal life, and salvation, though not to the kingdom of heaven; between which they distinguished. Where the fault was not on the side of the child, nor his parents, but of the minister, or where any unavoidable accident rendered baptism absolutely impossible, Hincmar, and others, make an exception, in holding the child saved without baptism.

Of the time, place, and subjects of baptism.

The receiving baptism is not limited to any time, or age of life. Some contend for its being administered like circumcision, precisely on the eighth day, as Greg. Nazianzen; and others would have it deferred till the child is three years of age, and able to hear the mystic words, and make answer thereto, though he do not undestand them. In the canon law we find divers injunctions against deferring the baptism of infants beyond the 37th day, 30th day, and the 9th day; some of them under pecuniary forfeitures.

Salmasius, and Suicerus from him, deliver it as authentic history, that for the two first ages, no one received baptism, who was not first instructed in the faith and doctrine of Christ, so as to be able to answer for himself, that he believed; because of those words, *He that believeth and is baptized;* which, in effect, is to say, that no infant, for the first two ages, was ever admitted to Christian baptism. But, afterwards, they own, that pædo-baptism came in, upon the opinion that baptism was necessary to salvation. But Vossius, Dr Forbes, Dr Hammond, Mr Walker, and especially Mr Wall, who has exactly considered the testimony and authority of almost every ancient writer that has said any thing upon this subject, endeavour to evince, that infants were baptized even in the apostolical age. It is certain, Tertullian pleads strongly against giving baptism to infants; which shows, at least, that there was some such practice in his age, though he disapproved of it. It is certain, the ordinary subjects of this sacrament, in the first ages, were converts from Judaism and Gentilism, who, before they could be admitted to baptism, were obliged to spend some time in the state of catechumens, to qualify them to make their professions of faith, and a Christian life, in their own persons: for, without such personal professions, there was ordinarily no admission of them to the privilege of baptism. Those baptized in their sick-beds were called *clinici;* and were held in some reproach, as not being reputed true Christians. Hence several censures, in councils and ecclesiastical writers, of clinic baptism. This clinic baptism was not sufficient to qualify the person, in case of recovery, for ordination. Some had their baptism put off by way of punishment, when they fell into gross and scandalous crimes, which were to be expiated by a longer course of discipline and repentance. This was sometimes 5, 10, 20 years or more; even all their lives to the hour of death, when their crimes were very flagrant.

In the earliest ages of the church, there was no stated time or place for the reception of baptism. Afterwards Easter, Whitsuntide, and Epiphany, became solemn seasons, out of which baptism was not administered, except in cases of necessity. The catechumens who were to receive it at these times, were called *competentes:* and to these it is that St Cyril addresses his catecheses. In the apostolical age, and some time after, before churches and baptisteries were generally erected, they baptized in any place where they had convenience; as John baptized in Jordan, and Philip baptized the eunuch in the wilderness, and Paul the jailor in his own house. But in after ages, baptisteries were built adjoining to the church; and then rules were made, that baptism should ordinarily be administered nowhere but in these buildings. Justinian, in one of his novels, refers to ancient laws, appointing that none of the sacred mysteries of the church should be celebrated in private houses. Men might have private oratories for prayer in their own houses; but they were not to administer baptism or the eucharist in them, unless by a particular license from the bishop of the place. Such baptisms are frequently condemned in the ancient councils, under the name *παραβαπτίσματα, baptisms in private conventicles.*

Ancient ceremonies.

As to the attendant ceremonies and manner of baptism in the ancient church: The person to be baptized, if an adult, was first examined by the bishop or officiating priest, who put some questions to him; as, first, Whether he abjured the devil and all his works; secondly, Whether he gave a firm assent to all the articles of the Christian faith: to both which he answered in the affirmative. If the person to be baptized was an infant, these interrogatories were answered by his *sponsores*, or godfathers. Whether the use of sponsors was as old as the apostles days, is uncertain: perhaps it was not, since Justin Martyr, speaking of the method and form of baptism, says not a word of them.—After the questions and answers, followed exorcism; the manner and end of which was this: The minister laid his hands on the person's head, and breathed in his face, implying thereby the driving away or expelling of the devil from him, and preparing him for baptism, by which the good and holy spirit was to be conferred upon him.—After exorcism, followed baptism itself: and first the minister, by prayer, consecrated the water for that use. Tertullian says, "any waters may be applied to that use: but then God must be first invocated; and then the Holy Ghost presently comes down from heaven, and moves upon them, and sanctifies them." The waters being consecrated, the person was baptized "in the name of the Father, and of the Son, and of the Holy Ghost;" by which "dedication of him to the blessed Trinity, the person, (says Clemens Alexandrinus) is delivered from the corrupt trinity, the devil, the world, and the flesh." In performing the ceremony of baptism, the usual custom (except in clinical cases, or

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Baptism

or where there was scarcity of water), was to immerse and dip the whole body. Thus St Barnabas, describing a baptized person, says, "We go down into the water full of sin and filth, but we ascend bearing fruit in our hearts." And this practice of immersing the whole body was so general, that we find no exceptions made in respect either to the tenderness of infants, or the bashfulness of the other sex, unless in case of sickness or other disability. But to prevent any indecency, men and women were baptized apart. To which end, either the baptisteries were divided into two apartments, one for the men, the other for the women, as Bingham has observed; or the men were baptized at one time and the women at another, as is shown by Vossius, from the *Ordo Romanus*, Gregory's *Sacramentarium*, &c. Add, that there was anciently an order of deaconesses, one part of whose business was to assist at the baptism of women. The precautions, however, rather indicate a scrupulous attention to delicacy, than imply any indecency in the circumstance of immersion itself. From the candidates being immersed, there is at least no reason to infer that they were naked: The present Baptists never baptize naked, though they always immerse. After immersion, followed the unction; by which (says St Cyril) was signified that they were now cut off from the wild olive, and were ingrafted into Christ, the true olive tree; or else to shew that they were now to be champions for the gospel, and were anointed thereto, as the old athletæ were against their solemn games. With this anointing was joined the sign of the cross, made upon the forehead of the person baptized; which being done, he had a white garment given him, to denote his being washed from the defilements of sin, or in allusion to that of the apostle, "As many as are baptized in Christ have put on Christ." From this custom the feast of Pentecost, which was one of the annual seasons of baptism, came to be called *Whitsunday*, i. e. *White-sunday*. This garment was afterwards laid up in the church, that it might be an evidence against such persons as violated or denied that faith which they had owned in baptism.—When the baptism was performed, the person baptized, according to Justin Martyr, "was received into the number of the faithful, who then sent up their public prayers to God, for all men, for themselves, and for those who had been baptized."

The ordinary ministers, who had the right of administering this sacrament, that is, of applying the water to the body, and pronouncing the formula, were presbyters or bishops; though on extraordinary occasions laymen were admitted to perform the same.

Modern forms—In the church of Rome.

As to the present form of administering baptism, the church of Rome uses the following. When a child is to be baptized, the persons who bring it wait for the priest at the door of the church, who comes thither in his surplice and purple stole, attended by his clerks. He begins with questioning the godfathers, whether they promise, in the child's name, to live and die in the true catholic and apostolic faith, and what name they would give the child. Then follows an exhortation to the sponsors; after which the priest, calling the child by its name, asks it as follows: *What dost thou demand of the church?* The godfather answers, *Eternal life*. The priest goes on: *If you are desirous of obtaining eternal life, keep God's commandments, thou shalt love the Lord thy God*, &c. After which he breathes three times in the child's face, saying, *Come out of this child, thou evil spirit, and make room for the Holy Ghost*. This said, he makes the sign of the cross on the child's forehead and breast, saying, *Receive the sign of the cross on thy forehead, and in thy heart*. Then taking off his cap, he repeats a short prayer; and laying his hand gently on the child's head, repeats a second prayer: which ended, he blesses some salt; and putting a little of it into the child's mouth, pronounces these words, *Receive the salt of wisdom*. All this is performed at the church door. The priest, with the godfathers and god-mothers, coming into the church, and advancing towards the font, repeat the apostles creed and the Lord's prayer. Being come to the font, the priest exorcises the evil spirit again; and taking a little of his own spittle, with the thumb of his right hand, rubs it on the child's ears and nostrils, repeating, as he touches the right ear, the same word (*Ephatha, be thou opened*) which our Saviour made use of to the man born deaf and dumb. Lastly, they pull off its swaddling-clothes, or strip it below the shoulders, during which the priest prepares the oils, &c. The sponsors then hold the child directly over the font, observing to turn it due east and west: whereupon the priest asks the child, *Whether he renounces the devil and all his works?* and the godfather having answered in the affirmative, the priest anoints the child between the shoulders in the form of a cross. Then taking some of the consecrated water, he pours part of it thrice on the child's head, at each perfusion calling on one of the Persons of the Holy Trinity. The priest concludes the ceremony of baptism with an exhortation.—The Romish church allows midwives, in cases of danger, to baptize a child before it comes entirely out of its mother's womb: where it is to be observed, that some part of the body of the child must appear before it can be baptized, and that it is baptized on the part which first appears: if it be the head, it is not necessary to rebaptize the child; but if only a foot or hand appears, it is necessary to repeat baptism. A stillborn child thus baptized may be buried in consecrated ground.

In the Greek church.

The Greek church differs from the Romish, as to the rite of baptism, chiefly in performing it by immersion, or plunging the infant all over in the water.

English form in the liturgy of King Edward.

The forms of administering baptism among us being too well known to require a particular description, we shall only mention one or two of the more material differences between the form, as it stood in the first liturgy of King Edward, and that in the English Common Prayer Book at present. First, the form of consecrating the water did not make a part of the office, in King Edward's liturgy, as it does in the present, because the water in the font was changed, and consecrated, but once a month. The form likewise itself was something different from that now used; and was introduced with a short prayer, that *Jesus Christ, upon whom (when he was baptized) the Holy Ghost came down in the likeness of a dove, would send down the same Holy Spirit, to sanctify the fountain of baptism;* which prayer was afterwards left out, at the second review.—By King Edward's first book, the minister is to dip the child in the water thrice; first, dipping the right side; secondly, the left; the third time, dipping the face toward the foot. This trine immersion was a very ancient

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cient practice in the Christian church, and used in honour of the Holy Trinity; though some later writers say, it was done to represent the death, burial, and resurrection, of Christ, together with his three days continuance in the grave. Afterwards, the Arians making an ill use of it, by persuading the people that it was used to denote that the three Persons in the Trinity were three distinct substances, the orthodox left it off, and used only one single immersion.

By the first common-prayer of King Edward, after the child was baptized, the godfathers and godmothers were to lay their hands upon it, and the minister was to put on him the white vestment commonly called the *chrysome*, and to say, "Take this white vesture, as a token of the innocency, which, by God's grace, in this holy sacrament of baptism, is given unto thee; and for a sign, whereby thou art admonished, so long as thou livest, to give thyself to innocence of living, that after this transitory life thou mayest be partaker of the life everlasting. Amen." As soon as he had pronounced these words, he was to anoint the infant on the head, saying, "Almighty God, the father of our Lord Jesus Christ, who hath regenerated thee by water and the Holy Ghost, and hath given unto thee remission of all thy sins; may he vouchsafe to anoint thee with the unction of his Holy Spirit, and bring thee to the inheritance of everlasting life. Amen." This was manifestly done in imitation of the practice of the primitive church.

The custom of sprinkling children, instead of dipping them in the font, which at first was allowed in case of the weakness or sickness of the infant, has so far prevailed, that immersion is at length quite excluded. What principally tended to confirm the practice of affusion or sprinkling, was, that several of our Protestant divines, flying into Germany and Switzerland during the bloody reign of Queen Mary, and returning home when Queen Elizabeth came to the crown, brought back with them a great zeal for the Protestant churches beyond sea, where they had been sheltered and received; and having observed, that at Geneva and some other places, baptism was administered by sprinkling, they thought they could not do the church of England a greater piece of service than by introducing a practice dictated by so great an oracle as Calvin. This, together with the coldness of our northern climate, was what contributed to banish entirely the practice of dipping infants in the font.

Notions concerning the effects of baptism.

Many different notions have been entertained concerning the effects of baptism, which it would be endless to enumerate.—The Remonstrants and Socinians reduce baptism to a mere sign of divine grace. The Romanists, on the contrary, exalt its power; holding, that all sin is entirely taken away by it; that it absolutely confers the grace of justification, and consequently grace *ex opere operato*. Some also speak of an indelible character impressed on the soul by it, called *character dominicus*, and *character regius*: but this is held, by others, a mere chimera; for that the spiritual character, conferred in regeneration, may easily be effaced by mortal sins. Dodwell maintained, that it is by baptism the soul is made immortal; so that those who die without it will not rise again. It must be added, he restrains this effect to episcopal baptism alone. From the effects ordinarily ascribed to baptism, even by ancient writers, it should seem, that the ceremony is as much of heathen as Jewish origin; since Christians do not restrain the use of it, like the Jews, to the admission of new members into the church, but hold, with the heathens, a virtue in it for remitting and washing away sins. The Bramins are still said to baptize with this latter view, at certain seasons, in the river Ganges; to the waters whereof they have annexed a cleansing or sanctifying quality; and hence it is that they flock from all parts, even of Tartary, driven by the expectation of their being eased of their load of sins. But, in this point, many Christians seem to have gone beyond the folly of the heathens. It was only the smaller sins of infirmity which these latter held to be expiable by washing; for crimes of a blacker dye, they allowed no water could efface them, no purgation could discharge them. The Christian doctrine of a total remission of sins by baptism could not fail, therefore, to scandalize many among the heathens, and furnished Julian an occasion of satirizing Christianity itself: "Whoever (says he) is guilty of rapes, murders, sacrilege, or any abominable crime, let him be washed with water, and he will become pure and holy."

In the ancient church, baptism was frequently conferred on Jews by violence: but the church itself never seems to have allowed of force on this occasion. By a canon of the fourth council of Toledo, it is expressly forbid to baptize any against their wills. That which looks most like force in this case, allowed by law, were two orders of Justinian; one of which appoints the heathens, and the other Samaritans, to be baptized, with their wives and children and servants, under pain of confiscation. By the ancient laws, baptism was not to be conferred on image-makers, stage-players, gladiators, *aurigæ* or public drivers, magicians, or even strolling beggars, till they quitted such professions. Slaves were not allowed the privilege of baptism without the testimony and consent of their masters; excepting the slaves of Jews, Heathens, and heretics; who were not only admitted to baptism, but, in consequence thereof, had their freedom. Vossius has a learned and elaborate work *De Baptismo*, wherein he accurately discusses all the questions concerning baptism according to the doctrine of the ancients.

Bingham. Orig. Eccl. lib. xi. c. 5. § 4. lib. viii. c. 14. § 7.

Baptism by Fire, spoken of by St John the Baptist, has occasioned much conjecture. The generality of the fathers held, that believers, before they enter paradise, are to pass through a certain fire, which is to purify them from all pollutions remaining on them unexpiated. Others, with St Basil, understand it of the fire of hell; others, of that of tribulation and temptation. Others, with St Chrysostom, will have it denote an abundance of graces. Others suppose it to mean the descent of the Holy Ghost on the apostles, in form of fiery tongues. Lastly, others maintain, that the word *fire* here is an interpolation; and that we are only to read the text, *He that shall come after me will baptize you with the Holy Ghost*. In reality, it is not found in divers manuscript copies of St Matthew.

The ancient Selucians and Hermians, understanding the passage literally, maintained, that material fire was necessary in the administration of baptism. But we do not find how or to what part of the body they applied it, or whether they were satisfied with obliging the

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the person baptized to pass through the fire. Valentinus rebaptized all who had received water-baptism, and conferred on them the baptism of fire.

Bis docuit tingi, traductoque corpore flamma.
TERTULL. Carm. contr. Marc. l. 1.

Heracleon, cited by Clemens Alexandrinus, says, that some applied a red-hot iron to the ears of the person baptized, as if to impress some mark upon him.

Baptism of the Dead, a custom which anciently prevailed among some people in Africa, of giving baptism to the dead. The third council of Carthage speak of it as a thing that ignorant Christians were fond of. Gregory Nazianzen also takes notice of the same superstitious opinion prevailing among some who delayed to be baptized. In his address to this kind of men, he asks, whether they stayed to be baptized after death? Philastrius also notes it as the general error of the Montanists or Cataphrygians, that they baptized men after death. The practice seems to be grounded on a vain opinion, that, when men had neglected to receive baptism in their life-time, some compensation might be made for this default by receiving it after death.

Baptism of the Dead was also a sort of vicarious baptism, formerly in use, when a person dying without baptism, another was baptized in his stead.

St Chrysostom tells us, this was practised among the Marcionites with a great deal of ridiculous ceremony; which he thus describes: After any catechumen was dead, they hid a living man under the bed of the deceased; then coming to the dead man, they asked him whether he would receive baptism; and he making no answer, the other answered for him, and said, he would be baptized in his stead: and so they baptized the living for the dead.

Epiphanius assures us, the like was also practised among the Corinthians. This practice they pretended to found on the Apostle's authority; alleging that text of St Paul for it, *If the dead rise not at all, what shall they do who are baptized for the dead?* A text which has given occasion to a great variety of different systems and explications. Vossius enumerates no less than nine different opinions among learned divines concerning the sense of the phrase, *being baptized for the dead.*

St Ambrose and Walafred Strabo seem clearly of opinion, that the apostle had respect to such a custom then in being; and several moderns have given into the same opinion, as Baronius, Jos. Scaliger, Justellus, and Grotius.

Several among the Roman Catholics, as Bellarmin, Salmeron, Menochius, and a number of schoolmen, understand it of the baptism of tears, and penance, and prayers, which the living undergo for the dead; and thus allege it as a proof of the belief of purgatory in St Paul's days.

Hypothetical Baptism, that formerly administered in certain doubtful cases, with this formula: *If thou art baptized, I do not rebaptize; if thou art not, I baptize thee in the name of the Father*, &c. This sort of baptism, enjoined by some ancient constitutions of the English church, is now fallen into disuse.

Solemn Baptism, that conferred at stated seasons; such, in the ancient church, were the *Paschal baptism*, and that at Whitsuntide. This is sometimes also called *general baptism.*

Lay Baptism, we find to have been permitted by both the Common-prayer Books of King Edward and that of Queen Elizabeth, when an infant is in immediate danger of death, and a lawful minister cannot be had. This was founded upon the mistaken notion of the impossibility of salvation without the sacrament of baptism: but afterwards, when they came to have clearer notions of the sacraments, it was unanimously resolved in a convocation, held in the year 1575, that even private baptism, in a case of necessity, was only to be administered by a lawful minister.

BAPTISM is also applied, abusively, to certain ceremonies used in giving names to things inanimate.

The ancients knew nothing of the custom of giving baptism to inanimate things, as bells, ships, and the like, by a superstitious consecration of them. The first notice we have of this is in the Capitulars of Charles the Great, where it is only mentioned to be censured: but, afterwards, it crept into the Roman offices by degrees. Baronius carries its antiquity no higher than the year 968, when the greatest bell of the church of Lateran was christened by Pope John III. At last it grew to that superstitious height, as to be thought proper to be complained of in the *Centum Gravamina* of the German nation, drawn up in the public diet of the empire held at Nuremberg *anno* 1581; where (after having described the ceremony of baptizing a bell, with godfathers, who make responses as in baptism, and give it a name, and clothe it with a new garment as Christians were used to be clothed, and all this to make it capable of driving away tempests and devils) they conclude against it, as not only a superstitious practice, but contrary to the Christian religion, and a mere seduction of the simple people.

BAPTISM, in the sea language, a ceremony in long voyages on board merchant ships, practised both on persons and vessels who pass the tropic or line for the first time. The baptizing the vessels is simple, and consists only in washing them throughout with sea-water; that of the passengers is more mysterious. The oldest of the crew, that has past the tropic or line, comes with his face blacked, a grotesque cap on his head, and some sea-book in his hand, followed by the rest of the seamen dressed like himself, each having some kitchen utensil in his hand, with drums beating; he places himself on a seat on the deck, at the foot of the mainmast. At the tribunal of this mock magistrate, each passenger, not yet initiated, swears he will take care the same ceremony be observed, whenever he is in the like circumstances: Then, by giving a little money by way of gratification, he is discharged with a little sprinkling of water; otherwise he is heartily drenched with streams of water poured upon him; and the ship boys are enclosed in a cage, and ducked at discretion.—The seamen, on the baptizing a ship, pretend to a right of cutting off the beak-head unless redeemed by the captain.

BAPTISMAL, something belonging to baptism; thus we say baptismal vow, presents, &c.

Baptismal Vow or *Covenant*, a profession of obedience to the laws of Christ, which persons in the ancient church made before baptism. It was an indispensable

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pensable part of the obligation on catechumens before they were admitted to the ceremony of regeneration. It was made by turning to the east; for what mystical reasons, is not well agreed on.

Baptismal Presents are in use in Germany, made by the sponsors to the infant, consisting of money, plate, or even sometimes fiefs of lands; which by the laws of the country are to be kept for the child till of age, the parents having only the trust, not the right, of disposing of them. An anonymous author has published a discourse express on this occasion, entitled, *De pecunia lustrica.*

BAPTIST, John Monnoyer, a painter of flowers and fruit, was born at Lisle in 1635, and educated at Antwerp, where he perfected himself in the knowledge of his art, and in his first years was intended for a painter of history: but having soon observed that his genius more strongly inclined him to the painting of flowers, he applied his talents to those subjects, and in that style became one of the greatest masters. His pictures are not so exquisitely finished as those of Van Huysum, but his composition and colouring are in a bolder style. His flowers have generally a remarkable freedom and looseness, as well in the disposition as in the penciling; together with a tone of colouring that is lively, admirable, and nature itself. The disposition of his objects is surprisingly elegant and beautiful; and in that respect his compositions are easily known, and as easily distinguished from the performances of others. He died in 1699.—He left a son, Anthony, who painted flowers in the same style and manner, and had great merit.

BAPTISTS, in ecclesiastical history, (from βαπτίζω, *I baptize*); a denomination of Christians, distinguished from other Christians by their particular opinions respecting the mode and the subjects of baptism.

Instead of administering the ordinance by sprinkling or pouring water, they maintain that it ought to be administered only by immersion. Such, they insist, is the meaning of the word βαπτίζω; so that a command to baptize is a command to immerse. Thus it was understood by those who first administered it. John the Baptist, and the apostles of Christ, administered it in Jordan and other rivers and places where there was much water. Both the administrators and the subjects are described as going down into, and coming up again out of, the water; and the baptized are said to be buried in baptism, and to be raised again: which language could not, they say, be properly adopted on supposition of the ordinance being administered in any other manner than by immersion. Thus also, they affirm, it was in general administered in the primitive church. Thus it is now administered in the Russian and Greek church: and thus it is, at this day, directed to be administered in the church of England, to all who are thought capable of submitting to it in this manner. With regard to the subjects of baptism, the Baptists say, that this ordinance ought not to be administered to children or infants at all, nor to grown up persons in general; but to adults only of a certain character and description. Our Saviour's commission to his apostles, by which Christian baptism was instituted, is to go and teach all nations, baptizing them: that is, say they, not to baptize all they meet with; but first to instruct them—to teach all nations, or to preach the gospel to every creature—and whoever receives it, him to baptize in the name of the Father, and of the Son, and of the Holy Ghost. To such persons, and to such only, baptism appears to have been administered by the apostles, and the immediate disciples of Christ. They are described as repenting of their sins, as believing in Christ, and as having gladly received the word. Without these qualifications, Peter acquaints those who were converted by his sermon, that he could not have admitted them to baptism. Philip holds the same language in his discourse with the eunuch; and Paul treats Lydia, the jailor, and others, in the same manner. Without these qualifications, Christians in general think it wrong to admit persons to the Lord's supper; and, for the same reasons, without these qualifications, at least a profession of them, the Baptists think it wrong to admit any to baptism. Wherefore they withhold it, not only from the impenitently vicious and profane, and from infidels who have no faith; but also from infants and children, who have no knowledge, and are incapable of every action civil and religious. They further insist, that all positive institutions depend entirely upon the will and declaration of the institutor: and therefore, that reasoning by analogy from abrogated Jewish rites is to be rejected, and the express commands of Christ respecting the mode and subjects of baptism ought to be our only rule.

The Baptists in England form one of the denominations of Protestant dissenters. They separate from the establishment for the same reasons as their brethren of the other denominations do; and from additional motives derived from their particular tenets respecting baptism. The constitution of their churches, and their modes of worship, are congregational or independent: in the exercise of which they are protected, in common with other dissenters, by the act of toleration. Before this act, they were liable to pains and penalties as nonconformists, and often for their peculiar sentiments as Baptists. A proclamation was issued out against them, and some of them were burnt in Smithfield in 1538. They bore a considerable share in the persecutions of the last and of the preceding centuries; and, as it should seem, in those of some centuries before; for there were several among the Lollards and the followers of Wickliff, who disapproved of infant baptism. There were many of this persuasion among the Protestants and reformers abroad. In Holland, Germany, and the North, they went by the names of Anabaptists, and Mennonites; and, in Piedmont and the south, they were found among the Albigenses and Waldenses. See the histories of the Reformation and the above articles in this Dictionary.

The *Baptists* subsist under two denominations, viz. the *Particular* or Calvinistical, and the *General* or Arminian. The former is by far the most numerous. Some of both denominations allow of *mixed communion*, viz. of persons who have been sprinkled in their infancy, and therefore unbaptized in the view of the Baptists; others disallow it; and some of them observe the seventh day of the week as the Sabbath, apprehending the law that enjoined it not to have been repealed by Christ or his apostles. But a difference of opinion respecting these

and

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and other matters, is not peculiar to the Baptists: it is common to all Christians, and to all bodies of men who think and judge for themselves.

BATISTERY, in ecclesiastical writers, a place in which the ceremony of baptism is performed.

In the ancient church it was one of the exedræ or buildings distinct from the church itself: and consisted of a porch or anti-room where the persons to be baptized made their confession of faith, and an inner room where the ceremony of baptism was performed. Thus it continued till the sixth century, when the baptisteries began to be taken into the church-porch, and afterwards into the church itself.

The ancient baptisteries were commonly called φωτιστηρια, *photisteria*, q..d. places of illumination; an appellation sometimes given to baptism. Or they might have the name for another reason, because they were the places of an illumination, or instruction, preceding baptism: for here the catechumens seem to have been trained up, and instructed in the first rudiments of the Christian faith.

Those baptisteries were anciently very capacious: because, as Dr Cave observes, the stated times of baptism returning but seldom, there were usually great multitudes to be baptized at the same time: and then the manner of baptizing, by immersion, or dipping under water, made it necessary to have a large font likewise. In *Venantius Fortunatus*, it is called *aula baptismatis*, the large hall of baptism; which was indeed so capacious, that we sometimes read of councils meeting and sitting therein. This hall, or chapel, was always kept shut during Lent, and the door sealed up with the bishop's seal, not to be opened till Maunday-Thursday.

The baptistery was always reputed a sacred place. In the Roman order, we find the ceremonies used in the consecration of the baptisteries: they were to be built of a round figure, and distinguished with the image of St John the Baptist; over the basen or font was a figure of a dove in gold or silver, to represent the Holy Ghost.

The name *baptistery* is sometimes also given to a kind of chapel in a large church, which served for the same office. It is an observation of some learned men, that anciently there was but one baptistery in a city, and that at the bishop's church; and that afterwards they were set up in parish churches, with the special allowance however of the bishop.

BAR, in a general sense, denotes a slender piece of wood or iron, for keeping things close together.

BAR, in courts of justice, an enclosure made with a strong partition of timber, where the counsel are placed to plead causes. It is also applied to the benches where the lawyers or advocates are seated, because anciently there was a bar to separate the pleaders from the attorneys and others. Hence our lawyers who are called to the bar, or licensed to plead, are termed *barristers*, an appellation equivalent to *licentiate* in other countries.

BAR, or *Barr*, (Latin *barra*, and in French *barre*), in a legal sense, is a plea or peremptory exception of a defendant, sufficient to destroy the plaintiff's action. And it is divided into bar to common intendment, and bar special; bar temporary, and perpetual. Bar to a common intendment is an ordinary or general bar, which usually disableth the declaration of the plaintiff; bar special is that which is more than ordinary, and falls out upon some special circumstance of the fact as to the case in hand. Bar temporary is such a bar as is good for the present, but may afterwards fail; and bar perpetual is that which overthrows the action of the plaintiff for ever.

BAR, in *Heraldry*, an ordinary in form of the fess, but much less. See HERALDRY.

BAR, in the manege, the highest part of that place of a horse's mouth situated between the grinders and tushes, so that the part of the mouth which lies under and at the side of the bars retains the name of the gum. A horse with sensible bars has a fine light mouth, with an even and firm appui. See APPUI.

To BAR a Vein, in *Farriery*, is an operation performed upon the veins of the legs of a horse and other parts, with intent to stop the malignant humours. It is done by opening the skin above it, disengaging it, and tying it both above and below, and striking between the two ligatures.

BAR, in *Music*, a stroke drawn perpendicularly across the lines of a piece of music, including between each two a certain quantity or measure of time, which is various as the time of the music is either triple or common. In common time, between each two bars is included the measure of four crotchets; in triple, three. The principal use of bars is to regulate the beating of time in a concert. The use of bars is not to be traced higher than the time when the English translation of Adrian le Roy's book on the Tablature was published, viz. the year 1574; and it was some time after that before the use of bars became general. To come nearer to the point, Barnard's cathedral music, printed in 1641, is without bars; but bars are to be found throughout in the *Ayres and Dialogues* of Henry Lawes published in 1653; from whence it may be conjectured that we owe to Lawes this improvement.

BAR, in *Hydrography*, denotes a bank of sand, or other matter, whereby the mouth of a river is in a manner choked up.

The term *bar* is also used for a strong beam wherewith the entrance of a harbour is secured: this is more commonly called *boom*.

BAR of a tavern or coffeehouse, the place where the waiters attend to answer the calls of the customers.

BAR, among printers, denotes a piece of iron with a wooden handle, whereby the screw of the press is turned in printing. See PRINTING.

BARS of Iron, are made of the metal of the sows and pigs as they come from the furnace. These pass through two forges, called the *finery* and the *chaufery*; where, undergoing five several heats, they are formed into bars.

BAR, a very strong city of Podolia in Poland, upon the river Kiow. E. Long. 28. 30. N. Lat. 50. 6.

BAR, formerly a duchy of France, now the department of Meuse, is bounded on the east by Lorrain, on the north by Luxembourg, on the west by Champagne, on the south by part of the same country, and by Franche Compte. It is crossed by the river Meuse from north to south, and watered by several other rivers, which render it very fertile. It was divided into four balliages, viz. Bassilyni, Bar, St Michael, and

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and Clermont. The chief towns are Bar-le-duc, Clermont, St Michael, Longuey, Pont à Mousson, and Stenay. In 1736, it was given to Stanislaus then king of Poland.

Bar le-duc, the capital of the late duchy of Bar, in the department of Meuse, is seated on the declivity of a hill. It is divided into the higher and lower town: the lower is watered by the rivulet Orney, which abounds with excellent trouts. The wines are excellent, and not inferior to those of Champagne. E. Long. 5. 30. N. Lat. 48. 35.

Bar-le-Mont, a town of France, in the department of the North, situated on the river Sambre. E. Long. 3. 40. N. Lat. 50. 10.

Bar sur Aube, an ancient town of France, in the department of Aube, seated at the foot of a mountain. It is much celebrated for excellent wines. E. Long. 4. 50. N. Lat. 48. 14.

Bar sur Seine, a town of France, in the duchy of Burgundy, now in the department of Aube, seated between a mountain which covers it on the west, and the river Seine which runs on the east. E. Long. 4. 30. N. Lat. 48. 5.

Bar-Master, among miners, the person who keeps the gauge, or dish, for measuring the ore.

BARA, in *Ancient Geography*, a small island in the Adriatic, opposite to Brundusium: the *Pharos* of Mela. Also a frith or arm of the sea of Britannia Secunda (Ptolemy); supposed to be the Murray frith.

Bara, one of the Hebrides or Western islands of Scotland. It is a small rock, only a quarter of a mile in circumference, being part of a chain called the *Long Island*, the whole cluster appearing at low water as one island. Bara is altogether barren; but abounds with great numbers of sea-fowl, such as solan geese, guillamotes, puffins, &c.

Bara, the name of a festival celebrated with much magnificence at Messina, and representing the assumption of the Virgin. The *bara*, though used as the general denomination of this festival, signifies more particularly a vast machine 50 feet high, at the top of which a young girl of 14, representing the Virgin, stands upon the hand of an image of Jesus Christ.

Houel's Descriptive Travels through Sicily, &c.

Round him turn vertically, in a circle, 12 little children which represent the seraphims; below them, in another circle, which turns horizontally, are 12 more representing the cherubims: below these a sun turns vertically, with a child at the extremity of each of the four principal *radii* of his circle, who ascend and descend with his rotation, yet still stand upright. Below the sun is the lowest circle, about seven feet from the ground, in which 12 boys turn horizontally without interruption; these are intended for the twelve apostles, who are supposed to surround the tomb of the Virgin at the moment when she ascends into heaven. This complication of superstitious whirligigs may have already nearly turned the stomachs of some of our readers, or at least rendered them squeamish. But think of the poor little cherubims, seraphims, and apostles, who are twirled about in this procession! for, says Mr Houel, some of them fall asleep, many of them vomit, and several do still worse: but these unseemly effusions are no drawback upon the edification of the people; and nothing is more common than to see fathers and mothers soliciting with ardour for their boys and girls the pious distinction of puking at the bara. This machine is not drawn by asses or mules, but by a multitude of robust monks.

BARABINZIANS, a tribe of Tartars, living on both sides of the river Irtis. They seem to derive their name from the *Barabaian* desert, whose lakes supply them abundantly with fish, on which and their cattle they chiefly subsist. They have plenty of game and wild-fowl of every kind, particularly ducks and puffins. Most of them are heathens, but Mahometanism daily gains ground among them. Some of them pay tribute to the empress of Russia, and others to the Khan Taisha.

BARACOA, a town in the north-east part of the island of Cuba. W. Long. 74. 50. N. Lat. 20. 25.

BARALIPTON, among logicians, a term denoting the first indirect mode of the first figure of syllogism. A syllogism in baralipton, is when the two first propositions are general, and the third particular, the middle term being the subject in the first proposition and the predicate in the second. The following is of this kind.

> Ba. Every evil ought to be feared;
> ra. Every violent passion is an evil;
> lip. Therefore something that ought to be feared is a violent passion.

BARALLOTS, in *Church History*, a sect of heretics at Bologna in Italy, who had all things in common, even their wives and children. Their facility in complying with all manner of debauchery made them get the name *obedientes*, "compliers."

BARANCA de malambo, a town of Terra Firma in America, with a bishop's see and a good haven. It is a place of great trade, and is seated on the river Magdaline. W. Long. 75. 30. N. Lat. 11. 10.

BARANGI, officers among the Greeks of the lower empire. Cujas calls them in Latin *protectores*, and others give them the name of *securigeri*. It was their business to keep the keys of the city gates, where the emperor resided.

BARANWAHR, a town of Lower Hungary, in a county of the same name, taken by the emperor of Germany from the Turks in 1684. It is seated between Buda and Belgrade, in E. Long. 18. 5. N. Lat. 46. 0.

BARATHRUM, in antiquity, a deep dark pit at Athens, into which condemned persons were cast headlong. It had sharp spikes at the top, that no man might escape out; and others at the bottom, to pierce and torment such as were cast in. Its depth and capaciousness made it to be applied proverbially to a covetous person: to a glutton, called *Barathro* by the Romans (Lucretius, Horace); and *Barathrum* in the same sense (Horace); and for a common prostitute (Plautus).

BARATIERE, Philip, a most extraordinary instance of the early and rapid exertion of mental faculties. This surprising genius was the son of Francis Baratiere, minister of the French church at Schwobach near Nuremberg, where he was born Jan. 10. 1721. The French was his mother tongue, together with some words of High Dutch; but by means of his father insensibly talking Latin to him, it became as familiar to him as the rest: so that, without knowing the rules of grammar, he at four years of age talked French to his mother,

mother, Latin to his father, High Dutch to the maid or neighbouring children; and all this without mixing or confounding the respective languages. About the middle of his fifth year he acquired Greek in like manner; so that in 15 months he perfectly understood all the Greek books in the Old and New Testament, which he readily translated into Latin. When he was five years and eight months old, he entered upon Hebrew; and in three years time was so expert in the Hebrew text, that from a bible without points, he could give the sense of the original in Latin or French; or translate extempore the Latin or French versions into Hebrew, almost word for word; and had all the Hebrew psalms by heart. He composed at this time a dictionary of rare and difficult Hebrew words, with critical remarks and philological observations, in about 400 pages in 4to; and, about his tenth year, amused himself for twelve months with the Rabbinical writers. With these he intermixed a knowledge of the Chaldaic, Syriac, and Arabic; and acquired a taste for divinity and ecclesiastical antiquity, by studying the Greek fathers, and councils of the first four ages of the church. In the midst of these occupations, a pair of globes coming into his possession, he could in 8 or 10 days time resolve all the problems on them; and in about three months, in Jan. 1735, devised his project for the discovery of the longitude, which he communicated to the Royal Society at London and the Royal Academy of Sciences at Berlin. In June 1731, he was matriculated in the university of Altorf; and at the close of the year 1732, he was presented by his father at the meeting of the reformed churches of the circle of Franconia; who, astonished at his wonderful talents, admitted him to assist in the deliberations of the synod; and to preserve the memory of so singular an event, it was ordered to be registered in their acts. In 1734, the margrave of Brandenburg Auspach granted this young scholar the use of whatever books he wanted from the Anspach library, together with a pension of 50 florins, which he enjoyed three years; and his father receiving a call from the French church at Stetin in Pomerania, young Baratiere was, on the journey, admitted master of arts, with universal applause, at the university of Hall: at Berlin he was honoured with several conversations with the king of Prussia, and was received into the Royal Academy. Towards the close of his life he acquired a taste for medals, inscriptions, and antiquities; metaphysical inquiries, and experimental philosophy, intervening occasionally between these studies. He wrote several essays and dissertations; made astronomical remarks, and laborious calculations; took great pains toward a history of the heresies of the anti-trinitarians, and of the 30 years war in Germany: his last publication, which appeared in 1740, was on the succession of the bishops of Rome. The final work he engaged in, and for which he had gathered large materials, was *Inquiries concerning the Egyptian Antiquities*. But the substance of this blazing meteor was now almost exhausted: he was always weak and sickly; and died October 5. 1740, aged 19 years 8 months and 16 days. He published 11 different pieces, and left 29 manuscripts on various subjects, the contents of which may be seen in his life written by M. Formey professor of philosophy at Berlin.

BARATZ, (*Turkish*), letters-patent granted by the Turkish emperors to the Greek patriarch, bishops, &c. for the exercise of their ecclesiastical functions. This *Baratz* gives the bishops full power and authority to establish and depose the inferior clergy, and all other religious persons; to grant licenses for marriages, and issue out divorces; to collect the revenues belonging to the churches; to receive the pious legacies bequeathed to them; in short, to enjoy all the privileges and advantages belonging to their high station; and all this (as it is expressed in the baratz itself) "according to the vain and idle ceremonies of the Christians."

BARB, or BARBE, a horse brought from Barbary. See EQUUS, MAMMALIA *Index*.

BARBA, in *Botany*, a species of *pubes*, or down, with which the surface of some plants is covered. The term was invented by Linnæus; and by its application in the *Species Plantarum*, seems to signify a tuft or bunch of strong hairs terminating the leaves. *Mesembryanthemum barbatum* furnishes an example.

The word is also often used in composition with some other, to form the trivial names of several plants, as *barba jovis*, *barba capræ*, &c.

BARBACAN, or BARBICAN, an outer defence or fortification to a city or castle, used especially as a fence to the city or walls; also an aperture made in the wall of a fortress, to fire through upon the enemy. See CASTLE.

BARBACAN is also used to denote a fort at the entrance of a bridge, or the outlet of a city, having a double wall with towers.

BARBADOES, the most easterly of all the Caribbee islands, subject to Great Britain, and according to the best geographers, lying between 59° 50′ and 60° 2′ of west longitude, and between 12° 56′ and 13° 16′ of north latitude. It lies 20 leagues east from St Vincent, which may be seen in a clear day. It is 21 miles in length and 14 in breadth; but these mensurations are subject to so many uncertainties, that it will perhaps convey a more adequate idea of this island, to tell the reader that in reality it does not contain above 107,000 acres. The climate is hot, but not unwholesome, the heat being qualified by sea-breezes; and a temperate regimen renders this island as safe to live in as any climate south of Great Britain; and, according to the opinion of many, as even Great Britain itself. The island has on its east side two streams that are called rivers, and in the middle is said to have a bituminous spring which sends forth a liquor like tar, which serves for the same uses as pitch or lamp-oil. The island abounds in wells of good water, and has several reservoirs for rain-water. Some parts of the soil are said to be hollowed into caves, some of them capable of containing 300 people. These are imagined to have been the lurking-places of runaway negroes, but may as probably be natural excavations. The woods that formerly grew upon the island have been all cut down, and the ground converted into sugar plantations. When those plantations were first formed, the soil was prodigiously fertile, but has since been worn out, insomuch, that about the year 1730, the planters were obliged to raise cattle for the sake of their dung, by which means the profit of their plantations was reduced to less than a tenth of its usual value. Notwithstanding the smallness of Barbadoes, its soil is different;

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Barbadoes. different; being in some places sandy and light, in others rich, and in others spongy; but all of it is cultivated according to its proper nature, so that the island presents to the eye the most beautiful appearance that can be imagined. Oranges and lemons grow in Barbadoes in great plenty, and in their utmost perfection. The lemon juice here has a peculiar fragrancy. The citrons of Barbadoes afford the best drams and sweetmeats of any in the world, the Barbadoes ladies excelling in the art of preserving the rind of the citron fruit. The juice of the limes, or dwarf-lemons, is the most agreeable souring we know, and great quantities of it have of late been imported into Britain and Ireland. The pine apple is also a native of Barbadoes, and grows there to much greater perfection than it can be made to do in Europe by any artificial means. A vast number of different trees peculiar to the climate are also found to flourish in Barbadoes in great perfection; such as the aloe, mangrove, calabash, cedar, cotton, mastich, &c. Here likewise are produced some sensitive plants, with a good deal of garden stuff, which is common in other places. In short, a native of the finest, the richest, and most diversified country in Europe, can hardly form an idea of the variety of delicious and at the same time nutritive vegetable productions with which this island abounds.

When Barbadoes was first discovered by the English, few or no quadrupeds were found upon it, except hogs, which had been left there by the Portuguese. For convenience of carriage to the sea side, some of the planters at first procured camels; which undoubtedly would in all respects have been preferable to horses for their sugar and other works; but the nature of the climate disagreeing with that animal, it was found impossible to preserve the breed. They then applied for horses to Old and New England: from the former they had those that were fit for show and draught; from the latter those that were proper for mounting their militia, and for the saddle. They had likewise some of an inferior breed from Curassoa, and other settlements. They are reported to have had their first breed of black cattle from Bonavista and the isle of Mayo; they now breed upon the island, and often do the work of horses. Their asses are very serviceable in carrying burdens to and from the plantations. The hogs of Barbadoes are finer eating than those of Britain, but the few sheep they have are not near so good. They likewise have goats, which when young are excellent food. Racoons and monkeys are also found here in great abundance. A variety of birds are produced in Barbadoes, of which the humming bird is the most remarkable. Wild fowl do not often frequent this island: but sometimes teal are found near their ponds. A bird which they call the *man of war*, is said to meet ships at 20 leagues from land, and their return is, to the inhabitants, a sure sign of the arrival of these ships. When the wind blows from the south and south-west, they have flocks of curlews, plovers, snipes, wild pigeons, and wild ducks. The wild pigeons are very fat and plentiful at such seasons, and rather larger than those of England. The tame pigeons, pullets, ducks, and poultry of all kinds, that are bred at Barbadoes, have also a fine flavour, and are accounted more delicious than those of Europe. Their rabbits are scarce; they have no hares; and if they have deer of any kind, they are kept as curiosities. Barbadoes. The insects of Barbadoes are not venomous, nor do either their snakes or scorpions ever sting. The musketoes are troublesome, and bite, but are more tolerable in Barbadoes than on the continent. Various other insects are found on the island, some of which are troublesome, but in no greater degree than those that are produced by every warm summer in England. Barbadoes is well supplied with fish; and some caught in the sea surrounding it are almost peculiar to itself; such as the parrot-fish, snappers, gray cavallos, terbums, and coney-fish. The mullets, lobsters, and crabs, caught here are excellent; and the green turtle is perhaps the greatest delicacy that ancient or modern luxury can boast of. At Barbadoes this delicious shell-fish seldom sells for less than a shilling a pound, and often for more. There is found in this island a kind of land crab, which eats herbs wherever it can find them, and shelters itself in houses and hollows of trees. According to report, they are a shell-fish of passage; for in March they travel to the sea in great numbers. See CANCER.

The inhabitants may be reduced to three classes; viz. the masters, the white servants, and the blacks. The former are either English, Scots, or Irish: but the great encouragement given by government to the peopling this and other West Indian islands, induced some Dutch, French, Portuguese, and Jews, to settle among them with their estates; by which, after a certain time, they acquire the rights of naturalization in Great Britain. The white servants, whether by covenant or purchase, lead more easy lives than the day-labourers in England; and when they come to be overseers, their wages and other allowances are considerable. As to the treatment of the negro slaves in this and the other islands, that falls to be spoken of under the articles NEGRO, SLAVE, WEST-INDIES; which see. The manners of the white inhabitants, in general, are the same as in most polite towns and countries in Europe. The capital of the island is called *Bridge-Town*; see that article.

As the history of this island furnishes no very remarkable events, the following short hints concerning it may suffice.

When the English, some time after the year 1625, first landed here, they found it the most savage and destitute place they had hitherto visited. It had not the least appearance of ever having been peopled even by savages. There was no kind of beasts of pasture or of prey, no fruit, no herb, no root fit for supporting the life of man. Yet as the climate was so good, and the soil appeared fertile, some gentlemen of small fortune in England resolved to become adventurers thither. The trees were so large, and of a wood so hard and stubborn, that it was with great difficulty they could clear as much ground as was necessary for their subsistence. By unremitting perseverance, however, they brought it to yield them a tolerable support; and they found that cotton and indigo agreed well with the soil; and that tobacco, which was beginning to come into repute in England, answered tolerably. These prospects, together with the storm between the king and parliament, which was beginning to break out in England, induced many new adventurers to transport themselves into this island. And what is extremely

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tremely remarkable, so great was the increase of people in Barbadoes, 25 years after its first settlement, that in 1650 it contained more than 50,000 whites, and a much greater number of negro and Indian slaves. The latter they acquired by means not at all to their honour: for they seized upon all those unhappy men, without any pretence, in the neighbouring islands, and carried them into slavery; a practice which has rendered the Caribbee Indians irreconcilable to us ever since. They had begun a little before this to cultivate sugar, which soon rendered them extremely wealthy. The number of slaves, therefore, was still augmented; and in 1676 it is supposed that their number amounted to 100,000, which, together with 50,000 whites, make 150,000 on this small spot: a degree of population unknown in Holland, in China, or any other part of the world most renowned for numbers. Their annual exports, in sugar, indigo, ginger, cotton, and citron-water, were above 350,000l. and their circulating cash at home was 200,000l. Such was the increase of population, trade, and wealth, in the course of 50 years. But these accounts are supposed by Mr Bryan Edwards to be greatly exaggerated. But since that time this island has been much on the decline; which is to be attributed partly to the growth of the French sugar colonies, and partly to their own establishments in the neighbouring isles. Their numbers in 1811 were 16,289 whites, 62,258 slaves, and 3392 free persons of colour. The official value of the exports in 1810 was 271,597l. and of the imports 311,400l.

Barbadoes-Tar, a mineral fluid of the nature of the thicker fluid bitumens, of a nauseous bitterish taste, very strong and disagreeable smell, found in many parts of America trickling down the sides of the mountains, and sometimes floating on the surface of the waters. It has been greatly recommended in coughs and other disorders of the breast and lungs.

BARBARA, among logicians, the first mode of the first figure of syllogisms. A syllogism in barbara is one whereof all the propositions are universal and affirmative; the middle term being the subject of the first proposition, and attribute in the second.

Examp. Bar. Every wicked man is miserable;
Ba. All tyrants are wicked men;
Ra. Therefore all tyrants are miserable.

BARBARIAN, a name given by the ancient Greeks and Romans to all who were not of their own country, or were not initiated in their language, manners, and customs. In this sense, the word signified with them no more than foreigner; not signifying, as among us, a wild, rude, or uncivilized person.

BARBARISM, in a general sense, a rudeness of language or behaviour.

Barbarism, in *Grammar*, an offence against the purity of style or language; or an ungrammatical way of speaking or writing, contrary to the true idiom of any particular language.

BARBAROSSA, Aruch, and Hayradin, two famous corsairs, the sons of a potter in the isle of Lesbos; who, turning pirates, carried on their depredations with such success and conduct, that they were soon possessed of 12 galleys besides smaller vessels. Of this fleet Aruch the elder brother, called *Barbarossa* from the redness of his beard, was admiral, and Hayradin the second in command: they called themselves the *friends of the sea*, and the *enemies of all who sailed upon it*; and their names became terrible from the straits of Dardanelles to those of Gibraltar. With such a power they wanted an establishment; and the opportunity of settling themselves offered in 1516, by the inconsiderate application of Eutemi king of Algiers to them for assistance against the Spaniards. Aruch, leaving his brother to command the fleet, carried 5000 men to Algiers, where he was received as their deliverer; and secretly murdering the prince he came to aid, caused himself to be proclaimed king in his stead. To this usurpation he added the conquest of Tremecen; when his exploits and piracies induced the emperor Charles V. to furnish the marquis de Gomarez, governor of Oran, with troops to suppress him; by whom he was defeated and killed near Tremecen. His brother Hayradin, known also by the name of *Barbarossa*, assumed the sceptre at Algiers with the same abilities, and with better fortune; for the Spaniards, sufficiently employed in Europe, giving him no disturbance, he regulated the interior police of his kingdom with great prudence, carried on his naval operations with vigour, and extended his conquests on the continent of Africa. He put his dominions under the protection of the Grand Signior, Solyman the Magnificent; and obtained the command of the Turkish fleet. With so powerful a protector, he acquired the kingdom of Tunis in a manner similar to that by which his brother gained Algiers. Since the time of the Barbarossas, Algiers has been understood to be dependent on the Porte; but this dependence is now little more than merely nominal.

BARBARUS, Francis, a noble Venetian, was a man of great fame in the 15th century, not only for learning, but likewise for a skilful address in the management of public affairs. He is author of a book *De Re Uxoria*, and some speeches.

Barbarus, *Hermolaus*, grandson of the preceding, one of the most learned men in the 15th century. The public employments he was intrusted with early, did not prevent him from cultivating polite learning with great application. As he was very skilful in the Greek, he undertook the most difficult translations, and began with a famous paraphrase upon Aristotle. He then attempted Dioscorides, whose text he corrected, gave a translation of him, and added a commentary. But of all his works, there is none which has gained him so much reputation as that which he made upon Pliny; he corrected in him above 5000 passages, and occasionally restored 300 in Pomponius Mela. Pope Innocent VIII. to whom he was ambassador, conferred the patriarchate of Aquileia upon him. He was so imprudent as to accept of it without waiting for the consent of his superiors; though he could not be ignorant that the republic of Venice had made laws to forbid all the ministers they sent to the court of Rome to accept any benefice. His superiors were inflexible; and not being able to gain any thing upon them either by his flattery or his father's interest, the father died of grief, and the son soon followed him.

Barbarus, *Daniel*, of the same family with the preceding, was patriarch of Aquileia, and famous for his learning. He was ambassador from Venice to England;

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land; and was one of the fathers of the council of Trent, where he acted with great zeal for the interest of the pope. He wrote, 1. A commentary on Vitruvius. 2. *Catena Græcorum Patrum in quinquaginta Psalmos Latinè Versa.* 3. *La Pratica della Perspectiva.* He died in 1569, at 41 years of age.

BARBARY, a region of Africa, including the states of *Algiers*, *Morocco*, *Tripoli*, and *Tunis;* (see those articles). This country contains almost the whole of

1 Extent, &c.

what the Romans possessed of the continent of Africa, excepting Egypt. It stretches itself in length from east to west, beginning at the southern limits of Egypt, to the straits of Gibraltar, full 35 degrees of longitude; and from thence to Santa Cruz, the utmost western edge of it, about six more, in all 41 degrees; so that the utmost length of Barbary from east to west is computed at above 759 German leagues. On the south, indeed, it is confined within much narrower bounds, extending no farther than from 27 to 35½ degrees of north latitude; so that its utmost breadth, from north to south, does not exceed 128 German miles. More particularly, Barbary begins on the west of the famed Mount Atlas, called by the Arabs *Ay Duacal*, or *Al Duacal*, enclosing the ancient kingdoms of Suez and Dela, now provinces of Morocco; thence stretching north-eastward along the Atlantic to the pillars of Hercules at Cape Finisterre, then along the coast of the Mediterranean, it is at last bounded by the city of Alexandria in Egypt.

2 Whence named.

Concerning the origin of the name *Barbary*, there are many conjectures. According to some, the Romans, after they had conquered this large country, gave it that name out of contempt and dislike to the barbarous manners of the natives, according to their custom of calling all other people but themselves *Barbarians*. Marmol, on the contrary, derives the word *Barbary* from *Berber*, a name which the Arabs gave to its ancient inhabitants, and which they retain to this day in many parts of the country, especially along the great ridge of the mountains of Atlas; and which name was given them on account of the barrenness of their country. According to Leo Africanus, the name of Barbary was given by the Arabs on account of the strange language of the natives, which appeared to them more like a murmur or grumbling of some brute animals than articulate sounds. Others, however, derive it from the Arabic word *bar*, signifying a desert, twice repeated; which was given by one *Ifric*, or *Africus*, a king of Arabia, from whom the whole continent of Africa is pretended to have taken its name. According to them, this king being driven out of his own dominions, and closely pursued by his enemies, some of his retinue called out to him *Bar, Bar;* that is, *To the desert, To the desert;* from which the country was afterwards called *Barbary*.

3 Subject to the Romans.

Among the Romans this country was divided into the provinces of Mauritania, Africa Propria, &c. and they continued absolute masters of it from the time of Julius Cæsar till the year of Christ 428. At that time Bonifacius the Roman governor of these provinces, having through the treachery of Ætius been forced to

4 Bonifacius calls in the Vandals.

revolt, called in to his assistance Genseric king of the Vandals, who had been some time settled in Spain. The terms offered, according to Procopius, were, that Genseric should have two thirds, and Bonifacius one third, of Africa, provided they could maintain themselves against the Roman power; and to accomplish this they were to assist each other to the utmost.—This proposal was instantly complied with; and Genseric set sail from Spain in May 428, with an army of 80,000 men, according to some, or only 24,000 according to others, together with their wives, children, and all their effects. In the mean time, however, the empress Placidia having discovered the true cause of Bonifacius's revolt, wrote a most kind and obliging letter to him, in which she assured him of her favour and protection for the future, exhorting him to return to his duty, and exert his usual zeal for the welfare of the empire, by driving out the Barbarians whom the malice of his enemies had obliged him to call in for his own safety and preservation.

5 Endeavours unsuccessfully to persuade them to return.

Bonifacius readily complied with this request, and offered the Vandals considerable sums if they would retire out of Africa and return to Spain. But Genseric, already master of the greatest part of the country, first returned a scoffing answer, and then, falling unexpectedly on him, cut most of his men to pieces, and obliged Bonifacius himself to fly to Hippo, which place he invested in May 430. The siege lasted till the month of July the following year; when the Vandals were forced, by a famine that began to rage in their camp, to drop the enterprise, and retire. Soon after, Bonifacius having received two reinforcements, one from Rome, and the other under the conduct of the celebrated Aspar, from Constantinople, a resolution was taken by the Roman generals to offer the enemy

6 Romans defeated by Genseric king of the Vandals.

battle. The Vandals readily accepting the challenge, a bloody engagement ensued, in which the Romans were utterly defeated, a prodigious number of them taken, and the rest obliged to shelter themselves among the rocks and mountains. Aspar, who commanded the eastern troops, escaped with difficulty to Constantinople, and Bonifacius was recalled to Italy. Upon their departure, the Vandals overran all Africa, committing everywhere the most terrible ravages; which struck the inhabitants of Hippo with such terror, that they abandoned their city, which was first plundered, and then set on fire by the victorious enemy; so that Cirtha and Carthage were now the only strong places possessed by the Romans.

7 Peace concluded with the Vandals.

In 435, Genseric, probably being afraid of an attack by the united forces of the eastern and western empires, concluded a peace with the Romans, who yielded to him part of Numidia, the province of Proconsularis, and likewise Byzancene; for which, according to Prosper, he was to pay a yearly tribute to the emperor of the east. Genseric delivered up his son Hunneric by way of hostage; but so great was the confidence which the Romans placed in this barbarian, that some time after they sent him back his son. Of this they soon had reason to repent; for in 439, the Romans being engaged in a war with the Goths in Gaul,

8 Genseric's treachery.

Genseric laid hold of that opportunity to seize upon the city of Carthage; by which he considerably enlarged his African dominions. Valentinian, the Roman emperor, however, maintained as long as he lived the two Mauritanias, with Tripolitana, Tingitana, and that part of Numidia where Cirtha stood.

On the taking of Carthage, Genseric made it the seat of his empire; and in 440 made a descent on the

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Barbary.

island of Sicily, where he ravaged the open country, and even laid siege to Palermo. Not being able, however, to reduce that place, he soon returned to Africa with an immense booty and a vast number of captives. Being now become formidable to both empires, Theodosius emperor of the east resolved to assist Valentinian against so powerful an enemy. Accordingly, he fitted out a fleet consisting of 1100 large ships; and putting on board of it the flower of his army, under the conduct of Arcovindas, Ansilas, and Germanus, he ordered them to land in Africa, and joining the western forces there, to drive Genseric out of the countries he had seized. But Genseric in the mean time pretending a desire to be reconciled with both empires, amused the Roman general with proposals for peace, till the season for action was over; and, next year, Theodosius being obliged to recal his forces to oppose the Huns, Valentinian found it necessary to conclude a peace with the Vandals; and this he could obtain on no other terms than yielding to them the quiet possession of the countries they had seized.

So powerful was Genseric now become, or rather so low was the Roman empire by this time reduced, that in 455 he took and plundered the city of Rome

9 Makes himself master of all the Roman provinces.

itself, as is fully related under the article ROME; and, after his return to Africa, made himself master of the remaining countries held by the Romans in that part of the world. Hereupon Avitus, who had succeeded Valentinian in the empire, despatched ambassadors to Genseric, putting him in mind of the treaty he had concluded with the empire in 442; and threatening, if he did not observe the articles at that time agreed upon, to make war upon him not only with his own forces, but with those of his allies the Vesigoths, who were ready to pass over into Africa. To this Genseric was so far from paying any regard, that he immediate-

10 Defeated by Ricimer and Majorianus.

ly put to sea with a fleet of 60 ships; but being attacked by the Roman fleet under Ricimer, he was utterly defeated, and forced to fly back into Africa: he returned, however, soon after with a more powerful fleet, committing great ravages on the coast of Italy; but in a second expedition he was not attended with so good success; the Romans falling unexpectedly upon his men while busied in plundering the country, put great numbers of them to the sword, and among the rest the brother-in-law of Genseric himself. Not content with this small advantage, Majorianus, at that time emperor, resolved to pass over into Africa, and attempt the recovery of that country. For this purpose he made great preparations; but his fleet being surprised and defeated by the Vandals, through the treachery, it is said, of some of his commanders, the enterprise miscarried.

Notwithstanding this misfortune, however, Majorianus persisted in his resolution; and would in all likelihood have accomplished his purpose, had not he himself been murdered soon after by Ricimer. After his death, Genseric committed what ravages he pleased in the poor remains of the western empire, and even made descents on Peloponnesus and the islands belonging to

11 Genseric defeats the eastern emperor's fleet.

the emperor of Constantinople. To revenge this affront, Leo made vast preparations for the invasion of Africa, insomuch, that, according to Procopius, he laid out 130,000 pounds weight of gold in the equipment of his army and navy. The forces employed on this occasion were sufficient for expelling the Vandals, had they been much more powerful than they were; but the command being given to Basiliscus, a covetous and ambitious man, the fleet was utterly defeated through his treachery, and all the vast preparations came to nothing. By this last defeat the power of the Vandals in Africa was fully established, and Genseric made himself master of Sicily, as well as of all the other islands between Italy and Africa, without opposition from the western emperors, whose power was entirely taken away in the year 476.

12 Kingdom of the Vandals founded.

Thus was the Vandalic monarchy in Barbary founded by Genseric, between the years 428 and 468. If we take a view of that prince's government in his new dominions, it presents no very agreeable prospect. Being

13 Barbarity and tyranny of Genseric.

himself an absolute barbarian in the strictest sense of the word, and an utter stranger to every useful art, he did not fail to show his own prowess by the destruction of all the monuments of Roman greatness which were so numerous in the country he had conquered. Accordingly, instead of improving his country, he laid it waste, by demolishing all the stately structures both public and private, and all other valuable and sumptuous works with which those proud conquerors had adorned this part of their dominions. So that, whatever monuments the Romans had been at such an immense expence to erect, in order to eternize their own glory, the barbarous Vandals were now at no less pains to reduce into heaps of ruins. Besides this kind of devastations, Genseric made his dominions a scene of blood and slaughter, by persecuting the orthodox Christians; being himself, as well as most of his countrymen, a zealous Arian; and for this his long reign is chiefly remarkable. He died in 477, after a reign of 60 years: and was succeeded by his son Hunneric.

14 Hunneric a bloody tyrant.

The new king proved yet a greater tyrant than his father, persecuting the orthodox with the utmost fury; and, during his short reign of seven years and a half, destroyed more of them than Genseric had done in all

15 His terrible death.

his lifetime. He is said to have died in the same manner as the heresiarch Arius *; before which time his flesh had been rotting upon his bones, and crawling with worms, so that he looked more like a dead carcase than a living man. Concerning his successors Gutamund, Thrasamund, and Hilderic, we find nothing remarkable, except that they sometimes persecuted, and sometimes were favourable to, the orthodox; and by his favour for them the last king was ruined. For, having unadvisedly published, in the beginning of his reign, a manifesto, wherein he repealed all the acts of his predecessors against the orthodox, a rebellion was the imme-

16 Hilderic deposed by Gilimer.

diate consequence. At the head of the malcontents was one Gilimer, or Gildemar, a prince of the blood-royal, who by degrees became so powerful, as to depose Hilderic in the seventh year of his reign; after which he caused the unhappy monarch, with all his family, to be closely confined, and was himself crowned king of the Vandals at Carthage.

Gilimer proved a greater tyrant than any that had gone before him. He not only cruelly persecuted the orthodox, but horribly oppressed all the rest, so that

17 Belisarius invades Africa;

he was held in universal abhorrence and detestation when the Greek emperor Justinian projected an invasion of Africa. This expedition of Justinian's is said to have

* See Arius.

have been occasioned by an apparition of Lætus an African bishop, who had been murdered some time before, but now commanded the emperor to attempt the recovery of Africa, and assured him of success. Accordingly, this, or some other motive, prevailed upon Justinian so far, that, notwithstanding his being at that time engaged in a war with Persia, he sent a powerful fleet and army to Africa, under the command of the celebrated general Belisarius, who was for that reason recalled from Persia.

So much was Gilimer, all this time, taken up with his own pleasures, or with oppressing his subjects, that he knew little or nothing of the formidable preparations that were making against him. On the arrival of Belisarius, however, he was constrained to put himself into a posture of defence. The management of his army he committed to his two brothers Gundimer and Gelamund, who accordingly attacked the Romans at the head of a numerous force. The engagement was

18 Belisarius defeats the Vandals.

long and bloody; but at last the Vandals were defeated, and the two princes slain. Gilimer, grown desperate at this news, sallied out at the head of his corps de reserve, with full purpose to renew the attack with the utmost vigour; but by his own indiscretion lost a fair opportunity of defeating the Romans. For no sooner did they perceive Gilimer hastening after them at the head of a fresh army, than they betook themselves to flight; and the greatest part were dispersed in such a manner, that, had the king followed them close, they must have been totally cut off. Instead of this, however, stumbling unfortunately on the body of one of his slain brothers, the sight of it made him lose all thoughts about the enemy; and instead of pursuing them, he spent part of his time in idle lamentation, and part in burying the corpse with suitable pomp and dignity. By this means Belisarius had an opportunity of rallying his men; which he did so effectually, that, coming unexpectedly upon Gilimer, he easily obtained a new and complete victory over him.

19 takes Carthage;

This defeat was followed by the loss of Carthage, which the barbarians had been at no pains to put into a posture of defence. After which Gilimer, having in vain endeavoured to obtain assistance from the Moors and Goths, was obliged to recal his brother Tzason from Sardinia. The meeting between the two brothers was very mournful; but they soon came to a resolution of making one desperate attempt to regain the lost kingdom, or at least recover their captives out of the hands of the enemy. The consequence of this resolution was another engagement, in which Tzason was killed with 800 of his choicest men, while the Romans lost no more than 50; after which Belisarius moving suddenly forward at the head of all his army, fell upon the camp of the Vandals. This Gilimer was no sooner apprised of, than, without staying to give any more orders to the rest of his army, he fled towards Numidia in the utmost consternation. His flight was not immediately known among his troops; but when it was, such an universal confusion ensued, that they abandoned their camp to the Romans, who had now nothing to do but plunder it; and not content with this, they massacred all the men found in it, carrying away the women captives.

20 and puts an end to the Vandalic monarchy.

Thus a total end was put to the power of the Vandals in Barbary, and the Romans once more became masters of this country. The Vandal inhabitants were permitted to remain as they were, on condition of exchanging the heresy of Arius for the orthodox faith. As for Gilimer, he fled with the utmost expedition to Medamus, a town situated on the top of the Pappuan mountain, and almost inaccessible by reason of its height and ruggedness. The siege of this place was committed to Pharas, an officer of great experience, who having shut up all avenues to the town, the un-

21 Gilimer's extreme distress.

happy Gilimer was reduced to the greatest straits for want of provisions. Pharas being soon apprised of the distress he was in, wrote him a most friendly and pathetic letter, earnestly exhorting him to put an end to the distress of himself and his friends by a surrender. This Gilimer declined; but at the same time concluded his answer with a most submissive request, that Pharas would so far pity his great distress as to send him a loaf of bread, a sponge, and a lute. This strange request greatly surprised Pharas; but at last it was explained by the messenger, who told him that the king had not tasted any baked bread since his arrival on that mountain, and earnestly longed to eat a morsel of it before he died: the sponge he wanted to allay a tumour that was fallen on one of his eyes; and the lute, on which he had learned to play, was to assist him in setting some elegiac verses he had composed on the subject of his misfortunes to a suitable tune. At this mournful report Pharas could not refrain from tears, and immediately despatched the messenger with the things he wanted.

Gilimer had spent near three winter months on the summit of this inhospitable mountain, his misery hardening him still more against the thoughts of surrendering, when a melancholy scene in his own family at once reconciled him to it. This was a bloody struggle between two boys, one of them his sister's son, about a flat bit of dough, laid on the coals; which the one seized upon, burning hot as it was, and clapped it into his mouth; but the other by dint of blows forced it out, and ate it from him. This quarrel, which might have ended fatally had not Gilimer interposed, made so deep an impression upon him, that he immediately despatched a messenger to Pharas, acquainting him that he was willing to surrender himself and all his effects upon the conditions he had offered, as soon as he was assured that they were embraced by Belisarius. Pharas lost no time to get them ratified and sent back to him; after which he was conducted to Belisarius, who gave him a very kind reception. Gilimer was afterwards brought before Justinian in gold chains, whom he besought in

22 Kindly treated by Justinian.

the most submissive manner to spare his life. This was readily granted by the emperor; who also allowed him a handsome yearly pension to live upon as a private gentleman. But his mind and heart were too much unsettled and broken to enjoy the sweets of a private state; so that Gilimer, oppressed with grief, died in the year 534, the first of his captivity, and five years after he had been raised to the throne.

23 Barbary reduced by the Saracens.

Barbary being thus again reduced under the power of the Romans, its history falls to be taken notice of under that of Rome. In the caliphate of Omar, this country was reduced by the Saracens, as we have already related under the article Arabia. It continued subject to the caliphs of Arabia and Bagdad till the reign of Harun Al Raschid, who having appointed Ibrahim

24 Principal city of the Aglabites founded.

brahim Ebn Aglab governor of the western parts of his empire, that prefect took the opportunity, first of assuming greater powers to himself than had been granted by the caliph, and then erecting a principality altogether independent of the caliphs. The race of Aglab continued to enjoy their new principality peaceably till the year of the Hegira 297 or 298, during which time they made several descents on the island of Sicily, and conquered part of it. About this time, however, one Obeidallah rebelled against the house of Aglab, and assumed the title of caliph of *Kairwan* (the ancient Cyrene, and residence of the Aglabite princes). To give the greater weight to his pretensions, he also took the surname of Al Mohdi, or Al Mahedi, the *director*. According to some, also, he pretended to be descended in a right line from Ali Ebn Abu Taleb, and Fatima the daughter of Mahomet; for which reason, say they, the Arabs called him and his descendants *Fatemites*. He likewise encouraged himself and his followers by a traditional prophecy of Mahomet, that at the end of 300 years the sun should rise out of the west. Having at length driven the Aglabites into Egypt, where they became known by the name of *Magrebians*, he extended his dominions in Africa and Sicily, making Kairwan the place of his residence.

25 Driven out by Al Mohdi the first Fatemite caliph.

26 His general Habbasah invades Egypt.

In the 300th year of the Hegira, Habbasah, one of Al Mohdi's generals, overthrew the caliph Al Mokhtader's forces in the neighbourhood of Barca, and made himself master of that city. After which he reduced Alexandria itself; and was making great progress in the conquest of the whole country, when Al Mokhtader despatched against him his two generals, Takin and Al Kasem, with an army of 100,000 men. Habbasah being informed that the caliph's troops were in motion, advanced at the head of his army to give them battle, and at last came up with them in an island called by the Arabs *Ard Al Khamsin*. Here he attacked them with incredible bravery, notwithstanding their force was much superior to his; but the approach of night obliged both generals to sound a retreat.—The action therefore was by no means decisive, though extremely bloody, the caliph's generals having lost 20,000, and Habbasah 10,000. The latter, however, durst not renew the fight next morning; but stole off in the night, and returned home, so that Al Mokhtader in effect gained a victory. In the 302d year of the Hegira, however, Habbasah returned, possessed himself of Alexandria a second time, defeated a body of the caliph's forces, and killed 7000 of them upon the spot. What further progress he made at that time we are not certainly told; but in the 307th year of the Hegira, Abul Kasem, son to the Fatemite caliph Al Mohdi, again entered Egypt with an army of 100,000 men. At first he met with extraordinary success, and overran a considerable part of that fine country. He made himself master of Alexandria, Al Tayum, Al Baknasa, and the isle of Al Ashmaryin, penetrating even to Al Jizah, where the caliph's army under the command of Munes was posted in order to oppose him. In this country he found means to maintain himself till the 308th year of the Hegira. This year, however, he was entirely defeated by Munes, who made himself master of all his baggage, as well as of the plunder he had acquired; and this blow obliged him to fly to Kairwan with the shattered remains of his army, where he remained without making any further attempt on Egypt.

27 As does also his son Abul Kasem,

28 who is utterly defeated by Munes.

Al Mohdi reigned 24 years; and was succeeded by his son Abul Kasem above mentioned, who then took the surname *Al Kayem Mohdi*. During his reign we read of nothing remarkable, except the revolt of one Yezid Ebn Condat, a man of mean extraction, but who, having been raised to the dignity of chancellor, found means to raise such a strong party, that the caliph was obliged to shut himself up in the castle of Mohedia. Yezid, being then at the head of a powerful army, soon reduced the capital of Kairwan, the cities of Al Rakkada and Tunis, and several other fortresses. He was no less successful in defeating a considerable number of troops which Al Kayem had raised and sent against him; after which he closely besieged the caliph himself in the castle where he had shut himself up. The siege continued seven months; during which time the place was reduced to such straits, that the caliph must either have surrendered it or been starved, when death put an end to his anxiety in the 12th year of his reign, and the 334th of the Hegira.

29 Rebellion of Yezid.

Al Kayem was succeeded by his son Ishmael, who immediately took upon himself the title of *Al Mansur*. This caliph thought proper to conceal the death of his father till he had made the preparations necessary for reducing the rebels. In this he was so successful that he obliged Yezid to raise the siege of Mohedia the same year; and in the following gave him two great overthrows, obliging him to shut himself up in the fortress of Kothama, or Cutama, where he besieged him in his turn. Yezid defended the place a long time with desperate bravery; but finding the garrison at last obliged to capitulate, he made shift to escape privately. Al Mansur immediately despatched a body of forces in pursuit of him; who overtook, and brought him back in fetters; but not till after a vigorous defence, in which Yezid received several dangerous wounds, of which he died in prison. After his death, Al Mansur caused his body to be flayed, and his skin stuffed and exposed to public view. Of Al Mansur's exploits in Sicily an account is given under that article. Nothing farther remarkable happened in his African dominions; and he died after a reign of seven years and 16 days, in the 341st of the Hegira.

30 Al Mansur caliph.

31 Death of Yezid.

Al Mansur was succeeded by his son Abu Zammin Moad, who assumed the surname of *Al Moez Ledinillah*. He proved a very warlike prince, and maintained a bloody contest with Abdalrahman, caliph of Andalusia; for a particular account of which see the article Spain. In the 347th year of the Hegira, beginning March 25th, 958, Al Moez sent a powerful army to the western extremity of Africa, under the command of Abul Hasan Jawhar, one of his slaves, whom he had advanced to the dignity of vizir. Jawhar first advanced to a city called *Tahart*, which he besieged for some time ineffectually. From thence he marched to Fez, and made proper dispositions for attacking that city. But finding that Ahmed Ebn Becr, the emir of the place, was resolved to defend it to the last, he thought proper to abandon the enterprise. However, having traversed all the tract between that capital and the Atlantic ocean, he again sat down before Fez, and took it by storm the following year.

32 Al Moez Ledinillah caliph.

But

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Barbary, Barbatelli. But the greatest achievement performed by this caliph was his conquest of Egypt, and the removal of the caliphate to that country. This conquest, though
33 He conquers Egypt, long projected, he did not attempt till the year of the Hegira 358. Having then made all necessary preparations for it, he committed the care of that expedition to a faithful and experienced general called *Giafar*, or *Jaafar*; but in the mean time, this enterprise did not divert Al Moez from the care of his other conquests, particularly those of Sicily and Sardinia: to the last of which he sailed in the year of the Hegira 361, continuing a whole year in it, and leaving the care of his African dominions to an experienced officer named *Yusef Ben Zeiri*. He sailed thence the following year for Tripoli in Barbary, where he had not staid long before he received the agreeable news that his general had made himself master of Alexandria. He lost no time, but immediately embarked for it, leaving the government of his old African dominions in the hands of his trusty servant Yusef above mentioned, and arriving safely at that port was received with all the de-
34 and transfers the seat of government to that country. monstrations of joy. Here he began to lay the foundations of his new Egyptian dynasty, which was to put a final end to the old one of Kairwan after it had continued about 65 years.

Al Moez preserved all his old dominions of Kairwan or Africa Proper. But the ambition or avarice of the governors whom he appointed suffered them to run quickly to a shameful decay; particularly the new and opulent metropolis of Mohedia, on which immense sums had been lavished, as well as labour and care, so as to render it not only one of the richest and stateliest, but one of the strongest, cities in the world: so that we may truly say, the wealth and splendour of this once famed, though short-lived state, took their final leave of it with the departure of the caliph Al Moez, seeing the whole maritime tract from the Egyptian confines to the straits of Gibraltar hath since become the nest of the most odious piratical crew that can be imagined.

Under the article ALGIERS we have given a short account of the erection of a new kingdom in Barbary by Texefien; which, however, is there no farther continued than is necessary for the proper understanding the history of that country. A general history might here be given of the whole country of Barbary; but as that would necessarily occasion repetitions under the articles MOROCCO, TRIPOLI, TUNIS, &c. we must refer to those articles for the historical part, as well as for an account of the climate, inhabitants, &c.

BARBATELLI, BERNARDINO, otherwise called *Pochetti*, a painter of history, fruit, animals, and flowers, was born at Florence in 1542. He was the disciple of Ridolfo Ghirlandaio at Florence; from whose school he went to Rome, and studied there with such uncommon assiduity, that he was frequently so abstracted, and so absolutely engrossed by the objects of his contemplations, as to forget the necessary refreshments of sleep and food. He was excellent for painting every species of animals, fruit, or flowers; and in those subjects not only imitated, but equalled nature. His touch was free, light and delicate, and the colouring of his objects inexpressibly true; and, beside his merit in this most usual style of painting, the historical subjects which he designed from sacred or profane authors were much esteemed and admired. He died in 1612. Barbe ‖ Barberino.

BARBE, or BARB. See BARB.

BARBE in the military art. To fire in barbe, means to fire the cannon over the parapet, instead of firing through the embrasures; in which case the parapet must not be above three feet and a half high.

BARBE, or BARDE, is an old word, denoting the armour of the horses of the ancient knights and soldiers, who were accoutred at all points. It is said to have been an armour of iron and leather, wherewith the neck, breast, and shoulders of the horse were covered.

BARBE, *St*, a town of Biscay in Mexico, near which are rich silver mines. W. Long. 109. 55. N. Lat. 26. 0.

BARBED, in a general sense, bearded like a fish-hook set with barbs; also shaved or trimmed.

BARBED and Crested, in *Heraldry*, an appellation given to the combs and gills of a cock, when particularized for being of a different tincture from the body.

A *barbed cross*, is a cross the extremities whereof are like the barbed irons used for striking fish.

BARBEL, in *Ichthyology*. See CYPRINUS.

BARBELICOTÆ, an ancient sect of Gnostics, spoken of by Theodoret. Their doctrines were absurd, and their ceremonies too abominable to be repeated.

BARBER, one who makes a trade of shaving or trimming the beards of other men for money. Anciently a lute or viol, or some such musical instrument, was part of the furniture of a barber's shop, which was used then to be frequented by persons above the ordinary level of the people, who resorted to the barber either for the cure of wounds, or to undergo some chirurgical operation, or as it was then called, to be *trimmed*, a word that signified either shaving or cutting and curling the hair; these, together with letting blood, were the ancient occupations of the barber-surgeon. As to the other important branch of surgery, the setting of fractured limbs, that was practised by another class of men called *bone-setters*, of whom there are hardly any now remaining. The musical instruments in his shop were for the entertainment of waiting customers; and answered the end of a newspaper, with which at this day those who wait for their turn at the barber's amuse themselves. For the origin of the barber's *pole*, see the article APPELLATION.

BARBERINI, FRANCIS, one of the most excellent poets of his age, was born at Barberino, in Tuscany, in the year 1264. As his mother was of Florence, he settled in that city; where his profession of the law, but especially the beauty of his poetry, raised him a very considerable character. The greatest part of his works are lost; but that which is entitled the *Precepts of Love*, which is a moral poem calculated to instruct those in their duty who have a regard for glory, virtue, and eternity, has had a better fate. It was published at Rome, adorned with beautiful figures, in 1640, by Frederic Ubaldini: he prefixed the author's life; and as there are in the poem many words which are grown obsolete, he added a glossary to explain them, which illustrates the sense by the authority of cotemporary poets.

BARBERINO, a town of Tuscany in Italy, situated

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tuated at the foot of the Apennine mountains, in E. Long. 12. 25. N. Lat. 43. 40.

BARBERRY. See BERBERIS, BOTANY *Index*.

BARBESUL, in *Ancient Geography*, a town and river of Bætica, and a colony in the resort of the Conventus Gaditanus in Spain: now *Morbella* in Granada.

BARBET, in *Natural History*, a name given by M. Reaumur, and other of the French writers, to a peculiar species of the worms which feed on the pucerons or aphides. See APHIS, ENTOMOLOGY *Index*.

BARBETS, the name of the inhabitants of several valleys in Piedmont, particularly those of Lucern, Angrona, Perusa, and St Martin.

BARBEYRAC, JOHN, was born at Besiers in Lower Languedoc in 1674. He was made professor of law and history at Lausanne in 1710; which he enjoyed for seven years, and during that time was three times rector: in 1717, he was professor of public and private law at Groningen. He translated into French the two celebrated works of Puffendorff, his *Law of Nature and Nations*, and his *Duties of a Man and a Citizen;* to both which he wrote excellent notes, and to the former an introductory preface. He translated also Grotius's treatise *De Jure Belli ac Pacis*, with large and excellent notes; and several of Tillotson's sermons. He wrote a work entitled *Traité de Jeu*, 2 vols. 8vo.

BARBEZIEUH, a town of France, in the department of Charente. It had a manufactory of linen cloth; and contained 2740 inhabitants in 1815. W. Long. 0. 5. N. Lat. 45. 23.

BARBICAN, or BARBACAN. See BARBACAN.

BARBIERI, GIOVANNI FRANCESCO, otherwise called *Guercino da Cento*, an eminent historical painter, was born at Cento, a village not far from Bologna, in 1590. At first he was the disciple of Benedetto Gennari; but he afterwards studied for some time in the school of the Caracci, though he did not adopt the manner of that famous academy. He seemed to prefer the style of Caravaggio to that of Guido or Albano, imagining it impossible to imitate nature truly, without the assistance of strong lights and strong shadows; and from that principle, his light was admitted into his painting room from above. In effect, by the opposition of his strong lights and shadows, he gave such force to his pictures, that few, except those of Caravaggio, can stand near them, and not seem feeble in their effect: however, that manner is censured as not being like nature, because it makes objects appear as if they were seen by candle-light, or by the brightness of a sun-beam, which alone can justify the deepness of his shadowing. The principal attention of Guercino seems to have been fixed on arriving at perfection in colouring; he saw the astonishing effects produced by the colouring of the celebrated Venetian masters; and observed, that notwithstanding any imperfections in regard to grace, correctness, or elegance, the works of these masters were the objects of universal admiration. From which observation, he seems to have devoted his whole study to excel in colouring; as if he were convinced, that few are qualified to discern the elevation of thought, which constitutes the excellence of a composition; few may be touched with the grandeur or beauty of the design, or perhaps have a capacity to examine even the correctness of any part of a painting; and yet every eye, and even every imperfect judge of a picture, may be sensibly affected by the force and beauty of the colouring. His taste of design was natural, easy, and often grand, but without any extraordinary share of elevation, correctness, or elegance. The airs of his heads often want dignity, and his local colours want truth. However, there is great union and harmony in his colours, although his carnations are not very fresh; and in all his works there is a powerful and expressive imitation of life, which will for ever render them estimable. Towards the decline of his life, he observed that the clearer and brighter style of Guido and Albano had attracted the admiration of all Europe; and therefore he altered his manner, even against his own judgment. But he apologized for that conduct, by declaring, that in his former time he painted for fame, and to please the judicious; and he now painted to please the ignorant, and enrich himself. He died in 1666.—The most capital performance of Guercino, is the history of S. Petronilla, which is considered as one of the ornaments of St Peter's at Rome.

BARBIERI, *Paolo Antonio*, da Cento, painter of still life and animals, was the brother of Guercino, and born at Cento in 1596. He chose for his subjects fruits, flowers, insects, and animals; which he painted after nature with a lively tint of colour, great tenderness of pencil, and a strong character of truth and life. He died in 1640.

BARBITOS, or BARBITON, an ancient instrument of music, mounted with three, others say seven, strings; much used by Sappho and Alcæus, whence it is also denominated *Lesboum*.

BARBLES, or BARBS, in *Farriery*, the knots or superfluous flesh that grow up in the channels of a horse's mouth; that is, in the intervals that separate the bars, and lie under the tongue. These, which are also called *barbes*, obtain in black cattle as well as horses, and obstruct their eating. For the cure, they cast the beast, take out his tongue, and clip off the barbles with a pair of scissars, or cut them with a sharp knife; others choose to burn them off with a hot iron.

BARBOUR, JOHN, archdeacon of Aberdeen, was esteemed an excellent poet in the reign of David II. He wrote the history of Robert the Bruce, in a heroic poem, which is still extant, and which contains many facts and anecdotes omitted by other historians. The latest edition of this book is that of Glasgow, 8vo, printed in the year 1672. It is entitled, "The acts and life of the most victorious conqueror Robert Bruce king of Scotland; wherein also are contained the martial deeds of the valiant princes Edward Bruce, Sir James Dowglass, Earl Thomas Randel, Walter Steward, and sundry others." In one passage, he calls it a *romance;* but that word was then of good reputation: every body knows that the 'Romant of romants' has been innocently applied to true history, as well as the 'Ballad of ballads' to a sacred song.

BARBUDA, one of the British Caribbee islands, about 20 miles long and 12 broad. It is low land, but fruitful and pretty populous. The inhabitants employ themselves in husbandry, and find always a ready market for their corn and cattle in the sugar islands. Barbuda is the property of the Codrington family, who have

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have great numbers of negroes here as well as in Barbadoes. It lies in W. Long. 61. 3. N. Lat. 18. 5.

BARCA, a large country of Africa, lying on the coast of the Mediterranean sea, between the kingdoms of Egypt and Tripoli, extending itself in length from east to west from the 39th to the 46th degree of east longitude, and in breadth from north to south about 30 leagues, as is generally supposed. It is for the most part, especially in the middle, a dry sandy desert: on which account the Arabs call it *Sahart* or *Ceyart Barka*, that is, the desert or road of whirlwinds or hurricanes. It labours almost everywhere under a great scarcity of water; and except in the neighbourhood of towns and villages, where the ground produces some small quantities of grain, such as millet and some maize, the rest is in a manner quite barren and uncultivated, or, to speak more properly, uncultivable: and even of that small quantity which those few spots produce, the poor inhabitants are obliged to exchange some part with their indigent neighbours, for dates, sheep, and camels, which they stand in greater need of than they, by reason of their great scarcity of grass and other proper food; for want of which, those that are brought to them seldom thrive or live long. In this country stood the famed temple of Jupiter Ammon; and notwithstanding the pleasantness of the spot where it stood, this part of the country is said to have been the most dangerous of any, being surrounded with such quick and burning sands as are very detrimental to travellers; not only as they sink under their feet, but being light, and heated by the rays of the sun, are easily raised by every breath of wind; which, if it chance to be in their faces, almost burns their eyes out, and stifles them for want of breath; or, if vehement, often overwhelms whole caravans. Against this temple Cambyses king of Persia despatched an army of 50,000 men. They set out from Thebes in Upper Egypt, and under the conduct of proper guides reached the city of Oasis seven days journey from that place: but what was their fate afterwards is uncertain; for they never returned either to Egypt or to their own country. The Ammonians informed Herodotus, that, after the army had entered the sandy desert which lies beyond Oasis a violent wind began to blow from the south at the time of their dinner, and raised the sand to such a degree, that the whole army was overwhelmed and buried alive.

Concerning the government or commerce of this country we know nothing certain. Most probably the maritime towns are under the protection of the Porte: but whether under the bashaw of Egypt or Tripoli, or whether they have formed themselves into independent states like those of Algiers and Tunis, we cannot say; only we are told that the inhabitants of the maritime towns are more civilized than those that dwell in the inland parts. The first profess Mahometanism, and have imbibed some notions of humanity and justice; whilst the latter, who have neither religion nor any sign of worship among them, are altogether savage and brutish. They are a sort of Arabs, and like them live entirely upon theft and plunder. By them this tract, which before was a continued desert, was first inhabited. At their first coming in, they settled themselves in one of the best places of the country; but as they multiplied, and had frequent wars with one another, the strongest drove the weakest out of the best spots, and sent them to wander in the desert parts, where they live in the most miserable manner, their country hardly affording one single necessary of life. Hence it is that they are said to be the ugliest of all the Arabs: their bodies having scarcely any thing but skin and bone, their faces meagre, with fierce ravenous looks; their garb, which is commonly what they take from the passengers who go through those parts, tattered with long wearing; whilst the poorest of them have scarce a rag to cover their nakedness. They are most expert and resolute robbers, that being their chief employment and livelihood; but the travellers in these parts are so few, that the Barcans are often necessitated to make distant excursions into Numidia, Libya, and other southern countries. Those that fall into their hands are made to drink plenty of warm milk: then they hang them up by the feet, and shake them, in order to make them vomit up any money they think they have swallowed; after which, they strip them of all their clothes, even to the last rag: but with all this inhumanity, they commonly spare their life, which is more than the other African robbers do. Yet notwithstanding every artifice they can use, the Barcans are so poor, that they commonly let, pledge, or even sell their children to the Sicilians and others from whom they have their corn, especially before they set out on any long excursion.

BARCALON, an appellation given to the prime minister of the king of Siam. The barcalon has in his department every thing relating to commerce, both at home and abroad. He is likewise superintendant of the king's magazines.

BARCELONA, a handsome, rich, and strong city of Spain, in the province of Catalonia, of which it is the capital. This city was originally founded by Hamilcar Barcas, and from him called *Barcino*. It was reduced by the Romans, and continued subject to them till the kingdom of Spain was overrun by the Goths and Vandals, and afterwards by the Saracens and Moors. In the beginning of the 9th century, Barcelona was in the hands of the Moors, and under the government of one *Zade*. This governor having more than once abused the clemency of Charlemagne, at last irritated Lewis king of Aquitain, and son to Charles, to such a degree, that he gave orders to his generals to invest the city, and not to rise from before it till they had put Zade into his hands. The Moor made a most obstinate resistance, so that the siege lasted many months: at last, finding it impossible to preserve the city much longer, and being destitute of all hopes of relief, he determined, or rather was compelled by the inhabitants, to go to the Christian camp and implore the emperor's mercy; but here he was no sooner arrived than he was arrested and sent prisoner to Charlemagne, who condemned him to perpetual banishment. The people gaining nothing by this expedient, continued to hold out for six weeks longer, when the king of Aquitain himself took the command of the siege. To him they made a proposal, that if he would allow them to march out and go where they pleased, they would surrender the place. Lewis having agreed to this, made his public entry into Barcelona, where he formed a design of extending his father's dominions as far as the Ebro; but being recalled before he could put his design in execution, he

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he appointed one Bera count of Barcelona. The city continued subject to him and his successors, who still enjoyed the title of *counts of Barcelona*, from the year 802 to 1131; during which time we find nothing remarkable, except that the city was once taken by the Moors, but soon after retaken by the assistance of Lewis IV. king of France. In 1131 it was united to the crown of Arragon by the marriage of Don Raymond V. count of Barcelona with the daughter of Don Ramiro the monk, king of Arragon. In 1465 the Catalonians revolted against Don Juan II. king of Arragon, out of hatred to his queen Donna Juanna; the consequence of which was, that Barcelona was besieged by that monarch in 1471. Various efforts were made by Lewis XI. of France and the duke of Lorrain in order to raise the siege, but without effect. Things at length were brought to the utmost extremity, when the king offered to pardon them all, without the smallest punishment either in person or property, provided they would submit: but these terms they rejected, chiefly through the influence of the count de Pailhars, who had been pardoned the year before. The army, on the other hand, was very earnest on being led on to the assault, in hopes of plunder. The king, however, wrote a letter to the citizens, dated the 6th of October, in terms as affectionate as if he had been writing to his children, bewailing the miseries they had brought on themselves, and concluding with a protestation that they, and not he, must be answerable for the consequences. Upon this, at the persuasion of a priest who had a reputation for sanctity, they sent deputies to the king, and made a capitulation on the 17th of the same month. In this the king acknowledged they had taken up arms on just motives; and forgave every body except Pailhars, who was, however, suffered to escape. On the 22d of October the king made his entry into the city, and confirmed all their ancient privileges. In 1697, Barcelona was taken by the French, after a bloody siege of 52 days; and the loss of this city had a considerable effect in disposing the Spaniards to agree to the treaty of Ryswick. In Queen Anne's time it was taken by the allies under the earl of Peterborough. In 1808 it was surprised by a body of French troops under General Duhesme, and continued in their possession till 1814. It contains 10,200 houses, and 111,500 inhabitants, including the contiguous town of Barcelonetta.

Barcelona is situated by the sea-side, of a form between a square and an oval. It is surrounded with a good brick wall, round which is another, with 14 bastions, horn-works, ramparts, and ditches; the ramparts are high, broad, and spacious, insomuch that 100 coaches may be seen every evening driving thereon for pleasure. The city is divided into two parts, the Old and the New, which are separated from each other by a wall and a large ditch; the streets are handsome, well paved with large stones, wide, and very clean. It is the residence of a viceroy, is a bishop's see, has a fine university, a mint, a good port, and is adorned with handsome buildings. Here is a court of inquisition, which the inhabitants look upon as an advantage. The remarkable buildings are the cathedral, which is large, handsome, and adorned with two high towers, the church of the Virgin Mary, the palace of the bishop, that of the inquisition, and several religious houses: add to these the palace of the viceroy; the arsenal,

which contains arms for 1000 men; the exchange, where the merchants meet; the tersana, where they build the galleys; and the palace where the nobility of the country meet, called *La Casa de la Deputation.* This last is built with fine large freestone, and adorned with columns of marble: there is in it a large hall, with a gilt ceiling and a handsome portico, wherein persons may either walk or sit; the hall is adorned with the portraits of all the counts of Barcelona. There are several fine squares, particularly that of St Michael, into which all the great streets run. The port is wide, spacious, deep, and safe; defended on the one side by a great mole, and on the other sheltered from the west wind by two mountains that advance into the sea, and form a kind of promontory: the mole is 750 paces long, with a quay, at the end of which is a light-house and a small fort. One of the mountains, called *Mount Joy*, is very high, and rises in the middle of the plain near the city: it is covered with gardens, vineyards, groves of trees, and has a strong fort for the defence of the city. This mountain, being a rock, yields an inexhaustible quarry of fine hard freestone. Barcelona is a place of great trade, on account of the conveniency of its harbour. Since the trade with Mexico has been thrown open, the commerce of this port has increased surprisingly. Before the late revolution its trade inward and outward was computed at 1,750,000l. Sterling. The number of vessels that entered the harbour in 1803, was 1333. The women are well shaped, and as handsome as any in Spain; they are brisk and lively in their conversation, and more free and unrestrained in their behaviour than in other parts of Spain. E. Long. 2. 5. N. Lat 41. 26.

BARCELONETTE, a town of France, in the department of the Lower Alps, formerly in the government of Dauphiny, and capital of the valley of its own name. It belonged to the duke of Savoy, and was ceded to France by the treaty of Utrecht in 1712. E. Long. 6. 40. N. Lat. 44. 26.

BARCELOR, a town of Asia, in the East Indies, on the coast of Malabar. It is supposed to be the ancient Barace, and has a considerable trade in pepper. E. Long. 74. 15. N. Lat. 13. 45.

BARCELOS, a town of Portugal, with the title of a duchy. It is seated on the river Cavado, over which there is a handsome bridge. W. Long. 7. 0. N. Lat. 41. 20.

BARCINO, in *Ancient Geography*, a town of the Tarraconensis in Spain, and capital of the Laletani. Now BARCELONA. See that article.

BARCLAY, ALEXANDER, a learned monk in the reign of Henry VIII. Where he was born, though of no great importance, was nevertheless a matter of virulent contention among his former biographers. Bale, who was his cotemporary, is of opinion he was born in Somersetshire. There is indeed a village of his name, and a numerous family, in that county. Pits thinks he was born in Devonshire. Mackenzie is positive he was a Scotchman; but without proof, unless we admit as such his name *Alexander*. He was, however, educated in Oriel-college, Oxford. After leaving the university he went abroad, and continued some time in France, Italy, and Germany, where he acquired a competent knowledge of the languages of those countries, as appears from several translations of books, which

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Barclay.

which he afterwards published. On his return to England, he was made chaplain to his patron the bishop of Tyne, who likewise appointed him a priest of St Mary, at the college of Ottery in Devonshire, founded by Grandison bishop of Exeter. After the death of his patron, he became a Benedictine monk of Ely. On the dissolution of that monastery, he first obtained the vicarage of St Matthew at Wokey in Somersetshire; and, in 1549, being then doctor of divinity, was presented to the vicarage of Much Badew in Essex. In 1552, he was appointed rector of Allhallows, Lombard-street, which he lived to enjoy but a very short time. He died at Croydon in Surry in June 1552. He is generally allowed to have improved the English language, and to have been one of the politest writers of his time. He composed several original works; but was chiefly remarkable for his translations from the Latin, Italian, French, and German languages. His version from Sallust of the war of Jugurtha is accurate, and not without elegance. His lives of several saints, in heroic verse, are still unpublished. His *Stultifera navis*, or *The ship of fools*, is the most singular of his performances. It was printed by Richard Pynson at London, 1509, in folio; and contains a variety of wooden plates, which are worthy the inspection of the curious.

Barclay, *William*, a learned civilian, was born in Aberdeenshire in the year 1541. He spent the early part of his life, and much of his fortune, at the court of Mary queen of Scots, from whose favour he had reason to expect preferment. In 1573 he went over to France, and at Bourges commenced student of civil law under the famous Cujacius. He continued some years in that seminary, where he took a doctor's degree; and was soon after appointed professor of civil law in the university of Pont à Mousson, then first founded by the duke of Lorrain. That prince afterwards made him counsellor of state and master of requests. Barclay, in the year 1581, married Ann de Mallaville, a French lady, by whom he had a son, who became a celebrated author, and of whom the reader will find an account in the next article. This youth the Jesuits would gladly have received into their society. His father refused his consent, and for that reason these disciples of Jesus soon contrived to ruin him with the duke his patron. Barclay now embarked for Britain, where King James I. offered him a considerable preferment, provided he would become a member of the church of England: but not choosing to comply, he returned to France in 1604; and, soon after his arrival, was appointed professor of civil law in the university of Angers, where he died the year following, and was buried in the Franciscan church. He was esteemed a learned civilian; and wrote elaborately in defence of the divine right of kings, in answer to Buchanan and others. The titles of his works are, 1. *De regno et regali potestate*, &c. 2. *Commentarius in tit. pandectarum de rebus creditis, et de jurejurando*. 3. *De potestate papæ*, &c. 4. *Primitiæ in vitam Agricolæ*.

Barclay, *John*, son of the former, was, as we have above mentioned, so great a favourite of the Jesuits, that they used all their efforts to engage him in their society. His father would not consent, and carried his son with him into England, who was already an author, for he had published "A Commentary upon the Thebais of Statius," and a Latin poem on the coronation of King James, and the first part of *Euphormio*, 1603. He returned to France with his father; and after his father's death went to Paris, and soon after came back to London: he was there in 1606. He published "The History of the Gunpowder Plot," a pamphlet of six leaves, printed at Amsterdam. He published at London in 1610 "An Apology for the Euphormio," and his father's treatise *De potestate papæ*. And at Paris, 1612, he published a book entitled *Pietas*, in answer to Cardinal Bellarmin, who had written against William Barclay's book concerning the power of the Pope. Two years after he published *Icon Animorum*. He was invited to Rome by Pope Paul V. and received a great deal of civility from Cardinal Bellarmin, though he had written against him. He died at Rome in 1621, while his *Argenis* was printing at Paris. This celebrated work has since gone through a great number of editions, and has been translated into most languages. M. de Peiresc, who had the care of the first edition, caused the effigies of the author to be placed before the book; and the following distich, written by Grotius, was put under it:

Gente Caledonius, Gallus natalibus, hic est,
Romam Romano qui docet ore loqui.

Barclay, *Robert*, one of the most eminent among the Quakers, the son of Colonel David Barclay, descended of the ancient family of Barclays, was born at Edinburgh in 1648. He was educated under an uncle at Paris, where the Papists used all their efforts to draw him over to their religion. He joined the Quakers in 1669, and distinguished himself by his zeal and abilities in defence of their doctrines. In 1676 he published in Latin at Amsterdam his "Apology for the Quakers;" which is the most celebrated of his works, and esteemed the standard of the doctrine of the Quakers. The *Theses Theologicæ*, which were the foundation of this work, and addressed to the clergy of what sort soever, were published before the writing of the *Apology*, and printed in Latin, French, High-Dutch, Low Dutch, and English. The dedication of his *Apology* to King Charles II. is very remarkable for the uncommon frankness and simplicity with which it is written. Amongst many other extraordinary passages, we meet with the following: "There is no king in the world who can so experimentally testify of God's providence and goodness; neither is there any who rules so many free people, so many true Christians; which thing renders thy government more honourable, thyself more considerable, than the accession of many nations filled with slavish and superstitious souls. Thou hast tasted of prosperity and adversity; thou knowest what it is to be banished thy native country, to be over-ruled as well as to rule and sit upon the throne; and being oppressed, thou hast reason to know how hateful the oppressor is both to God and man: if, after all those warnings and advertisements, thou dost not turn unto the Lord with all thy heart, but forget him who remembered thee in thy distress, and give thyself up to follow lust and vanity, surely great will be thy condemnation."—He travelled with the famous Mr William Penn through the greatest part of England,

 Holland,

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Barclay || Bard.

Holland, and Germany, and was everywhere received with the highest respect; for though both his conversation and behaviour were suitable to his principles, yet there was such liveliness and spirit in his discourse, and such serenity and cheerfulness in his deportment, as rendered him extremely agreeable to all sorts of people. When he returned to his native country, he spent the remainder of his life in a quiet and retired manner. He died at his own house at Ury on the 3d of Oct. 1690, in the 42d year of his age.

BARCOCHEBAS, or rather BARCOCHAB, a Jewish impostor, whose real name was *Akiba;* but he took that of *Barcochab*, which signifies the *Son of a Star;* in allusion to the prophecy of Balaam, "There shall a star arise out of Jacob." He proclaimed himself the Messiah; and talking of nothing but wars, victories, and triumphs, made his countrymen rise against the Romans, by which means he was the author of innumerable disorders; he ravaged many places, took a great number of fortresses, and massacred an infinite multitude of people, particularly the Christians. The emperor sent troops to Rufus, governor of Judea, to suppress the sedition. Rufus in obedience exercised a thousand cruelties, but could not finish his attempt. The emperor was therefore obliged to send Julius Severus, the greatest general of that time; who attained his end without a direct battle: he fell on them separately; cut off their provisions; and at last the whole contest was reduced to the siege of Bitter, in the 18th year of Hadrian. The impostor perished there. This war cost the Romans a great deal of blood.

BARD, a word denoting one who was a poet by his genius and profession; and "who sung of the battles of heroes, or the heaving breasts of love." *Ossian's Poems*, I. 37.

Kaimes's Sketches, Sk. v. sect. ii.

The curiosity of man is great with respect to the transactions of his own species; and when such transactions are described in verse, accompanied with music, the performance is enchanting. An ear, a voice, skill in instrumental music, and, above all, a poetical genius, are requisite to excel in that complicated art. As such talents are rare, the few that possessed them were highly esteemed; and hence the profession of a bard, which, besides natural talents, required more culture and exercise than any other known art. Bards were capital persons at every festival and at every solemnity. Their songs, which, by recording the achievements of kings and heroes, animated every hearer, must have been the entertainment of every warlike nation. We have Hesiod's authority, that in his time bards were as common as potters or joiners, and as liable to envy. Demodocus is mentioned by Homer as a celebrated bard; and Phemius, another bard, is introduced by him deprecating the wrath of Ulysses in the following words:

"O King! to mercy be thy soul inclin'd,
"And spare the poet's ever-gentle kind:
"A deed like this thy future fame would wrong,
"For dear to gods and men is sacred song.
"Self-taught I sing; by heav'n, and heav'n alone,
"The genuine seeds of poesy are sown;
"And (what the gods bestow) the lofty lay,
"To gods alone, and godlike worth, we pay.
"Save then the poet, and thyself reward;
"'Tis thine to merit, mine is to record."

Odyssey, viii.

Bard.

Cicero reports, that at Roman festivals, anciently, the virtues and exploits of their great men were sung. The same custom prevailed in Peru and Mexico, as we learn from Garcilasso and other authors. We have for our authority Father Gobien, that even the inhabitants of the Marian islands have bards, who are greatly admired, because in their songs are celebrated the feats of their ancestors.

But in no part of the world did the profession of bard appear with such lustre as in Gaul, in Britain, and in Ireland. Wherever the Celtæ or Gauls are mentioned by ancient writers, we seldom fail to hear of their druids and their bards; the institution of which two orders, was the capital distinction of their manners and policy. The druids were their philosophers and priests; the bards, their poets and recorders of heroic actions: and both these orders of men seem to have subsisted among them, as chief members of the state, from time immemorial. The Celtæ possessed, from very remote ages, a formed system of discipline and manners, which appears to have had a deep and lasting influence. Ammianus Marcellinus * gives them this express testimony, that there flourished among them the study of the most laudable arts; introduced by the bards, whose office it was to sing in heroic verse the gallant actions of illustrious men; and by the druids, who lived together in colleges or societies, after the Pythagorean manner, and philosophizing upon the highest subjects, asserted the immortality of the human soul. Though Julius Cæsar, in his account of Gaul, does not expressly mention the bards; yet it is plain, that, under the title of *Druids*, he comprehends that whole college or order; of which the bards, who, it is probable, were the disciples of the druids, undoubtedly made a part. It deserves remark, that, according to his account, the druidical institution first took rise in Britain, and passed from thence into Gaul; so that they who aspired to be thorough masters of that learning were wont to resort to Britain. He adds too, that such as were to be initiated among the druids, were obliged to commit to their memory a great number of verses, insomuch that some employed 20 years in this course of education; and that they did not think it lawful to record these poems in writing, but sacredly handed them down by tradition from race to race.

Blair's Dissertation, subjoined to Ossian's Poems, vol. ii. p. 306.

* Lib. xv. c. 9.

De Bel. Gal. lib. vi.

So strong was the attachment of the Celtic nations to their poetry and their bards, that amidst all the changes of their government and manners, even long after the order of the druids was extinct, and the national religion altered, the bards continued to flourish; not as a set of strolling songsters, like the Greek Ἀοιδοὶ or *rhapsodists*, in Homer's time, but as an order of men highly respected in the state, and supported by a public establishment. We find them, according to the testimonies of Strabo and Diodorus, before the age of Augustus Cæsar; and we find them remaining under the same name, and exercising the same functions as of old, in Ireland, and in the north of Scotland, almost down to our own times. It is well known, that, in both

Bard.

both these countries, every *regulus* or chief had his own bard, who was considered as an officer of rank in his court.

Of the honour in which the bards were held, many instances occur in Ossian's poems. On all important occasions, they were the ambassadors between contending chiefs; and their persons were held sacred. "Cairbor feared to stretch his sword to the bards, though his soul was dark. Loose the bards (said his brother Cathmor), they are the sons of other times. Their voice shall be heard in other ages, when the kings of Temora have failed."—The bards, as well as the druids, were exempted from taxes and military services, even in times of the greatest danger; and when they attended their patrons in the field, to record and celebrate their great actions, they had a guard assigned them for their protection. At all festivals and public assemblies they were seated near the person of the king or chieftain, and sometimes even above the greatest nobility and chief officers of the court. Nor was the profession of the bards less lucrative than it was honourable. For, besides the valuable presents which they occasionally received from their patrons when they gave them uncommon pleasure by their performances, they had estates in land allotted for their support. Nay, so great was the veneration which the princes of these times entertained for the persons of their poets, and so highly were they charmed and delighted with their tuneful strains, that they sometimes pardoned even their capital crimes for a song.

Ossian, ii. 22.

Henry's History, vol. i. p. 365.

We may very reasonably suppose, that a profession that was at once so honourable and advantageous, and enjoyed so many flattering distinctions and desirable immunities, would not be deserted. It was indeed very much crowded; and the accounts which we have of the numbers of the bards in some countries, particularly in Ireland, are hardly credible. We often read, in the poems of Ossian, of a hundred bards belonging to one prince, singing and playing in concert for his entertainment. Every chief bard, who was called *Allah Redan*, or *doctor in poetry*, was allowed to have 30 bards of inferior note constantly about his person; and every bard of the second rank was allowed a retinue of 15 poetical disciples.

Though the ancient Britons of the southern parts of this island had originally the same taste and genius for poetry with those of the north, yet none of their poetical compositions of this period have been preserved. Nor have we any reason to be surprised at this. For after the provincial Britons had submitted quietly to the Roman government, yielded up their arms, and had lost their free and martial spirit, they could take little pleasure in hearing or repeating the songs of their bards in honour of the glorious achievements of their brave ancestors. The Romans, too, if they did not practise the same barbarous policy which was long after practised by Edward I. of putting the bards to death, would at least discourage them, and discountenance the repetition of their poems, for very obvious reasons. The sons of the song being thus persecuted by their conquerors, and neglected by their countrymen, either abandoned their country or their profession; and their songs being no longer heard, were soon forgotten.

It is probable that the ancient Britons, as well as many other nations of antiquity, had no idea of poems that were made only to be repeated, and not to be sung to the sound of musical instruments. In the first stages of society in all countries, the two sister arts of poetry and music seem to have been always united; every poet was a musician, and sung his own verses to the sound of some musical instrument. This, we are directly told by two writers of undoubted credit, was the case in Gaul, and consequently in Britain, in this period. "The bards (says Diodorus Siculus *) sung their poems to the sound of an instrument not unlike a lyre." "The bards (according to Ammianus Marcellinus †, as above hinted) celebrated the brave actions of illustrious men, in heroic poems, which they sung to the sweet sounds of the lyre." This account of these Greek and Latin writers is confirmed by the general strain, and by many particular passages, of the poems of Ossian. "Beneath his own tree, at intervals, each bard sat down with his harp. They raised the song, and touched the string, each to the chief he loved ‡."

Bard || Bardas.

* Lib. v. sect. 31.

† Lib. xv. c. 9.

‡ Vol. ii. p. 112, 113.

The invention of writing made a considerable change in the bard profession. It is now an agreed point, that no poetry is fit to be accompanied with music, but what is simple: a complicated thought or description requires the utmost attention, and leaves none for the music; or, if it divide the attention, it makes but a faint impression §. The simple operas of Quinault bear away the palm from every thing of the kind composed by Boileau or Racine. But when a language, in its progress to maturity, is enriched with variety of phrases fit to express the most elevated thoughts, men of genius aspired to the higher strains of poetry, leaving music and song to the bards: which distinguished the profession of a poet from that of a bard. Homer, in a lax sense, may be termed a bard; for in that character he strolled from feast to feast. But he was not a bard in the original sense: he, indeed, recited his poems to crowded audiences; but his poems are too complex for music, and he probably did not sing them, nor accompany them with the lyre. The Trovadores of Provence were bards in the original sense, and made a capital figure in the days of ignorance, when few could read, and fewer write. In later times, the songs of the bards were taken down in writing, which gave every one access to them without a bard; and the profession sunk by degrees into oblivion. Among the Highlanders of Scotland, reading and writing in their own tongue is not common even at present; and that circumstance supported long the bard profession among them, after being forgot among the neighbouring nations.

Kaimes's Sketches, ubi supra.

§ See the article *Attention*.

BARDANA, or BURDOCK. See ARCTIUM, BOTANY *Index*.

BARDARIOTÆ, in antiquity, were a kind of ancient guard attending the Greek emperors, armed with rods, wherewith they kept off the people from crowding too near the prince when on horseback. Their captain, or commander, was denominated *primivergius*.—The word was probably formed from the *bardæ*, or housings on their horses.

BARDAS, the brother of the empress Theodora, and uncle of the famous Photius, is said to have had no other good quality besides that of loving the sciences and polite literature, which he established in the Eastern

Eastern empire; for he was treacherous, cruel, and ambitious. In the year 856, he assassinated Theoctistes, general of the emperor Michael's forces, and obtained his post. At length he caused the disgrace of the empress Theodora; and St Ignatius, patriarch of Constantinople, reproaching him for his vices, he had him deposed in 858, in order to make room for Photius. Bardas was assassinated by Basilius the Macedonian, in 866.

BARDED, in *Heraldry*, is used in speaking of a horse that is caparisoned. He bears sable, a *cavalier d'or*, the horse *barded*, argent.

BARDESANISTS, a sect of ancient heretics, thus denominated from their leader, Bardesanes, a Syrian of Edessa in Mesopotamia. Bardesanes, born in the middle of the second century, became eminent, after his conversion to Christianity, for his zeal against heretics; against whom, we are informed by St Jerome and Eusebius, he wrote a multitude of books: yet had he the misfortune to fall, himself, into the errors of Valentinus, to which he added some others of his own. He taught, that the actions of men depend altogether on fate, and that God himself is subject to necessity. His followers went further, and denied the resurrection of the body, and the incarnation and death of our Saviour; holding that these were only apparent or fantastical.

BARDEWICK, a town of Germany, in the circle of Lower Saxony and duchy of Lunenburg; formerly a very large place; but being ruined in 1189, by the duke of Saxony, has never yet recovered itself. It is seated on the river Ilmenau, in E. Long. 10. 6. N. Lat. 53. 40.

BARDT, a strong and rich town of Germany, in the duchy of Pomerania, with a castle and spacious harbour. It is subject to the Swedes; and is situated near the Baltic sea, in E. Long. 13. 20. N. Lat. 54. 23.

BARE, in a general sense, signifies *not covered*. Hence we say bare-headed, bare-footed, &c.

The Roman women, in times of public distress and mourning, went *bare-headed*, with their hair loose.—Among both Greeks, Romans, and Barbarians, we find a feast called *Nudipedalia*.—The Abyssinians never enter their churches, nor the palaces of kings and great men, but *bare-footed*.

Bare-Foot Carmelites and Augustines, are religious of the order of St Carmel and St Austin, who live under a strict observance, and go without shoes, like the Capuchins. There are also bare-foot fathers of mercy. Formerly there were bare-foot Dominicans, and even bare-foot nuns of the order of St Augustine.

BAREITH, a town of Germany in Franconia, now subject to Bavaria, and containing 10,000 inhabitants. It was formerly the chief town of a margravate of the same name. E. Long. 11. 50. N. Lat. 50. 0.

BARENT, Diteric, an excellent painter, was born at Amsterdam, and was the son of a very industrious painter. He studied in Italy, and became the favourite disciple of Titian, with whom he lived a long time; but at length returned to Amsterdam, where he painted many extraordinary pieces. He died in 1582, aged 48.

BARFLEUR, a town of France, in Normandy, now the department of the Channel. It was ruined, and had its harbour filled up by the English in 1346. The cape of that name is 12 miles east of Cherburg, and near it part of the French fleet was destroyed in 1692. W. Long. 1. 6. N. Lat. 49. 40.

BARGAIN and Sale, a species of conveyance in the English law. It is a kind of a real contract, whereby the bargainer for some pecuniary consideration bargains and sells, that is, contracts to convey, the land of the bargainee; and becomes by such bargain a trustee for, or seized to the use of, the bargainee; and then the statute of uses completes the purchase: or, as it hath been well expressed, the bargain first vests the use, and then the statute vests the possession. But as it was foreseen that conveyances, thus made, would want all those benefits of notoriety which the old common-law assurances were calculated to give; to prevent therefore clandestine conveyances of freeholds, it was enacted in the same session of parliament, by statute 27 Hen. VIII. c. 16. that such bargains and sales should not endure to pass a freehold, unless the same be made by indenture, and enrolled within six months in one of the courts of Westminster-hall, or with the *custos rotulorum* of the county. Clandestine bargains and sales of chattel interests, or leases for years, were thought not worth regarding, as such interests were very precarious till about six years before; which also occasioned them to be overlooked in framing the statute of uses: and therefore such bargains and sales are not directed to be enrolled. But how impossible it is to foresee, and provide against, all the consequences of innovations! This omission has given rise to the species of conveyance by lease and release.

BARGE (*Bargie*, Dutch), a vessel or boat of state, furnished with elegant apartments, canopies, and cushions; equipped with a band of rowers, and decorated with flags and streamers: they are generally used for processions on the water, by noblemen, officers of state, or magistrates of great cities. Of this sort, too, we may naturally suppose the famous barge or galley of Cleopatra, which, according to Shakespeare,

——— Like a burnish'd throne,
Burnt on the water: the poop was beaten gold:
Purple her sails; and so perfum'd, that
The winds were love-sick with them: the oars were silver,
Which to the tune of flutes kept time, and made
The water which they beat to follow faster,
As amorous of their strokes.——
———— At the helm
A seeming mermaid steer'd: the silken tackles
Swell'd with the touches of those flower-soft hands
That yarely 'form'd their office.——

There are likewise other barges of a smaller kind, for the use of admirals and captains of ships of war. These are of a lighter frame, and may be easily hoisted into and out of the ships to which they occasionally belong.

Barge is also the name of a flat-bottomed vessel of burden, for lading and discharging ships, and removing their cargoes from place to place in a harbour.

Barge Couples, in *Architecture*, a beam mortised into another, to strengthen the building.

Barge-Course, with bricklayers, a term used for that

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that part of the tiling which projects over without the principal rafters, in all sorts of buildings where there is either a gable or a kirkin-head.

BARGHMASTER, Barmer, or Bar-Master, in the royal mines, the steward or judge of the barmote.—The bar-master is to keep two great courts of barmote yearly; and every week a small one, as occasion requires.

BARGHMOTE, or Barmote, a court which takes cognizance of causes and disputes between miners.—By the custom of the mines, no person is to sue any miner for ore-debt, or for ore, or for any ground in variance, but only in the court of barmote, on penalty of forfeiting the debt, and paying the charges at law.

BARI, a very handsome and rich town of Italy, in the kingdom of Naples; the capital of Terra di Bari, and an archbishop's see. It is well fortified, is seated on the gulf of Venice, and had formerly a good harbour, but it was destroyed by the Venetians. E. Long. 17. 40. N. Lat. 41. 31.

Bari, or *Terra di Bari*, a territory of Italy, in the kingdom of Naples, of which the above-mentioned city is the capital. It is bounded on the north by the Capitanata, on the north-west by the Ulterior Principato, on the south by the Basilicata, on the south-east by the Terra de Otranto, and on the north-east by the gulf of Venice. It has no considerable river except the Offanto, which separates it from the Capitanata. The air is temperate; and the soil produces plenty of corn, fruit, and saffron: but there are a great many serpents, and spiders called *tarantulas*. See Aranea. The principal towns are Bari the capital, Frani, Andria, Bavo, Bilonto, Conversano, Monopoli, Polignano, Barletto, and Malsetto. The two first are archiepiscopal, and all the rest episcopal.

BARILLA, or Barilha, the name of a plant cultivated in Spain for its ashes, from which the purest kinds of mineral alkali or soda are obtained.

There are four plants, which, in the early part of their growth, bear so strong a resemblance to each other as would deceive any but the farmers and nice observers. These four are, *barilla*, *gazul* (or, as some call it, *algazul*), *soza*, and *salicornia* or *salicor*. They are all burnt to ashes; but applied to different uses, as being possessed of different qualities. Some of the roguish farmers mix more or less of the three last with the first; and it requires a complete knowledge of the colour, taste, and smell of the ashes to be able to detect their knavery.

Barilla is sown afresh every year. Its greatest height above ground is four inches: each root pushes out a vast number of little stalks, which again are subdivided into smaller sprigs resembling samphire; and all together form a large spreading tufted bush. The colour is bright green; as the plant advances towards maturity, this colour vanishes away till it comes at last to be a dull green tinged with brown.

Gazul bears the greatest affinity to barilla, both in quality and appearance: the principal difference consists in its growing on a still drier salter earth, consequently it is impregnated with a stronger salt. It does not rise above two inches out of the ground, spreading out into little tufts. Its sprigs are much flatter and more pulpy than those of barilla, and are still more like samphire. It is sown but once in three, four, or five years, according to the nature of the soil.

Soza, when of the same size, has the same appearance as gazul; but in time grows much larger, as its natural soil is a strong salt marsh, where it is to be found in large tufts of sprigs, treble the size of barilla, and of a bright green colour, which it retains to the last.

Salicor has a stalk of a deep green colour inclining to red, which last becomes by degrees the colour of the whole plant. From the beginning it grows upright, and much resembles a bush of young rosemary. Its natural soil is on the declivities of hills near the salt marshes, or on the edges of the small drains or channels cut by the husbandmen for the purpose of watering the fields; before it has acquired its full growth, it is very like the barilla of those seasons in which the ground has been dunged before sowing. In those years of manuring, barilla, contrary to its usual nature, comes up with a tinge of red; and when burnt falls far short of its wonted goodness, being bitter, more impregnated with salts than it should be, and raising a blister if applied for a few minutes to the tongue. Barilla contains less salt than the others: when burnt, it runs into a mass resembling a spongy stone, with a faint cast of blue.

Gazul, after burning, comes as near barilla in its outward appearance as it does while growing in its vegetable form; but if broken, the inside is of a deeper and more glossy blue. Soza and salicor are darker, and almost black within, of a heavier consistence, with very little or no sign of sponginess.

All these ashes contain a strong alkali; but barilla the best and purest, though not in the greatest quantity. Upon this principle, it is fittest for making glass and bleaching linen; the others are used in making soap. Each of them would whiten linen; but all, except barilla, would burn it. A good crop of barilla impoverishes the land to such a degree, that it cannot bear good barilla a second time, being quite exhausted. For this reason the rich farmers lay manure upon the ground, and let it lie fallow for a season; at the end of which it is sown afresh without any danger, as the weeds that have sprung up in the year of rest have carried off all the pernicious effects of the dung. A proper succession of crops is thus secured by manuring and fallowing the different parts of the farm, each in their turn. The poorer tribe of cultivators cannot pursue the same method for want of capital; and are therefore under the necessity of sowing their lands immediately after manuring, which yields them a profit just sufficient to afford a present scanty subsistence, though the quality and price of their barilla be but trifling.

The method used in making barilla is the same as that followed in Britain in burning kelp. The plant as soon as ripe is plucked up and laid in heaps, then set on fire. The salt juices run out below into a hole made in the ground, where they run into a vitrified lump, which is left about a fortnight to cool. An acre may give about a tun.

BARING of trees, in *Agriculture*, the taking away some of the earth about the roots, that the winter-rain and snow-water may penetrate farther into

into the roots. This is frequently practised in the autumn.

BARJOLS, a town of Provence, now the department of Var, in France, containing 3025 inhabitants in 1815. E. Long. 5. 23. N. Lat. 43. 35.

BARIUM, in *Ancient Geography*, a town of Apulia, on the Adriatic; so called from the founders, who being expelled from the island Bara, built this town. It is now called BARI; see that article.

BARK, in the anatomy of plants, the exterior part of trees, corresponding to the skin of an animal. For its organization, texture, &c. see the article PLANTS.

As animals are furnished with a panniculus adiposus, usually replete with fat, which invests and covers all the fleshy parts, and screens them from external cold; plants are encompassed with a bark replete with fatty juices, by means whereof the cold is kept out, and in winter-time the spiculæ of ice prevented from fixing and freezing the juices in the vessels: whence it is, that some sort of trees remain evergreen the year round, by reason their barks contain more oil than can be spent and exhaled by the sun, &c.

The bark has its peculiar diseases, and is infested with insects peculiar to it.—It appears from the experiments of M. Buffon, that trees stripped of their bark the whole length of their stems, die in about three or four years. But it is very remarkable, that trees thus stripped in the time of the sap, and suffered to die, afford timber heavier, more uniformly dense, stronger, and fitter for service, than if the trees had been cut down in their healthy state. Something of a like nature has been observed by Vitruvius and Evelyn.

The ancients wrote their books on bark, especially of the ash and lime tree, not on the exterior, but on the inner and finer bark called *philyra*.

There are a great many kinds of barks in use in the several arts. Some in agriculture, and in tanning leather, as the oak-bark; some in physic, as the *quinquina* or Jesuit's bark, mace, &c.; others in dyeing, as the bark of alder, and walnut-trees; others in spicery, as cinnamon, cassia lignea, &c.; and others for divers uses, as the bark of the cork tree, &c.

In the East Indies, they prepare the bark of a certain tree so as to spin like hemp. After it has been beat and steeped in water, they extract long threads from it, which are something between silk and common thread; being neither so soft nor so glossy as silk, nor so rough and hard as hemp. They mix silk with it in some stuffs; and these are called *nillaes*, and *cherquemolles*.

Of the bark of a species of mulberry-tree the Japanese make their paper. See MORUS.

In the island of Otaheite, the natives make their cloth, which is of three kinds, of the bark of three different trees; the paper-mulberry above mentioned, the bread-fruit tree, and the cocoa tree. That made of the mulberry is the finest and whitest, and worn chiefly by the principal people. It is manufactured in the following manner. When the trees are of a proper size, they are drawn up, and stripped of their branches; after which, the roots and tops are cut off: the bark of these rods being then slit up longitudinally, is easily drawn off; and, when a proper quantity has been procured, it is carried down to some running water, in which it is deposited to soak, and secured from floating away by heavy stones: when it is supposed to be sufficiently softened, the women servants go down to the brook, and stripping themselves, sit down in the water, to separate the inner bark from the green part on the outside: to do this, they place the under side upon a flat smooth board, and with a kind of shell scrape it very carefully, dipping it continually in the water till nothing remains but the fine fibres of the inner coat. Being thus prepared in the afternoon, they are spread out upon plantain leaves in the evening; they are placed in lengths of about 11 or 12 yards, one by the side of another, till they are about a foot broad, and two or three layers are also laid one upon the other: care is taken that the cloth shall be in all parts of an equal thickness, so that if the bark happens to be thinner in any one particular part of one layer than the rest, a piece that is somewhat thicker is picked out to be laid over in the next. In this state it remains till the morning, when great part of the water which it contained when it was laid out is either drained off or evaporated, and the several fibres adhere together, so as that the whole may be raised from the ground in one piece. It is then taken away, and laid upon the smooth side of a long piece of wood prepared for the purpose, and beaten by the women servants. The instrument used for this purpose is a square wooden club, having each of its four sides or faces marked, lengthwise, with small grooves, or furrows, of different degrees of fineness; those on one side being of a width and depth sufficient to receive a small pack-thread, and the others finer in a regular gradation, so that the last are not more than equal to sewing silk. They beat it first with the coarsest side of this mallet, keeping time like our smiths; it spreads very fast under the strokes, chiefly however in the breadth, and the grooves in the mallet mark it with the appearance of threads; it is successively beaten with the other sides, last with the finest, and is then fit for use. Of this cloth there are several sorts, of different degrees of fineness, in proportion as it is more or less beaten. The other cloth also differs in proportion as it is beaten; but they differ from each other in consequence of the different materials of which they are made. The bark of the bread-fruit is not taken till the trees are considerably longer and thicker than those of the mulberry; the process afterwards is the same.—Of the bark, too, of a tree which they call *poerou**, they manufacture excellent matting; both a coarse sort which serves them to sleep upon, and a finer to wear in wet weather. Of the same bark they also make ropes and lines, from the thickness of an inch to the size of a small pack-thread.

* *Hibiscus tiliaceus* of Linnæus.

BARK, or *Jesuit's Bark*, is a name given by way of eminence to the quinquina, or cinchona. See CINCHONA.

BARK, in *Navigation*, a general name given to small ships; it is, however, peculiarly appropriated by seamen to those which carry three masts without a mizen topsail. Our northern mariners, who are trained in the coal-trade, apply this distinction to a broad-sterned ship which carries no ornamental figure on the stern or prow.

Water-BARKS, are little vessels used in Holland for the carriage of fresh water to places where it is wanting,

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ing, as well as for the fetching sea-water to make salt of. They have a deck, and are filled with water up to the deck.

Bark-Binding, a distemper incident to trees; cured by slitting the bark, or cutting along the grain.

Bark-Galling, is when the trees are galled with thorns, &c. It is cured by binding clay on the galled places.

Bark-Longue, or *Barca Longa*, a small, low, sharp-built, but very long vessel, without a deck. It goes with sails and oars, and is very common in Spain.

BARKHAMSTEAD, or BERKHAMSTEAD, a town of Hertfordshire in England, seems to have been the site of a Roman town. It had formerly a strong castle, which has long since been demolished. Population 1963 in 1811. W. Long. 0. 35. N. Lat. 45. 49.

BARKING, a town of Essex, in England, with 2421 inhabitants, seated on the river Roding, not far from the Thames, in a very unwholesome air. It has been chiefly noted for a large monastery, now in ruins; there being nothing left standing but a small part of the walls and a gate-house. E. Long. 0. 13. N. Lat. 51. 30.

Barking of Trees, the peeling off the rind or bark. This must be done, in our climate, in the month of May, because at that time the sap of the tree separates the bark from the wood. It would be very difficult to perform it at any other time of the year, unless the season was extremely wet and rainy; for heat and dryness are a very great hindrance to it.

By the French laws, all dealers are forbid to bark their wood while growing, on the penalty of 500 livres. This law was the result of ignorance; it being now found that barking of trees, and letting them die, increases the strength of timber.

BARKLEY, a town of Gloucestershire in England, seated on a branch of the river Severn, with 616 inhabitants in 1811. It had formerly a nunnery, and has still the title of a barony. W. Long. 2. 30. N. Lat. 51. 40.

BARKWAY, a town of Hertfordshire in England, on the great road from London to York. W. Long. 0. 5. N. Lat. 52.

BARLÆUS, GASPAR, professor of philosophy at Amsterdam, and one of the best Latin poets of the 17th century. There was scarce any thing great that happened in the world, while he lived, but he made a pompous elegy upon it, when reasons of state were no obstacle to it. He was a great defender of Arminius; and showed his abilities in history by his relation of what passed in Brasil during the government of Count Maurice of Nassau, published in 1647. He died the year after.

BARLERIA, SNAP-DRAGON. See BOTANY *Index*.

BARLETTA, a handsome and strong town of Italy, in the kingdom of Naples, and in the Terra di Bari, with a bishop's see. It is situated on the gulf of Venice, in E. Long. 16. 32. N. Lat. 41. 30.

BARLEY, in *Botany*. See HORDEUM, BOTANY and AGRICULTURE *Index*.

The principal use of barley among us is for making beer; in order to which it is first malted. See the article BEER.

The Spaniards, among whom malt liquors are little known, feed their horses with barley as we do with oats. In Scotland, barley is a common ingredient in broths; and the consumpt of it for that purpose is very considerable, *barley-broth* being a dish as frequent there as that of *soup* in France.

Pearl Barley, and *French Barley*; barley freed of the husk by a mill; the distinction between the two being, that the pearl barley is reduced to the size of small shot, all but the very heart of the grain being ground away.

Barley-Water, is a decoction of either of these, reputed soft and lubricating, of frequent use in physic. This well known decoction is a very useful drink in many disorders; and is recommended, with nitre, by some authors of reputation, in slow fevers.

Barley-Corn is used to denote a long measure, containing in length the third part of an inch, and in breadth the eighth. The French carpenters also use barley-corn, *grain d'orge*, as equivalent to a line, or the twelfth part of an inch.

Barley-Corn (*grain d'orge*), is also used in building for a little cavity between the mouldings of joiners work, served to separate or keep them asunder; thus called because made of a kind of plane of the same name.

BARLOW, WILLIAM, bishop of Chichester, descended of an ancient family in Wales, was born in the county of Essex. In his youth he favoured the Reformation; and travelled to Germany to be instructed by Luther, and other preachers of the new doctrine. How long he continued a Protestant is uncertain: but from his letter to King Henry VIII. quoted below, it appears that he wrote several books against the church of Rome. However, he was a regular canon in the Augustine monastery of St Osith in the county of Essex, and studied some time at Oxford with the brothers of that order, where he took the degree of doctor in divinity. He was then made prior of the convent at Bisham in Berkshire; and afterwards succeeded to the several priories of Blackmore, Typtree, Lega, Bromhole, and Haverford-west. On the dissolution of abbeys, he resigned not only with a good grace, but persuaded several other abbots to follow his example. King Henry was so pleased with his ready obedience on this occasion, that he sent him, in 1535, on an embassy to Scotland; in the same year made him bishop of St Asaph; in two months after, translated him to the see of St David's, and in 1547 to that of Bath and Wells. During this time, our good bishop, as appears from the following epistle to the king, was, or pretended to be, a staunch Papist: it was written in 1533. "Prayse be to God, who of his infynyte goodness and mercy inestymable hath brought me out of darkness into light, and from deadly ignorance into the quick knowledge of the truth. From which, through the fiend's instigation and false persuasion, I have greatly swerved. In so much that I have made certayn bokes, and have suffered them to be emprinted, as the tretise of the *Buryall of the Mass*, &c. In these tretises I perceive and acknowledge myself grievously to have erred, namely against the blessed sacrament of the altare; disallowing the masse and denying purgatory, with slanderous infamy of the pope and my lord cardinal, and outrageous rayling against the clergy; which I have forsaken and utterly renounced—Asks pardon William Barlow." However, when Edward VI. came to the crown, he was again a Protestant; and for that

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that reason, on Queen Mary's accession, was deprived of his bishopric, and sent prisoner to the Fleet, where he continued some time. At length he found means, to escape, and immediately joined the other English Protestants in Germany. When Queen Elizabeth ascended the throne, our prelate was raised to the see of Chichester, and soon after made first prebendary of the collegiate church of Westminister. He died in 1568, and was buried in the cathedral at Chichester. He had five daughters, each of whom married a bishop. He wrote, 1. The Buryal of the masse. 2. The climbing up of Fryers and religious Persons, portred with Figures. 3. Christian Homilies. 4. A book upon Cosmography. 5. The godly and pious Institution of a Christian Man, commonly called the *Bishop's Book;* and several other works. He is said to be the translator of the Apocrypha as far as the book of Wisdom. His letters to M. Parker are in manuscript in Corpus Christi college, Cambridge, Misc. i. 445.

BARLOW, *William*, a mathematician and divine, the son of the bishop of Chichester, was born in Pembrokeshire whilst his father was bishop of St David's. In 1560, he was entered commoner of Baliol college in Oxford; and in 1564, took a degree in arts, which having completed by determination, he left the university and went to sea; but in what capacity is uncertain: however, he acquired considerable knowledge in the art of navigation. About the year 1573, he entered into orders, and became prebendary of Winchester and rector of Easton near that city. In 1588 he was made prebendary of Litchfield, which he exchanged for the place of treasurer of that church. Some years after, he was made chaplain to Prince Henry, the son of King James I.; and in 1614, archdeacon of Salisbury. He was the first writer on the nature and properties of the magnet. Barlow died in the year 1625, and was buried in the church at Easton. His works are, 1. "The Navigator's Supply, containing many things of principal importance belonging to navigation, and use of diverse instruments framed chiefly for that purpose." London, 1597, 4to, Dedicated to Robert earl of Essex. 2. "Magnetical Advertisements, or diverse pertinent Observations and approved Experiments concerning the Nature and Properties of the Loadstone." London, 1616, 4to. 3. "A brief Discovery of the idle Animadversions of Mark Ridley, M. D. upon a Treatise entitled Magnetical Advertisements." London, 1618, 4to.

BARLOW, *Thomas*, born in 1607, was appointed fellow of Queen's college in Oxford in 1633; and two years after was chosen reader of metaphysics to the university. He was keeper of the Bodleian library, and in 1657 was chosen provost of Queen's college. After the restoration of King Charles II. he was nominated one of the commissioners for restoring the members unjustly expelled in 1648. He wrote at that time The Case of Toleration in Matters of Religion, to Mr R. Boyle. In 1675, he was made bishop of Lincoln. After the popish plot, he published several tracts against the Roman catholic religion; in which he shows an uncommon extent of learning, and skill in polemical divinity. Nevertheless, when the duke of York was proclaimed king, he took all opportunities of expressing his affection toward him; but after the revolution he as readily voted that the king had abdicated his kingdom; and was very vigorous in excluding those of the clergy who refused the oaths, from their benefices.

Mr Granger observes, that "this learned prelate, whom nature designed for a scholar, and who acted in conformity with the bent of nature, was perhaps as great a master of the learned languages, and of the works of the celebrated authors who have written in those languages, as any man in his age. The greatest part of his writings, of which Mr Wood has given us a catalogue, are against Popery: and his conduct for some time, like that of other Calvinists, appeared to be in direct opposition to the church of Rome. But after James ascended the throne, he seemed to approach much nearer to Popery than he ever did before. He sent the king an address of thanks for his declaration for liberty of conscience, and is said to have written reasons for reading that declaration. His compliances were much the same after the revolution. His moderation, to call it by the softest name, was very great; indeed so great as to bring the firmness of his character in question. But casuistry reconciles seeming contradictions. He was, abstracted from this laxity of principles, a very great and worthy man." He died at Buckden, in Huntingdonshire, on the 8th of October 1691, in the 85th year of his age.

BARLOW, *Francis*, an English painter, was born in Lincolnshire. On his coming to London, he was placed with one Shephard, a limner; but his genius led him chiefly to drawing of birds, fish, and other animals. There are six books of animals from his drawings, and he painted some ceilings with birds for noblemen and gentlemen in the country. His etchings are numerous; his illustration of Esop is his greatest work. He died in 1702. There is something pleasing in the composition and manner of this master, though neither is excellent. His drawing too is very indifferent; nor does he characterize any animal justly. His birds in general are better than his beasts.

BARLOW, *Joel*, an American literary and political character. See SUPPLEMENT.

BARM, the same with yest. See YEST.—Barm is said to have been first used by the Celtæ in the composition of bread. About the time of Agricola's entrance into Lancashire, a new sort of loaf had been introduced at Rome, which was formed only of water and flour, and much esteemed for its lightness: and it was called the *water cake* from its simple composition, and the *Parthian roll* from its original inventors. But even this was not comparable to the French or Spanish bread for its lightness. The use of curmi*, and the knowledge of brewing, had acquainted the Celtes with an ingredient for their bread, which was much better calculated to render it light and pleasant, than the leaven, the eggs, the milk, or the wine and honey, of other nations. This was the spume which arose on the surface of their curmi in fermentation, and which the Welch denominate *burm*, and we *barm*. The Celtes of Gaul, of Spain, and most probably therefore of South Britain, had long used it; and their bread was, in consequence of this, superior in lightness to that of any other nation in the world†. See the articles BAKING and BREAD.

* See *Ale*.

† *Pliny*, lib. xviii. c. 7.

BARMAS, an East Indian people, who in 1515 possessed

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possessed all the coast extending from Bengal to Pegu. It appears also, that they were formerly masters of Ava, the dominions of which extended as far as China; and of consequence the Barmas were masters of most of the northern parts of the peninsula beyond the Ganges. Their dominions, however, were afterwards reduced to very narrow bounds, and their king became tributary to the king of Pegu; but by degrees they not only recovered their former empire, but conquered the kingdoms of Pegu, Siam, and several others. By the latest accounts, their kingdom extends from the province of Yun-nan in China, about 800 miles in length from north to south, and 250 in breadth from east to west. See ASIA and PEGU.

BARN, in *Husbandry*, a covered place or house, with air-holes in the sides, for laying up any sort of grain, hay, or straw.

ST BARNABAS'S DAY, a Christian festival, celebrated on the 11th of June.—St Barnabas was born in Cyprus, and descended of the tribe of Levi, whose Jewish ancestors are thought to have retired thither to secure themselves from violence during the troublesome times in Judea. His proper name was *Joses;* to which, after his conversion to Christianity, the apostles added that of *Barnabas*, signifying either *the son of prophecy*, or *the son of consolation;* the first respecting his eminent *prophetic gifts*, the other his *great charity* in selling his estate for the comfort and relief of the poor Christians. He was educated at Jerusalem, under the great Jewish doctor Gamaliel; which might probably lay the foundation of that intimate friendship which was afterwards contracted between this apostle and St Paul. The time of his conversion is uncertain; but he is generally esteemed one of the seventy disciples chosen by our Saviour himself.

At Antioch, St Paul and St Barnabas had a contest, which ended in their separation: but what followed it with respect to St Barnabas is not related in the *Acts of the Apostles*. Some say, he went into Italy, and founded a church at Milan. At Salamis, we are told, he suffered martyrdom; whither some Jews, being come out of Syria, set upon him, as he was disputing in the synagogue, and stoned him to death. He was buried by his kinsman Mark, whom he had taken with him, in a cave near that city. The remains of his body are said to have been discovered in the reign of the emperor Zeno, together with a copy of St Matthew's gospel, written with his own hand, and lying on his breast.

St BARNABAS's Epistle, an apocryphal work ascribed to St Barnabas, and frequently cited by St Clement of Alexandria and Origen. It was first published in Greek, from a copy of Father Hugh Menard, a Benedictine monk. An ancient version of it was found in a manuscript of the abbey of Coebey, near a thousand years old. Vossius published it, in the year 1656, together with the epistles of St Ignatius.

St BARNABAS's Gospel, another apocryphal work, ascribed to St Barnabas the apostle, wherein the history of Jesus Christ is related in a manner very different from the account given us by the four Evangelists. The Mahometans have this gospel in Arabic, and it corresponds very well with those traditions which Mahomet followed in his Koran. It was, probably, a forgery of some nominal Christians; and afterwards altered and interpolated by the Mahometans, the better to serve their purpose.

BARNABITES, a religious order, founded in the 16th century by three Italian gentlemen, who had been advised by a famous preacher of those days to read carefully the epistles of St Paul. Hence they were called *clerks of St Paul;* and *Barnabites*, because they performed their first exercise in a church of St Barnabas at Milan. Their habit is black; and their office to instruct, catechise, and serve in mission.

BARNACLE, a species of goose. See ANAS, ORNITHOLOGY *Index*.

BARNACLES, in *Farriery*, an instrument composed of two branches joined at one end with a hinge, to put upon horses noses when they will not stand quietly to be shod, blooded, or dressed.

BARNADESIA. See BOTANY *Index*.

BARNARD, or BERNARD, JOHN, the son of John Barnard gent. was born at Castor in Lincolnshire, and educated at Cambridge. After several preferments, he was made a prebendary of the church of Lincoln. He wrote *Censura Clerior*, against scandalous ministers not fit to be restored to church livings; the Life of Dr Heylyn; and a few other works. He died at Newark, August 17. 1683.

BARNARD Castle, seated on the river Tees in the county of Durham, is a town and barony belonging to Vane earl of Darlington. It is indifferently large, and has a manufactory of stockings. W. Long. 1. 45. N. Lat. 54. 35.

BARNES, JOSHUA, professor of the Greek language at Cambridge, in the beginning of the 18th century. He was chosen queen's professor of Greek in 1695, a language he wrote and spoke with the utmost facility. His first publication was a whimsical tract, entitled *Gerania*, or a New Discovery of the little sort of people called Pygmies. After that appeared his Life of Edward III. in which he introduces his hero making long and elaborate speeches. In the year 1700, when he published many of his works, Mrs Mason, of Hemmingford, in Huntingdonshire, a widow lady of between 40 and 50, with a jointure of 200l. per annum, who had been for some time a great admirer of him, came to Cambridge, and desired leave to settle 100l. a-year upon him after her death; which he politely refused, unless she would likewise condescend to make him happy with her person, which was not very engaging. The lady was too obliging to refuse any thing to Joshua, for whom she said, "the sun stood still;" and they were accordingly married. Mr Barnes wrote several other books besides those above mentioned, particularly, Sacred Poems; The Life of Oliver Cromwell, the Tyrant; several dramatic pieces; a poetical Paraphrase on the History of Esther, in Greek verse, with a Latin translation, &c.: and he published editions of Euripides, Anacreon, and Homer's Iliad and Odyssey, with notes and a Latin translation. He wrote with greater ease in Greek than even in English, and yet is generally allowed not to have understood the delicacies of that language. He was of such a humane disposition, and so unacquainted with the world, that he gave his only coat to a vagrant begging at his door. This excellent man died on the 3d of August 1712, in the 58th year of his age.

BARNEVELDT, JOHN D'OLDEN, the celebrated Dutch

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Dutch statesman, and one of the founders of the civil liberty of Holland. His patriotic zeal inducing him to limit the authority of Maurice prince of Orange the second stadtholder of Holland, the partizans of that prince falsely accused him of a design to deliver his country into the hands of the Spanish monarch. On this absurd charge he was tried by 26 commissaries deputed from the seven provinces, condemned, and beheaded in 1619. His sons William and Réné, with a view of revenging their father's death, formed a conspiracy against the stadtholder, which was discovered. William fled: but Réné was taken and condemned to die; which fatal circumstance has immortalized the memory of his mother, of whom the following anecdote is recorded. She solicited a pardon for Réné; upon which Maurice expressed his surprise that she should do that for her son which she had refused for her husband. To this remark, she replied with indignation, "I would not ask a pardon for my husband, because he was innocent. I solicit it for my son, because he is guilty."

BARNET, a town partly in Middlesex and partly in Hertfordshire. It is a great thoroughfare, and the market is very remarkable for hogs. Population 1579. W. Long. 0. 5. N. Lat. 51. 42.

BARNSLEY, or BLACK BARNSLEY, a town of the west riding of Yorkshire, seated on the side of a hill, and five furlongs in length, and containing 5014 inhabitants in 1811. W. Long. 1. 20. N. Lat. 53. 35.

BARNSTABLE, a sea-port town of Devonshire, seated on the river Tau, over which there is a good bridge. It sends two members to parliament, and had 4019 inhabitants in 1811. W. Long. 4. 5. N. Lat. 51. 15.

BARO, or BARON, PETER, professor of divinity in the university of Cambridge, in the 16th century, was born at Estampes in France, and educated in the university of Bourges, where he was admitted a licentiate in the law: but being of the Protestant religion, he was obliged to leave his native country to avoid persecution; and withdrawing into England, was kindly entertained by Lord Burleigh. He afterwards settled at Cambridge; and by the recommendation of his noble patron, was, in 1574, chosen Lady Margaret's professor there. For some years he quietly enjoyed his professorship; but there was at last raised a restless faction against him, by his opposing the doctrine of absolute predestination; which rendered his place so uneasy to him, that he chose to leave the university, and to settle in London. He wrote, 1. *In Jonam Prophetam Prælectiones* xxxix. 2. *De Præstantia et Dignitate Divinæ Legis*; and other pieces. He died in London, about the year 1600.

BAROCCI, FREDERIC, a celebrated painter, was born at Urbino, where the genius of Raphael inspired him. In his early youth he travelled to Rome; where he painted several things in fresco. He then returned to Urbino; and giving himself up to intense study, acquired a great name in painting. His genius particularly led him to religious subjects. At his leisure hours, he etched a few prints from his own designs; which are highly finished, and executed with great softness and delicacy. The *Salutation* is his capital performance in that way: of which we seldom meet with any impressions, but those taken from the retouched plate, which are very harsh. He died at Urbino in 1612, aged 84.

BAROCHE, or BROACH, a town of Cambaya, in Hindostan; it is walled round, and was formerly a place of great trade. It is now inhabited by weavers and such mechanics as manufacture cotton cloth. Here they have the best cotton in the world, and the best bastas are manufactured in this place. It was taken possession of by the British in 1803, and is still retained by them. E. Long. 72. 5. N. Lat. 22. 15.

BAROCO, in *Logic*, a term given to the fourth mode of the second figure of syllogisms. A syllogism in baroco has the first proposition universal and affirmative, but the second and third particular and negative, and the middle term is the predicate in the two first propositions. For example,

Nullus homo non est bipes:
Non omne animal est bipes:
Non omne animal est homo.

BAROMETER (from βαρος, *weight*, and μετρον, *measure*), an instrument for measuring the weight of the atmosphere, and of use in foretelling the changes of the weather, and also for measuring the height of mountains, &c.

1 Principles of the barometer.

The common barometer consists of a glass tube hermetically sealed at one end, and filled with quicksilver well defecated and purged of its air. The finger being then placed on the open end, in immediate contact with the mercury, so as not to admit the least particle of air, the tube is inverted, and the lower end plunged into a bason of the same prepared mercury; then upon removing the finger, the mercury in the tube will join that in the bason, and the mercurial column in the tube will subside to the height of 29 or 30 inches, according to the state of the atmosphere at that time. This is the principle on which all barometers are constructed. Of their invention, the different kinds of them, and the theories by which their phenomena are solved, we shall proceed to give an historical account.

2 Discovered by Galileo, and improved by Torricelli.

In the beginning of the last century, when the doctrine of a plenum was in vogue, philosophers were of opinion, that the ascent of water in pumps was owing to the abhorrence of a vacuum; and that by means of suction, fluids might be raised to any height whatever. But Galileo, who flourished about that time, discovered that water could not ascend in a pump unless the sucker reached within 33 feet of its surface in the well. From hence he concluded, that not the power of suction, but the pressure of the atmosphere, was the cause of the ascent of water in pumps; that a column of water 33 feet high was a counterpoise to one of air, of an equal base, whose height extended to the top of the atmosphere; and that for this reason the water would not follow the sucker any farther. From this Torricelli, Galileo's disciple, took the hint; and considered, that if a column of water of about 33 feet in height was equal in weight to one of air having the same base, a column of mercury no longer than about $29\frac{1}{2}$ inches would be so too, because mercury being about 14 times heavier than water, a column of mercury must be 14 times shorter than one of water equally heavy. Accordingly, having filled a glass tube with mercury, and inverted it into a bason of the same, he found the mercury in the tube to descend till it stood about $29\frac{1}{2}$ inches above the surface of that in the bason.

3 Strange hypothesis of Linus.

Notwithstanding this clear proof of the pressure of the atmosphere, however, the assertors of a plenum left no means untried to solve the phenomena of the Torricellian experiment by some other hypothesis. The most ridiculous solution, and which at the same time gave the adverse party the greatest difficulty to overthrow it, was that of Linus. He contended, that in the upper part of the tube, there is a film or *rope of mercury*, extended through the seeming vacuity; and that, by this rope, the rest of the mercury was suspended, and kept from falling into the bason.

4 Experiments in confirmation of it.

Even this so absurd hypothesis he pretended to confirm by the following experiments. Take, says he, a small tube, open at both ends, suppose about 20 inches long; fill this tube with mercury, stopping the lower orifice with your thumb: Then closing the upper end with your finger, and immerging the lower in stagnant mercury, you shall perceive, upon the removal of your thumb, a manifest suction of your finger into the tube; and the tube and mercury will both stick so close to it that you may carry them about the room. Therefore, says he, the internal cylinder of mercury in the tube is not held up by the preponderate air without; for if so, whence comes so strong a suction, and so firm an adhesion of the tube to the finger?—The same effect follows, though the tube be not quite filled with mercury; for if a little space of air is left at the top, after the tube is immerged in the stagnant mercury, there will be a considerable suction as before.

5 Refuted.

These experiments, which are themselves clear proofs of the pressure of the air, supported for some time the *funicular* hypothesis, as it was called, of Linus. But when it was discovered, that if the tube was carried to the top of a high mountain the mercury stood lower than on the plain, and that if removed into the vacuum of an air-pump it fell out altogether, the hypothesis of Linus was rejected by every body.

6 Remarkable experiments by Mr Huygens.

—There, are, however, two experiments which create a considerable difficulty. One is mentioned by Mr Huygens, viz. that if a glass tube 75 inches long, or perhaps longer, is filled with mercury well purged of its air, and then inverted, the whole will remain suspended; whereas, according to the Torricellian experiment, it ought to subside immediately to the height of 29 or 30 inches. It is true indeed, that, upon shaking the tube, the mercury presently subsides to that height; but why it should remain suspended at all, more than twice the height to which it can be raised by the pressure of the most dense atmosphere, seems not easily accounted for:

7 Unsatisfactorily accounted for in the Philosophical Transactions.

and accordingly, in the Philosophical Transactions we find attempts to account for it by the pressure of a medium more subtile than the common air, and capable of pervading both the mercury and glass. We find there also another very surprising fact of the same kind mentioned; viz. that a pretty large tube under 29 inches in length, filled with mercury, and inverted into a bason of the same, will remain full, though there be a small hole in the top. This too, is there accounted for by the pressure of a medium more subtile than common air; but by no means in a satisfactory manner.

8 Mr Rowning's solution.

Mr Rowning, who mentions the phenomenon of the 75 inch tube, accounts for it in the following manner. "The cause of this phenomenon seems to be, that by the great weight of so long a column of mercury, it was pressed into so close contact with the glass in pouring in, that, by the mutual attraction of cohesion between the mercury and the glass, the whole column was sustained after the tube was inverted."

9 Insufficient.

—Here, however, we must observe, that this solution seems equally unsatisfactory with that of the subtile medium already mentioned; because it is only one end of the column which sustains so great a pressure from the weight of the mercury; and therefore, though five or six inches of the upper part of the tube, where the pressure had been strongest, might thus remain full of mercury, yet the rest ought to fall down. Besides, it is only the outside of the mercurial column that is in contact with the glass, and consequently these parts only ought to be attracted. Therefore, even granting the pressure to be equally violent, on the inversion of the tube, all the way from 29 to 75 inches, yet the glass ought to be only as it were silvered over by a very thin film of mercury, while the middle parts of the column ought to fall out by reason of their fluidity.

10 Another experiment with siphons.

The other experiment hinted at, is with regard to siphons: which, though it belongs more properly to the article HYDROSTATICS, yet seems necessary to be mentioned here. It is this: That a siphon, once set a running, will continue to do so though set under the receiver of an air-pump and the air exhausted in the most perfect manner; or if a siphon is filled, and then set under a receiver and the air exhausted, if by any contrivance the end of the lower leg is opened, it will immediately begin to run, and discharge the water of any vessel in which the other leg is placed, as though it was in the open air. The cause of this phenomenon, as well as the former, seems very difficult to be investigated.

11 Another solution.

Some philosophers have attempted a solution on a principle something similar to that of the funicular hypothesis of Linus above-mentioned; namely, that "fluids in siphons seem as it were to form one continued body; so that the heavier part, descending, like a chain pulls the lighter after it." This might be deemed a sufficient explanation, if the siphon were only to empty the water it at first contains in itself:

12 Insufficient.

but when we consider that the water in the vessel, which much exceeds the quantity contained in the siphon, is likewise evacuated, this hypothesis can by no means be admitted; because this would be like the lighter part of a chain pulling the heavier after it.

13 Another solution from the action of electricity.

Concerning the cause of these singular phenomena, we can only offer the following conjecture. The existence of a medium much more subtile than air, and which pervades the vacuum of an air-pump with the utmost facility, is now sufficiently ascertained in the phenomena of electricity. It is also well known, that this fluid surrounds the whole earth to an indeterminate height. If, therefore, this fluid either is the power of gravity itself, or is acted upon by that power, it must necessarily press upon all terrestrial bodies in a manner similar to the pressure of the atmosphere. If then we could from any vessel entirely exclude this subtile fluid, and form an electrial vacuum, as well as we can do an aerial one by means of the air-pump, we would in that case see fluids as evidently raised by the pressure of the electric matter, as we now see them raised by that of the air. But though this cannot be done, we are assured that there are certain substances, of which glass is one, through which the electric manner cannot

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Barometer. pass but with difficulty. We are likewise certain, that though the electric matter passes through the pores of water, metals, &c. with very great facility, yet it still must meet with some resistance from their solid and impenetrable parts, which cannot be pervaded by any material substance. We know also, that all substances do naturally contain a certain quantity of this electric matter, which they are not always ready to part with; and when by any means the fluid they contain is set in motion, they are then said to be *electrified*. Now, though we are certain, that the friction of glass by mercury does set in motion the electric fluid contained in the mercury or in the glass; yet when the tube is filled with the metallic fluid, whatever quantity has been extricated either from the glass or mercury during the time of filling, will be re-absorbed again by the metal and conveyed to the earth during the time of inversion; and consequently, the mercurial tube, when inverted, will not be electrified, but both glass and mercury will be in their natural state. Here, then, the pressure of the electrical fluid is kept off in some measure from the upper part of the mercury by the glass, which it cannot penetrate easily at least. To the mercury in the bason it has free access, and therefore presses more upon the lower than the upper part; the consequence of which is a suspension of the mercury. It is true, this fluid very easily penetrates the metallic matter; but it must be considered, that the electric fluid itself is in some measure entangled in the particles of the quicksilver, and cannot be extricated without motion. As soon therefore as the tube is shaken, some part of the electricity is extricated, and the mercury begins to descend. The subtility of the medium is such, that no sooner has it begun to extricate itself, than, by the motion of the metal downwards, it issues forth in great quantities, so as to become visible, like a blue flame, in the dark. The equilibrium is therefore destroyed in an instant, as it would be were we to admit air to the top of the barometer; nay, in a more effectual manner. For if a small quantity of air was admitted to the top of a barometer, the mercury would only descend in proportion to the quantity of air admitted; but here, no sooner is a quantity of electric matter admitted, than it procures admission for a vast deal more, and consequently the mercury descends with accelerated velocity.—On this principle the ascent of water in the siphon while *in vacuo* is so easily accounted for, that we need not take up time in explaining it farther.—But why an inverted glass tube should remain full of mercury when it has a hole either great or small in the top, is more difficult to be accounted for, and requires this farther circumstance to be taken into consideration, viz. that though all solid bodies will, by the action of gravity, or by any other impulse, easily approach very near to one another, yet they cannot be brought into absolute contact without a very considerable force, much greater than is sufficient to overcome their gravity; and thus it appears from some experiments, that the links of a chain are by no means in contact with one another, till the chain has a considerable weight appended to it. This may be the case with the tube in question. The air by its gravity descends upon it, and is ready to enter the small hole in the top; but, by a repulsive power from the glass, its action is prevented, so that the mercury cannot fall.

It was, however, some time after the Torricellian experiment had been made, and even after it had been universally agreed that the suspension of the mercury was owing to the weight of the atmosphere, before it was discovered that this pressure of the air was different at different times though the tube was kept in the same place. But the variations of altitude in the mercurial column were too obvious to remain long unobserved; and accordingly philosophers soon became careful enough to mark them. When this was done, it was impossible to avoid observing also, that the changes in the height of the mercury were accompanied, or very quickly succeeded, by changes in the weather. Hence the instrument obtained the name of the *weather-glass*, and was generally made use of with a view to the fore-knowledge of the weather. In this character, its principal phenomena are as follow:

14 Barometer used for prognosticating the weather.

15 Its phenomena as a weather-glass by Mr Patrick.

1. The rising of the mercury presages, in general, fair weather; and its falling, foul weather, as rain, snow, high winds, and storms.

2. In very hot weather, the falling of the mercury foreshows thunder.

3. In winter, the rising presages frost; and in frosty weather, if the mercury falls three or four divisions, there will *certainly* follow a thaw. But in a continued frost, if the mercury rises, it will *certainly* snow.

4. When foul weather happens soon after the falling of the mercury, expect but little of it; and, on the contrary, expect but little fair weather when it proves fair shortly after the mercury has risen.

5. In foul weather, when the mercury rises much and high, and thus continues for two or three days before the foul weather is quite over, then expect a continuance of fair weather to follow.

6. In fair weather, when the mercury falls much and low, and thus continues for two or three days before the rain comes, then expect a great deal of wet, and probably high winds.

7. The unsettled motion of the mercury denotes uncertain and changeable weather.

8. You are not so strictly to observe the words engraven on the plates (though in general it will agree with them), as the mercury's *rising* and *falling*. For if it stand at *much rain*, and then rises up to *changeable*, it presages fair weather; though not to continue so long as if the mercury had risen higher: and so, on the contrary, if the mercury stood at *fair*, and falls to *changeable*, it presages foul weather; though not so much of it as if it had sunk lower.

16 Remarks by Mr Rowning.

These are the observations of Mr Patrick, on which Mr Rowning makes the following remarks: "From these observations it appears, that it is not so much the height of the mercury in the tube that indicates the weather, as the motion of it up and down: wherefore, in order to pass a right judgment of what weather is to be expected, we ought to know whether the mercury is actually rising or falling; to which end the following rules are of use.

"1. If the surface of the mercury is convex, standing higher in the middle of the tube than at the sides, it is generally a sign that the mercury is then rising.

"2. If the surface is concave, it is then sinking: and,

"3. If it is plain, the mercury is stationary; or rather, if it is a little convex: for mercury being put into a

Barometer. a glass tube, especially a small one, will naturally have its surface a little convex, because the particles of mercury attract one another more forcibly than they are attracted by glass. Further,

"4. If the glass is small, shake the tube; and if the air is grown heavier, the mercury will rise about half the tenth of an inch higher than it stood before; if it is grown lighter, it will sink as much. This proceeds from the mercury's sticking to the sides of the tube, which prevents the free motion of it till it is disengaged by the shock: and therefore, when an observation is to be made with such a tube, it ought always to be shaken first; for sometimes the mercury will not vary of its own accord, till the weather it ought to have indicated is present.

17 These phenomena peculiar to the temperate and frigid zones.

Here we must observe, that the above-mentioned phenomena are peculiar to places lying at a considerable distance from the equator; for, in the torrid zone, the mercury in the barometer seldom either rises or falls much. In Jamaica, it is observed by Sir William Beeston *, that the mercury in the morning constantly stood at one degree below *changeable*, and at noon sunk to one degree above *rain*; so that the whole scale of variation there was only $\frac{1}{10}$ of an inch. At St Helena, too, where Dr Halley made his observations, he found the mercury to remain wholly stationary whatever weather happened. Of these phenomena, their causes, and why the barometer indicates an approaching change of weather, the Doctor gives us the following account:

* *Philos. Transact.* N° 220.

18 Phenomena of the barometer solved by Dr Halley.

"1. In calm weather, when the air is inclined to rain, the mercury is commonly low.

"2. In serene, good, and settled weather, the mercury is generally high.

"3. Upon very great winds, though they be not accompanied with rain, the mercury sinks lowest of all. With relation to the point of the compass the wind blows upon,

"4. *Cæteris paribus*, the greatest heights of the mercury are found upon easterly, or north-easterly, winds.

"5. In calm frosty weather, the mercury generally stands high.

"6. After very great storms of wind, when the mercury has been very low, it generally rises again very fast.

"7. The more northerly places have greater alterations of the barometer than the more southerly.

"8. Within the tropics, and near them, those accounts we have had from others, and my own observations at St Helena, make very little or no variation of the height of the mercury in all weathers.

"Hence I conceive, that the principal cause of the rise and fall of the mercury is from the variable winds which are found in the temperate zones, and whose great inconstancy here in England is notorious.

"A second cause is, the uncertain exhalation and precipitation of the vapours lodging in the air, whereby it comes to be at one time much more crowded than at another, and consequently heavier; but this latter depends in a great measure upon the former. Now from these principles I shall endeavour to explicate the several phenomena of the barometer, taking them in the same order I have laid them down. Thus,

"1. The mercury's being lower inclines it to rain; because the air being light, the vapours are no longer supported thereby, being become specifically heavier than the medium wherein they floated; so that they descend towards the earth, and, in their fall, meeting with other aqueous particles, they incorporate together, and form little drops of rain: but the mercury's being at one time lower than another, is the effect of two contrary winds blowing from the place where the barometer stands; whereby the air of that place is carried both ways from it, and consequently the incumbent cylinder of air is diminished, and accordingly the mercury sinks: As, for instance, if in the German ocean it should blow a gale of westerly wind, and at the same time, an easterly wind in the Irish sea; or, if in France it should blow a northerly wind, and in Scotland a southerly; it must be granted, that that part of the atmosphere impendant over England would thereby be exhausted and attenuated, and the mercury would subside, and the vapours which before floated in these parts of the air of equal gravity with themselves would sink to the earth.

"2. The greater height of the barometer is occasioned by two contrary winds blowing towards the place of observation, whereby the air of other places is brought thither and accumulated; so that the incumbent cylinder of air being increased both in height and weight, the mercury pressed thereby must needs stand high, as long as the wind continues so to blow; and then the air being specifically heavier, the vapours are better kept suspended, so that they have no inclination to precipitate and fall down in drops, which is the reason of the serene good weather which attends the greater heights of the mercury.

"3. The mercury sinks the lowest of all by the very rapid motion of the air in storms of wind. For the tract or region of the earth's surface, wherein the winds rage, not extending all round the globe, that stagnant air which is left behind, as likewise that on the sides, cannot come in so fast as to supply the evacuation made by so swift a current; so that the air must necessarily be attenuated when and where the said winds continue to blow, and that more or less according to their violence: add to which, that the horizontal motion of the air being so quick as it is, may in all probability take off some part of the perpendicular pressure thereof; and the great agitation of its particles is the reason why the vapours are dissipated, and do not condense into drops so as to form rain, otherwise the natural consequence of the air's rarefaction.

"4. The mercury stands highest upon the easterly and north-easterly winds; because in the great Atlantic ocean, on this side the 35th degree of north latitude, the winds are almost always westerly or south-westerly; so that whenever here the wind comes up at east and north-east, it is sure to be checked by a contrary gale as soon as it reaches the ocean; wherefore, according to our second remark, the air must needs be heaped over this island, and consequently the mercury must stand high as often as these winds blow. This holds true in this country; but is not a general rule for others, where the winds are under different circumstances: and I have sometimes seen the mercury here as low as 29 inches upon an easterly wind; but then it blew exceedingly hard, and so comes to be accounted for by what was observed in the third remark.

"5. In calm frosty weather the mercury generally stands

Barometer. stands high; because (as I conceive) it seldom freezes but when the winds come out of the northern and north-eastern quarters, or at least unless those winds blow at no great distance off. For the north parts of Germany, Denmark, Sweden, Norway, and all that tract from whence north-eastern winds come, are subject to almost continual frost all the winter: and thereby the lower air is very much condensed, and in that state is brought hitherward by those winds, and, being accumulated by the opposition of the westerly wind blowing in the ocean, the mercury must needs be pressed to a more than ordinary height; and as a concurring cause, the shrinking of the lower parts of the air into lesser room by cold, must needs cause a descent of the upper parts of the atmosphere, to reduce the cavity made by this contraction to an equilibrium.

"6. After great storms, when the mercury has been very low, it generally rises again very fast: I once observed it to rise one inch and a half in less than six hours after a long-continued storm of south-west wind. The reason is, because the air being very much rarefied by the great evacuations which such continued storms make thereof, the neighbouring air runs in the more swiftly to bring it to an equilibrium; as we see water runs the faster for having a greater declivity.

"7. The variations are greater in the more northerly places, as at Stockholm greater than at Paris (compared by M. Paschal); because the more northerly parts have usually greater storms of wind than the more southerly, whereby the mercury should sink lower in that extreme; and then the northerly winds bringing in the more dense and ponderous air from the neighbourhood of the pole, and that again being checked by a southerly wind at no great distance, and so heaped, must of necessity make the mercury in such case stand higher in the other extreme.

"8. Lastly, This remark, that there is little or no variation near the equinoctial, does above all others confirm the hypothesis of the variable winds being the cause of these variations of the height of the mercury; for in the places above named there is always an easy gale of wind blowing nearly upon the same point, viz. E. N. E. at Barbadoes, and E. S. E. at St Helena; so that there being no contrary currents of air to exhaust or accumulate it, the atmosphere continues much in the same state: however, upon hurricanes, the most violent of storms, the mercury has been observed very low; but this is but once in two or three years, and it soon recovers its settled state, about $29\frac{1}{2}$ inches."

19 Objections to this theory.

This theory has been controverted, and the principal objections are, "That if the wind was the sole agent in raising or depressing the mercury, the alterations of its height in the barometer would be only relative or topical; there would still be the same quantity supported at several places taken collectively: thus what a tube at London lost, another at Paris, Pisa, or Zurich, &c. would gain. But the contrary is found to be the case; for, from all the observations hitherto made, the barometers in several distant parts of the globe rise and fall together. This is a very surprising fact; and deserves to be well examined. Again, setting aside all other objections, it is impossible, on Dr Halley's hypothesis, to explain the mercury's fall before, and rise after, rain. For suppose two contrary winds sweeping the air from over London: We know that few if any of the winds reach above a mile high; all therefore they can do will be to cut off a certain part of the column of air over London: if the consequence of this be the fall of the mercury, yet there is no apparent reason for the rains following it. The vapours indeed may be let lower; but it will only be till they come into an air of the same specific gravity with themselves; and there they will stick as before. Lastly, it is impossible, according to the laws of fluids, that the air above any place could be exhausted by the blowing of two contrary winds from it; for, suppose a north-east and south-west wind both blow from London at the same time, there will be two others at the same time blowing towards it from opposite points, viz. a north-west and south-east one, which will every moment restore the equilibrium, so that it can never be lost in any considerable degree at least."

20 Hypothesis of Mr Leibnitz.

Mr Leibnitz accounted for the sinking of the mercury before rain upon another principle, viz. That as a body specifically lighter than a fluid, while it is suspended by it, adds more weight to that fluid than when, by being reduced in its bulk, it becomes specifically heavier, and descends; so the vapour, after it is reduced into the form of clouds, and descends, adds less weight to the air than before; and therefore the mercury falls. To which it is answered, 1. That when a body descends in a fluid, its motion in a very little time becomes uniform, or nearly so, a farther acceleration of it being prevented by the resistance of the fluid; and then, by the third law of nature, it forces the fluid downwards with a force equal to that whereby it tends to be farther accelerated, that is, with a force equal to its whole weight. 2. The mercury by its descent foretels rain a much longer time before it comes, than the vapour after it is condensed into clouds can be supposed to take up in falling. 3. Supposing that as many vapours as fall in rain during a whole year were at once to be condensed into clouds, and even quite cease to gravitate upon the air, its gravity would scarcely be diminished thereby so much as is equivalent to the descent of two inches of mercury in the barometer. Besides, in many places between the tropics, the rains fall at certain seasons in very great quantities, and yet the barometer shows there very little or no alteration in the weight of the atmosphere. — 21 Refuted.

22 Another hypothesis, but insufficient.

Another hypothesis somewhat similar to that of Leibnitz has been given: but as it is liable to the objections just now mentioned, especially the last, we forbear to give any particular account of it; and shall attempt, upon other principles, to give a satisfactory solution of this phenomenon.

23 Another theory.

The necessary preliminaries to our hypothesis are, 1. That vapour is formed by an intimate union between the element of fire and that of water, by which the fire or heat is so totally enveloped, and its action so entirely suspended by the watery particles, that it not only loses its properties of giving light and of burning, but becomes incapable of affecting the most sensible thermometer; in which case, it is said by Dr Black, the author of this theory, to be in the latent state. For the proofs of this, see the articles EVAPORATION, COLD, CONGELATION, &c. 2. If the atmosphere is affected

Barometer.

affected by any unusual degree of heat, it thence becomes incapable of supporting so long a column of mercury as before, for which reason that in the barometer sinks. This appears from the observations of Sir William Beeston already mentioned; and likewise from those of De Luc, which shall be afterwards taken notice of.

These axioms being established, it thence follows, that as vapour is formed by an union of fire with water, or if we please to call it an *elective* attraction between them, or solution of the water in the fire, it is impossible that the vapour can be condensed until this union, attraction, or solution, be at an end. The beginning of the condensation of the vapour then, or the first symptoms of an approaching rain, must be the separation of the fire which lies hid in the vapour. This may be at first slow and partial, or it may be sudden and violent: in the first case, the rain will come on slowly, and after a considerable interval; and in the other, it will be very quick, and in great quantity. But Dr Black hath proved, that when fire quits its latent state, however long it may have lain dormant and insensible, it always assumes its proper qualities again, and affects the thermometer as though it had never been absorbed. The consequence of this must be, that in proportion as the latent heat is discharged from the vapour, it must sensibly affect those parts of the atmosphere into which it is discharged; and in proportion to the heat communicated to these, they will become specifically lighter, and the mercury sink of course. Neither are we to imagine that the quantity of heat discharged by the vapour is inconsiderable; for Dr Black hath shown, that when any quantity of water, a pound for instance, is condensed from the vapour of a common still, as much heat is communicated to the head and refrigeratory as would have been sufficient to heat the pound of water red hot, could it have borne that degree of sensible heat.

The causes by which this separation between the fire and water is, or may be effected, come to be considered under the articles RAIN, CONDENSATION, VAPOUR, &c. Here we have only to observe, that as the separation may be gradual and slow, the barometer may indicate rain for a considerable time before it happens: or if the sensible heat communicated from the vapour to the atmosphere shall be absorbed by the colder parts, or by any unknown means carried off, or prevented from affecting the specific gravity of the air, the barometer will not be affected; and yet the water being deprived of the heat necessary to sustain it, must descend in rain; and thus it is found that the indications of the barometer do not always hold true. Hence also it appears, that though the specific gravity of the air is diminished, unless that diminution proceeds from a discharge of the latent heat contained in the vapours, no rain will follow; and thus the sinking of the barometer may prognosticate wind as well as rain, or sometimes nothing at all.

The difficulty, however, on this hypothesis, is to account for the barometer being stationary in all weathers between the tropics; whereas it ought to move up and down there as well as here, only more suddenly, as the changes of weather there are more sudden than here. But it must be considered, that in these climates, during the daytime, the action of the sun's rays is so violent, that what is gained by the discharge of latent heat from the vapour, is lost by the interposition of the clouds betwixt the sun and earth, or by the great evaporation which is constantly going on; and in the night, the cold of the atmosphere is so much increased, that it absorbs the heat as fast as the vapour discharges it, so that no sensible effect can be produced; for in warm climates, though the day is excessively hot, the night is observed to be vastly colder in proportion than it is with us. This, however, does not prevent the barometer from being affected by other causes, as well as with us; for Dr Halley observes, that in the time of hurricanes it sinks very low. The cause of this is most probably a great commotion in the electric fluid, by which the air is internally agitated, and its power of gravitation in part suspended.—A confirmation of the above hypothesis, however, is taken from the different heights at which the mercury arrives in different climates. The barometer range, for instance, at the latitude of 45° is the greatest of all; because here the evaporation and condensation of the vapours are both very considerable, at the same time that the latent heat discharged cannot be absorbed so suddenly as in the torrid zone, the difference betwixt the length of the days and nights being greater, and consequently the nights warmer in summer and colder in winter. Farther to the northward the range is less, and in the latitude of 60° only two inches, by reason of the greater cold and length of the days and nights; whence the quantity of vapour condensed, or of latent heat expelled, becomes proportionably less.

14 Different kinds of barometers described.

Having thus given an account of the several phenomena of the barometer considered as a weather-glass, and likewise endeavoured to account for them in the most satisfactory manner, we now proceed to give a particular description of the barometers most commonly made use of, with various schemes for their improvement.

Plate LXXXV.

Fig. 1. represents the common barometer, such as was invented by Torricelli, and such as we have already given a general description of. AB represents a tube of glass, a quarter of an inch in diameter, and 34 inches long, hermetically sealed at A. This tube being supposed to be filled with mercury, is then inverted into the bason CD; upon which the mercury in the tube falls down to GH, somewhat above 28 inches, while that in the bason rises to CF. The lowest station of the mercury in this country is found to be 28 inches, and the highest 31. From the surface of the mercury CF, therefore, 28 inches are to be measured on the tube AB, which suppose to reach to the point K. This point, therefore, is the lowest of the scale of variation, and in the common barometers is marked *stormy*. In like manner, the highest point of the scale of variation I, is placed 31 inches above EF; and is marked *very dry* on one side for the summer, and *very hard frost* on the other for the winter. The next half inch below is marked *set fair* on the one side, and *set frost* on the other. At 30 inches from CF is marked the word *fair* on one side, and *frost* on the other. Half an inch below that, is wrote the word *changeable*, which answers both for summer and winter. At 29 inches is *rain* on the one side, and *snow* on the other; and at $28\frac{1}{2}$ are the words *much rain* on the one side, and *much snow* on the other. Each of these large

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 large divisions is usually subdivided into 10; and there is a small sliding index fitted to the instrument, by which the ascent or descent of the mercury to any number of divisions is pointed out. Each of these tenths is sometimes divided into *ten* more, or *hundredths* of an inch, by means of a sliding slip of brass with a *vernier* scale on it, which shall be hereafter described and explained. This kind of barometer is the most common, and perhaps the most useful and accurate, of any that has yet been invented, from the following circumstance, that the natural simplicity of its construction, in preference to others hereafter described, does not admit of any kind of resistance to the free motion of the column of mercury in the tube. The scale of variation being only three inches, and it being naturally wished to discover more minute variations than can thus be perceived, several improvements have been thought of.

The improvement most generally adopted is the diagonal barometer represented fig. 2. in which the scale of variation, instead of three inches, may be made as many feet, by bending the tube so as to make the upper part of it the diagonal of a parallelogram, of which the shortest side is the three-inches scale of variation of the common barometer. This, however, has a very great inconvenience: for not only is the friction of the mercury upon the glass so much increased that the height doth not vary with every slight change of air; but the column of mercury is apt to break in the tube, and part of it to be left behind, upon any considerable descent.

Fig. 3. is the rectangular barometer; where AC represents a pretty wide cylinder of glass, from which proceeds the tube CDF bent into a right angle at D. Suppose now the cylinder AC to be four times larger than the tube CD, so that every inch of the cylinder from C to A should be equal in capacity to four inches of the tube CD. The whole being then filled with mercury, and inverted, the mercury will subside from A to B, at the same time that it cannot run out at the open orifice F, because the air presses in that way. If any alteration then happens in the weight of the air, suppose such as would be sufficient to raise the mercury an inch from B towards A, it is evident that this could not be done without the mercury in the horizontal leg retiring four inches from E towards D; and thus the scale of variation counted on the horizontal leg would be 12 inches. But the inconveniences of friction are much greater here than in the diagonal barometer; and besides, by the least accident, the mercury is apt to be driven out at the open orifice F.

The pendant barometer (fig. 4.) consists of a single tube, suspended by a string fastened to the end A. This tube is of a conical or tapering figure, the end A being somewhat less than the end B. It is hermetically sealed at A, and filled with mercury: then will the mercury sink to its common station, and admit of a length of altitude CD, equal to that in the common barometers. But from the conical bore of the tube, the mercury will descend as the air grows lighter, till it reaches its lowest altitude, when the mercury will stand from the lower part of the tube B to E, so that BE will be equal to 28 inches: consequently the mercury will, in such a tube, move from A to E, or 32 inches, if the tube be five feet, or 60 inches; and therefore the scale AE is here above ten times greater than in the common barometer: but the fault of this barometer is, that the tubes being of a very small bore, the friction will be considerable, and prevent its moving freely; and if the tube is made of a wider bore, the mercury will be apt to fall out.

Fig. 5. is an invention of Mr Rowning, by which the scale of variation may be increased to any length, or even become infinite. ABC is a compound tube hermetically sealed at A, and open at C, empty from A to D, filled with mercury from thence to B, and from thence to E with water. Let GBH be a horizontal line; then it is plain, from the nature of the siphon, that all the compound fluid contained in the part from H to G, will be always *in æquilibrio* with itself, be the weight of the air what it will, because the pressure at H and G must be equal. Whence it is evident that the column of mercury DH is *in æquilibrio* with the column of water GE, and a column of air taken conjointly, and will therefore vary with the sum of the variations of these. That the variation in this barometer may be infinite, will appear from the following computation. Let the proportion between the bores of the tube AF and FC be such, that when HD, the difference of the legs wherein the mercury is contained, is augmented one inch, GE, the difference of the legs wherein the water is contained, shall be diminished 14; then, as much as the pressure of the mercury is augmented, that of the water will be diminished, and so the pressure of both taken together will remain as it was; and consequently, after it has begun to rise, it will have the same tendency to rise on, without ever coming to an equilibrium with the air.

Fig. 6. represents Dr Hook's wheel-barometer. Here ACDG is a glass tube, having a large round head at A, and turned up at the lower end F. Upon the surface of the mercury in the bent leg is an iron ball G, with a string going over a pulley CD. To the other end of the string is fastened a smaller ball H, which as the mercury rises in the leg FG, turns the index KL from N towards M, on the graduated circle MNOP; as it rises in the other leg, the index is carried the contrary way by the descent of the heavier ball G along with the mercury. The friction of this machine, however, unless it is made with very great accuracy, renders it useless.

Fig. 7. is another barometer, invented by Mr Rowning, in which also the scale may be infinite. ABCD is a cylindrical vessel, filled with a fluid to the height W, in which is immerged the barometer SP consisting of the following parts: The principal one is the glass tube TP (represented separately at *tp*), whose upper end T is hermetically sealed: this end does not appear to the eye, being received into the lower end of a tin pipe GH, which in its other end G receives a cylindric rod or tube ST, and thus fixes it to the tube TP. This rod ST may be taken off, in order to put in its stead a larger or a lesser as occasion requires. S is a star at the top of the rod ST: and serves as an index by pointing to the graduated scale LA, which is fixed to the cover of the vessel ABCD. MN is a large cylindrical tube made of tin (represented separately at *mn*), which receives in its cavity the smaller part of the tube TP, and is well cemented to it at both ends, that none of the fluid may get in. The tube TP, with this apparatus,

Barometer.

apparatus, being filled with mercury, and plunged into the bason MP, which hangs by two or more wires upon the lower end of the tube MN, must be so poised as to float in the liquor contained in the vessel ABCD; and then the whole machine rises when the atmosphere becomes lighter, and *vice versa.* Let it now be supposed, that the fluid made use of is water; that the given variation in the weight of the atmosphere is such, that, by pressing upon the surface of the water at W, the surface of the mercury at X may be raised an inch higher (measuring from its surface at P) than before; and that the breadth of the cavity of the tube at X, and of the bason at P, are such, that by this ascent of the mercury, there may be a cubic inch of it in the cavity X more than before, and consequently in the bason a cubic inch less. Now, upon this supposition, there will be a cubic inch of water in the bason more than there was before; because the water will succeed the mercury, to fill up its place. Upon this account the whole machine will be rendered heavier than before by the weight of a cubic inch of water; and therefore will sink, according to the laws of hydrostatics, till a cubic inch of that part of the rod WS, which was above the surface of the water at W, comes under it. Then, if we suppose this rod so small, that a cubic inch of it shall be 14 inches in length, the whole machine will sink 14 inches lower into the fluid than before; and consequently the surface of the mercury in the bason will be pressed, more than it was before, by a column of water 14 inches high. But the pressure of 14 inches of water is equivalent to one of mercury; this additional pressure will make the mercury ascend at X as much as the supposed variation in the weight of the air did at first. This ascent will give room for a second cubic inch of water to enter the bason; the machine will therefore be again rendered so much heavier, and will subside 14 inches farther, and so on *in infinitum.* If the rod was so small that more than fourteen inches of it were required to make a cubic inch, the variation of this machine would be negative with respect to the common barometer; and instead of coming nearer to an equilibrium with the air by its ascent or descent, it would continually recede farther from it: but if less than 14 inches of rod were required to make a cubic inch, the scale of variation would be finite, and might be made in any proportion to the common one. Neither this nor the other infinite barometer have ever been tried, so that how far they would answer the purposes of a barometer is as yet unknown.

Fig. 8. represents another contrivance for enlarging the scale of the barometer to any size.—AB is the tube of a common barometer open at B and sealed at A, suspended at the end of the lever which moves on the fulcrum E.—CD is a fixed glass tube, which serves in place of the cistern. This last tube must be so wide as to allow the tube AB to play up and down within it.—AB being filled with mercury, is nearly counterbalanced by the long end of the lever. When the atmosphere becomes lighter, the mercury descends in the long tube, and the surface of the mercury rising in the cistern pushes up the tube AB, which at the same time becoming lighter, the lever preponderates, and points out the most minute variations. Here too the friction occasions inconveniences; but this may be in some measure remedied by a small shake of the apparatus at each inspection.

In the Philosophical Transactions, Mr Caswell gives the following account of a barometer, which has been commended as a very accurate one: "Let ABCD (fig. 9.) represent a bucket of water in which is the barometer *erezosm*, which consists of a body *ersm*, and a tube *ezyo*: the body and tube are both concave cylinders communicating with one another, and made of tin: the bottom of the tube, *zy*, has a lead weight to sink it so that the top of the body may just swim even with the surface of the water by the addition of some grain weights on the top. The water, when the instrument is forced with its mouth downwards, gets up into the tube to the height *yu*. There is added on the top a small concave cylinder, which I call the *pipe*, to distinguish it from the bottom small cylinder which I call the *tube*. This pipe is to sustain the instrument from sinking to the bottom: *md* is a wire; *ms*, *de*, are two threads oblique to the surface of the water, which threads perform the office of diagonals: for that while the instrument sinks more or less by the attraction of the gravity of the air, there, where the surface of the water cuts the thread, is formed a small bubble; which bubble acsends up the thread, as the mercury in the common barometer ascends.

The dimensions of this instrument given there are, 21 inches for the circumference of the body, the altitude 4, each base having a convexity of $6\frac{1}{2}$ inches. The inner circumference of the tube is 5.14 inches, and its length $4\frac{1}{2}$; so that the whole body and tube will contain almost $2\frac{1}{2}$ quarts. The circumference of the pipe, that the machine may not go to the bottom on every small alteration of the gravity of the air, is 2.14 inches; according to which dimensions, he calculates that it will require 44 grains to sink the body to the bottom, allowing it only four inches to descend; at the same time that it is evident, that the fewer grains that are required to sink it to this depth, the more nice the barometer will be. He also calculates, that when the mercury in the common barometer, is $30\frac{1}{2}$ inches high, the body with a weight of 44 grains on its top will be kept *in æquilibrio* with the water; but when the mercury stands at 28 inches, only 19 grains can be supported: and lastly, by computing the length of the diagonal threads, &c. he finds, that his instrument is 1200 times more exact than the common barometer. The following are his observations on the use of it.

25 Mr Caswell's observations with his barometer.

"1. While the mercury of the common barometer is often known to be stationary 24 hours together, the bubble of the new barometer is rarely found to stand still one minute.

"2. Suppose the air's gravity increasing, and accordingly the bubble ascending; during the time that it ascends 20 inches, it will have many short descents of the quantity of half an inch, one, two, three, or more inches; each of which being over, it will ascend again. These retrocessions are frequent, and of all varieties in quantity and duration; so that there is no judging of the general course of the bubble by a single inspection, though you see it moving, but by waiting a little time.

"3. A small blast of wind will make the bubble descend; a blast that cannot be heard in a chamber of the town will sensibly force the bubble downward. The blasts of wind sensible abroad, cause many of the above-mentioned retrocessions or accelerations in the general course; as I found by carrying my barometer to a place where the wind was perceptible.

"4. Clouds make the bubble descend. A small cloud approaching the zenith, works more than a great cloud near the horizon. In cloudy weather, the bubble descending, a break of the clouds (or clear place) approaching to the zenith, has made the bubble to ascend; and after that break had passed the zenith a considerable space, the bubble again descended.

"5. All clouds (except one) hitherto by me observed, have made the bubble to descend. But the other day, the wind being north, and the course of the bubble descending, I saw to the windward a large thick cloud near the horizon, and the bubble still descended: but as the cloud drew near the zenith, it turned the way of the bubble, making it to ascend; and the bubble continued ascending till the cloud was all passed, after which it resumed its former descent. It was a cloud that yielded a cold shower of small hail."

These are the most remarkable contrivances for the improvement of the common barometer; the last, on account of its being so exceedingly sensible, and likewise easy of construction and portable, seems to deserve attention much more than the others, which are always the more inaccurate, and the less easily moved, according to the enlargement of their scale; whereas this is seemingly subject to no such inconvenience. It is evident, however, that none of these could be used at sea, on account of the unsteady motion of the ship: for which reason Dr Hook thought of constructing a barometer upon other principles.

26 Marine barometer by Mr Hook.

This contrivance was no other than two thermometers. The one was the common spirit-of-wine thermometer, which is affected only by the warmth of the air: the other, which acts by the expansion of a bubble of air included, is affected not only by the external warmth, but by the various weight of the atmosphere. Therefore, keeping the spirit thermometer as a standard, the excess of the ascent or descent of the other above it would point out the increase or decrease of the specific gravity of the atmosphere. This instrument is recommended by Dr Halley, who speaks of it as follows. "It has been observed by some, that, in long keeping this instrument, the air included either finds means to escape, or deposits some vapours mixed with it, or else from some other cause becomes less elastic, whereby in process of time it gives the height of the mercury somewhat greater than it ought: but this, if it should happen in some of them, hinders not the usefulness thereof, for that it may at any time very easily be corrected by experiment; and the rising and falling thereof are the things chiefly remarkable in it, the just height being barely a curiosity.

27 Recommended by Dr Halley.

"I had one of these barometers with me in my late southern voyage, and it never failed to prognosticate and give early notice of all the bad weather we had, so that I depended thereon, and made provision accordingly; and from my own experience I conclude, that a more useful contrivance hath not for this long time been offered for the benefit of navigation."

Fig. 10. represents a kind of *Chamber Barometer*, or a complete instrument for observing in a fixed place, such as a room, &c. the changes in the atmosphere. It is constructed by Mr W. Jones, optician, London; and consists of a barometer *d*, thermometer *a a*, and hygrometer *c*, all in one mahogany frame. One advantage of this instrument is, that either the thermometer or hygrometer may be taken from the frame, and occasionally made use of in another place if required. The thermometer is separated by only unscrewing two screws *a, a*; and the hygrometer by unscrewing a brass pin at the back of the frame, not seen in this figure. The index of the hygrometer is at any time set, by only moving with your finger the brass wheel seen at *c*; the two sliding indexes of the barometer and thermometer are moved by a rack-work motion, set in action by the key *g* placed in the holes *h* and *i*. The divisions of the barometer plate *b* are in *tenths* of an inch, from 28 to 31 inches; these again subdivided into *hundredths* by means of the *vernier scale*, placed oppositely on a sliding slip of brass similar to the common barometers, most of which are now made with this *vernier*. On this vernier are *ten equal parts*, or divisions; (see A, fig. 11. which for the sake of perspicuity is drawn larger). All of these together are equal just to 11 of those on the scale of inches; that is, to eleven tenths. By this artifice the height of the mercury at E is evident by inspection only, to the one hundredth part of an inch. To understand this, nothing more is necessary than to consider, that *one tenth part of a tenth of an inch* is the *one hundredth part of an inch*. Now every tenth of an inch in the scale B is divided into ten equal parts by the slip or *vernier* A: for since ten divisions on that exceed ten on the scale by one division, that is, by one tenth of an inch; therefore one division on the vernier will exceed one division on the scale by *one tenth part*; and two divisions on the *vernier* will exceed two on the scale by *two tenths*, and so on: Therefore every division on the *vernier* will exceed the same number of divisions in the scale *by so many tenths of a tenth*, or *by so many hundredth parts of an inch*. Therefore the ten equal divisions of an inch on the scale B, must be looked upon as so many *ten hundredth parts of an inch*, and numbered thus, 10, 20, 30, 40, &c. parts of an inch; then the *vernier* gives the unit to each ten, thus: Set the index C very nicely to the top of the surface of the mercury E; and if at the same time the beginning of the divisions at C coincides with a line of division in the scale B, then it shows the altitude of the mercury in *inches* and *tenths of an inch* exactly. But suppose the index line C of the *vernier* falls *between* two divisions or tenths on the scale B, then there will be a coincidence of lines on both at that number of the vernier, which shows how many tenth parts of that tenth the index of the vernier has passed the last decimal division of the scale. Thus, for example, suppose the index of the vernier were to point somewhere between the sixth and seventh tenth above 30 on the scale: then if, by looking down the *vernier*, you observe the coincidence at number 8, it shows that the altitude of the mercury is 30 inches and 68 parts of a hundredth of another inch; or simply thus, 30.68 inches.

28 Chamber barometer by Mr William Jones.

29 Method of using the vernier scale.

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Barometer.

The screw at fig. 10. serves to press the mercury quite up into the tube, when required to be much moved or carried about, thereby rendering the barometer of the kind called *portable*. To the lower extremity of the tube (see fig. 14.) is cemented a wooden reservoir A, with a kind of leathern bag at bottom, the whole containing the mercury, but not quite full: and though the external air cannot get into the bag to suspend the mercury in the tube, by pressing on its surface, as in the common one; yet it has the same effect by pressing on the outside of the bag; which being flexible, yields to the pressure, and keeps the mercury suspended in the tube to its proper height. Through the under part of the frame passes the screw *f*, with a flat round plate at its end; by turning of this screw, the bag may be so compressed as to force the mercury up to the top of the tube, which keeps it steady, and hinders the tube from breaking by the mercury dashing against the top when carried about, which it is otherwise apt to do.

30 Marine barometer by Mr Nairne.

A new kind of marine barometer has lately been invented by Mr Nairne. It differs from the common one in having the bore of the tube small for about two feet in its lower part; but above that height it is enlarged to the common size. Through the small part of the instrument the mercury is prevented from ascending too hastily by the motion of the ship; and the motion of the mercury in the upper wide part is consequently lessened. Much is found to depend on the proper suspension of this instrument; and Mr Nairne has since found, by experiment, the point from which it may be suspended so as not to be affected by the motion of the ship.

31 By Passemente.

Another marine barometer has been invented by one Passemente, a French artist. It is only a common one having the middle of the tube twisted into a spiral consisting of two revolutions. By this contrivance, the impulses which the mercury receives from the motions of the ship are destroyed by being transmitted in contrary directions.

32 Barometer applied to the mensuration of altitudes.

We must now speak of the barometer in its second character, namely, as an instrument for measuring accessible altitudes. This method was first proposed by M. Pascal; and succeeding philosophers have been at no small pains to ascertain the proportion between the sinking of the mercury and the height to which it is carried. For this purpose, however, a new improvement in the barometer became necessary, viz. the making of it easily portable from one place to another without danger of its being broken by the motion of the mercury in the tube; which was effected by the contrivance already mentioned.

33 Statical barometer.

Among the number of portable barometers we may perhaps reckon what Mr Boyle called his *Statical* Barometer. It consisted of a glass bubble, about the size of a large orange, and blown very thin, so as to weigh only 70 grains. This being counterpoised by brass weights in a pair of scales that would turn with the 20th part of a grain, was found to act as a barometer. The reason of this was, that the surface of the bubble was opposed to a vastly larger portion of air than that of the brass weight, and consequently liable to be affected by the various specific gravity of the atmosphere: thus, when the air became specifically light, the bubble descended, and *vice versa*; and thus, he says, he could have perceived variations of the atmosphere no greater than would have been sufficient to raise or lower the mercury in the common barometer an eighth part of an inch.

34 Method of measuring the changes of the air by the sound of a wire.

To these we may add an account of a new and very singular barometer mentioned by M. Lazowski in his tour through Switzerland. "A curè, shortsighted, who nevertheless amused himself with firing at a mark, thought of stretching a wire in such a manner as to draw the mark to him, in order to see how he had aimed. He observed, that the wire sometimes sounded as if it had been oscillatory; and that this happened when a change was about to ensue in the atmosphere; so that he came to predict with considerable accuracy when there was to be rain or fine weather. On making further experiments, it was observed, that this wire was more exact, and its sounds more distinct, when extended in the plane of the meridian than in other positions. The sounds were more or less soft, and more or less continued, according to the changes of weather that were to follow; though the matter was not reduced to any accuracy, and probably is not capable of much. Fine weather, however, was said to be announced by the sounds of counter tenor, and rain by those of bass. M. Volta was said to have mounted 15 chords at Pavia, in order to bring this method to some perfection; but there are as yet no accounts of his success.

35 Difficulties in measuring heights by the barometer.

The portable barometer, as already observed, has long been in use for the mensuration of accessible altitudes; and, in small heights, was found to be more exact than a trigonometrical calculation, the mercury descending at the rate of about one inch for 800 feet of height to which it was carried: but, in great heights, the most unaccountable differences were found between the calculations of the most accurate observers; so that the same mountain would sometimes have been made thousands of feet higher by one person than another; nay, by the same person at different times. All these anomalies M. de Luc of Geneva undertook to account for, and to remove; and in this undertaking he persisted with incredible patience for 20 years. The result of his labour is as follows.

36 Removed by M. de Luc.

The first cause of irregularity observed was a fault in the barometer itself. M. de Luc found, that two barometers, though perfectly alike in their appearance, did not correspond in their action. This was owing to air contained in the tube. The air was expelled by boiling the mercury in them; after which, the motions of both became perfectly consonant.

37 Mercury, how boiled in the tubes, with the effects.

That the tubes may bear boiling, they must not be very thick, the thickness of the glass not above half a line, and the diameter of the bore ought to be from two and a half to three lines. The operation is performed in the following manner: A chaffing dish with burning coals is placed on a table; the tube hermetically sealed at one end, is inverted, and filled with mercury within two inches of the top; the tube is gradually brought near the fire, moving it obliquely up and down, that the whole length of it may be heated; and advancing it nearer and nearer, till it is actually in the flame, the globules of air begin to move visibly towards the top. The boiling at last commences; and it is easy to make it take place from one end to the other, by causing the several parts of the tube successively pass with rapidity

through

through the flame. By this operation the mercury is freed from all aerial particles, particularly those which line the inside of the tube, and which cannot easily be got clear of by any other method. When this last stratum of air is discharged, the tube may be afterwards emptied, and filled even with cold mercury, when it will be found nearly as free of air as before. The mercury in the tube thus prepared by a determinate quantity of heat, will rise higher than those in the common sort, and the barometers will more nearly correspond with each other: whereas there will be a difference of six or eight lines in the ascent of mercury in the common barometers. Instruments of this kind rise uniformly in a heated room, whilst those of the common kind descend in different proportions. On cooling the room, the former descend uniformly, while the latter descend unequally, by reason of the unequal proportions of air in them.

38
Variation of the height of the mercury by heat.

The next cause of variation was a difference of temperature. To discover the effects of heat on the mercury, several barometers were chosen that for a long time had been perfectly consonant in their motions. One of these was placed in an apartment by itself, to mark the change in the external air, if any should happen. The rest were situated in another apartment, along with three thermometers, graduated according to the scale of M. de Reaumur, and exactly correspondent with one another. The point at which the mercury stood when the experiment began, was carefully noted, and also the precise height of the thermometers. The latter apartment then was gradually heated; and with so much uniformity, that the thermometers continued still to agree. When the heat had been augmented as much as possible, the altitudes both of the barometers and thermometers were again accurately marked, to ascertain the differences that corresponded to one another. This experiment was repeated several times with next to no variation; and from the barometer in the first apartment it appeared, that no sensible alteration had taken place in the external air. Hence M. de Luc found, that an increase of heat sufficient to raise the thermometer from the point of melting ice to that of boiling water, augments the height of the mercury in the barometer precisely six lines; and, therefore, dividing the distance between these two points on the thermometer into 96 equal parts, there will be $\frac{1}{16}$th of a line to add to, or subtract from, the height of the mercury in the barometer, for every degree of variation of the thermometer so graduated. A scale of this kind, continued above boiling or below freezing water, accompanies his portable barometer and thermometer.—So accurate, he says, did long practice make him in barometrical observations, that he could distinguish a variation of $\frac{1}{16}$ of a line in the height of the mercury. He allows of no inclination of the tube, or other means to augment the scale, as all these methods diminish the accuracy of the instrument. Two observations are always required to measure the altitude of a mountain: one with a barometer left on the plain, and another on the summit; and both must be accompanied with a thermometer.

39
M. de Luc's portable barometer.

His portable barometer consists of two tubes, one of 34 French inches in length; and from the top, for this length, perfectly straight; but below this, it is bent round, so that the lower end turns up for a short space parallel to the straight part. On this open end is fixed a cock; and on the upper side of this cock is placed another tube, of the same diameter with the former, eight inches in length, open at both ends, and communicating with the long tube, through the cock. When the barometer is carried from one place to another, it is inverted very slowly, to hinder any air getting in; the quicksilver retires into the long tube on which the key of the cock is turned; and to preserve the cock from too great pressure of the mercury, the barometer is conveyed about in this inverted posture. When an observation is to be made, the cock is first opened; the tube is then turned upright, very slowly, to prevent, as much as possible, all the vibration of the mercury, which disturbs the observation; and according to the weight of the atmosphere, the mercury falls in the longer branch, and rises up through the cock, into the shorter.

The whole of the cock is made of ivory, except the key. The extremities of the tubes are wrapped round with the membrane employed by the gold-beaters, done over with fish-glue, in order to fix them tight, the one in the lower, and the other in the upper, end of the perpendicular canal of the cock. The part of the key that moves within the cock is of cork, and the outward part or the handle is of ivory. The cock is fastened firmly to the ivory by means of a broad thin plate of steel, which cuts both the ivory and cork, lengthwise, through the centre, and reaches inward to the hole of the key. This plate also counteracts the flexibility of the cork, and makes it obey the motion of the handle, notwithstanding it is very considerably compressed by the ivory, to render it tight. That this compression may not abridge the diameter of the hole of the key, it is lined with a thin hollow ivory cylinder, of the same diameter with the tubes.

On the upper end of the shorter tube is fixed, in the intervals of observation, a kind of funnel, with a small hole in it, which is shut with an ivory stopple. The use of it is to keep the tube clean; to replace the mercury that may have made its way through the cock in consequence of any dilatation; and likewise to replace the mercury taken out of the shorter tube, after shutting the cock, on finishing an observation; because, when the mercury is left exposed to the air; it contracts a dark pellicle on its surface, that sullies both itself and the tube. The shorter tube should be wiped from time to time, by a little brush of sponge fixed on the end of a wire.

The barometer, thus constructed, is placed in a long box of fir, the two ends of which are lined on the inside with cushions of cotton covered with leather. This box may be carried on a man's back, like a quiver, either walking or riding; and should have a cover of wax-cloth to defend it against rain. It should be kept at some distance from the body of the man, and be protected from the sun by an umbrella, when near the place of observation, to prevent its being affected by any undue degree of heat. The barometer should, farther, be attended with a plummet, to determine the perpendicular position of it; and a tripod to support it firm in that position at the time of observation.

The scale of the barometer begins on the long tube, at a point on a level with the upper end of the short one; and

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Barometer. and rises, in the natural order of the numbers, to 21 inches. Below the above point, the scale is transferred to the short tube: and descends on it, in the natural order of the numbers, to 7 inches. The whole length of the scale is 28 French inches: and since, as the mercury falls in the one tube, it must rise in the other, the total altitude will always be found by adding that part of the scale, which the mercury occupies in the long tube, to that part of it which the mercury does not occupy in the short one. In estimating, however, the total fall or rise on the long tube, every space must be reckoned twice; because, of barometers of this construction, half the real variation only appears in one of the branches.

Near the middle of the greater tube is placed the thermometer above mentioned, for ascertaining the corrections to be made on the altitude of the mercury in consequence of any change in the temperature of the air. It is placed about the middle of the barometer, that it may partake as much as possible of its mean heat. The ball is nearly of the same diameter with the tube of the barometer, that the dilatations or condensations of the fluids they contain may more exactly correspond. The scale is divided into 96 parts, between the points of boiling water and melting ice; and the term of 0 is placed one-eighth part of this interval above the lower point; so that there are 12 degrees below, and 84 above it. The reason for placing 0 here is, that as 27 French inches are about the mean height of the barometer, so the 12th degree above freezing is nearly the mean altitude of the thermometer. Hence, by taking these two points, the one for the mean altitude, and the other for the mean heat, there will be fewer corrections necessary to reduce all observations to the same state, than if any higher or lower points had been fixed upon.

If then the barometer remains at 27 inches, and the thermometer at 0, there are no corrections whatever to be made. But if, while the barometer continues at 27 inches, the thermometer shall rise any number of degrees above 0, so many sixteenths of a line must be subtracted from the 27 inches, to obtain the true height of the barometer produced by the weight of the atmosphere, and to reduce this observation to the state of the common temperature. If, on the other hand, the thermometer shall fall any number of degrees below 0, while the barometer still stands at 27 inches, so many sixteenths must be added to that height, to obtain the true altitude.

Nothing is more simple than these corrections, when the barometer is at or near 27 inches of height. If, however, it fall several inches below this point, as the portable barometer very frequently must, the dilatations will no longer keep pace with the degrees of heat, after the rate of $\frac{1}{16}$ of a line for every degree of the thermometer; because the columns of mercury being shortened, the quantity of fluid to be dilated will be diminished. The truth is, the quantity of the dilatations for the same degree of heat is just as much diminished as the column is shortened. If, then, it shall still be found convenient to reckon the dilatations by sixteenths of a line, these sixteenths must be counted on a scale, of which the degrees shall be as much longer than the degrees of the first scale, as the shortened column of mercury is less than 27 inches, the height to which the length of the degrees of the first scale was adapted. For instance, let the mercury descend to $13\frac{1}{2}$ inches, half the mean column, and let the thermometer ascend 10 degrees above the mean heat; 10 sixteenths should be deduced from the mean column, for this temperature, according to the rule; but 10 half-sixteenths only, or 5 whole sixteenths, must be subtracted from the column of $13\frac{1}{2}$ inches, because the sum of its dilatations will be half that of the former, the quantities of fluid being to one another in that proportion.

It would cause considerable embarassment if the sixteenths of correction were always to be subdivided into less fractions, proportional to every half inch of descent of the barometer; and the same end is obtained in a very easy manner, by reckoning the corrections on different scales of the same length, but of which the degrees are longer according as the columns of the barometer are shorter. For example, the degrees of correction on the scale applicable to the column of $13\frac{1}{2}$ inches, will be double in length what the same degrees are for the column of 27 inches; and of course the number of corrections will be reduced likewise one half, which we have seen by the rule they ought to be.

The author constructed, on a piece of vellum, scales with these properties, for no less than 23 columns of mercury, being all those between 18 inches and 29 inclusive, counting from half inch to half inch; within which extremes, every practical case will be comprehended. He wrapped this vellum on a small hollow cylinder, including a spring, like a spring-curtain, and fixed it on the right side of the thermometer. The vellum is made to pass from right to left, behind the tube of the thermometer, and to graze along its surface. The observer, to find the corrections to be made, pulls out the vellum till the scale corresponding to the observed altitude of the barometer comes to touch the thermometer, and on that scale he counts them. The vellum is then let go, and the screw gently furls it up.

40 His operations on the mountain of Saleve.

The author having now, as he imagined, completely finished the instruments necessary for the accurate mensuration of heights, proceeded to establish, by experiment, the altitudes corresponding to the different descents of the mercury. Much had been written, and many rules had been given, on this subject, by different eminent philosophers, since the days of Pascal, who first broached it: but these disagreed so much with one another, and presented so little good reason why any one of them should be preferred, that no conclusion could with confidence be deduced from them. It became requisite, therefore, to lay them all aside, and to endeavour to discover by practice what could not be ascertained by theory. Saleve, a mountain near Geneva, was chosen for the scene of these operations. This mountain is near 3000 French feet high. The height of it was twice measured by levelling, and the result of the mensurations differed only $10\frac{1}{2}$ inches; though there intervened six months between them, and the total altitude was so considerable. On this mountain were chosen no less than 15 different stations, rising after the rate of 200 feet, one above another, as nearly as

Barometer. as the ground would admit. At these stations, it was proposed to make such a number of observations as might be a good foundation either for establishing a new rule of proportion between the height of places and the descents of the mercury, or for preferring some one of those formerly discovered.

41
Strange anomalies of the barometer at different times of the day.

Little progress was made in this plan, when a phenomenon, altogether unexpected, presented itself. The barometer being observed, at one of the stations, twice in one day, was found to stand higher in the latter observation than in the former. This alteration gave little surprise, because it was naturally imputed to a change of the weight of the atmosphere, which would affect the barometer on the plain in the same manner. But it produced a degree of astonishment, when on examining the state of the latter, it was found, instead of corresponding with the motions of the former, to have held an opposite course, and to have fallen while the other rose. This difference could not proceed from any inaccuracy in the observations, which had been taken with all imaginable care; and it was so considerable as to destroy all hopes of success, should the cause not be detected and compensated.

The experiment was repeated several times at intervals, that no material circumstance might escape notice. An observer on the mountain, and another on the plain, took their respective stations at the rising of the sun, and continued to mark an observation, every quarter of an hour, till it set. It was found, that the lower barometer gradually descended for the first three quarters of the day; after which it reascended, till in the evening it stood at nearly the same height as in the morning. While the higher barometer ascended for the first three-fourths of the day; and then descended, so as to regain likewise, about sunset, the altitude of the morning.

42
Accounted for.

The following theory seems to account in a satisfactory manner for this phenomenon. When the sun rises above the horizon of any place, his beams penetrate the whole of the section of the atmosphere of which that horizon is the base. They fall, however, very obliquely on the greater part of it, communicate little heat to it, and consequently produce little dilatation of its air. As the sun advances, the rays become more direct, and the heat and rarefaction of course increase. But the greatest heat of the day is not felt even when the rays are most direct, and the sun is in the meridian. It increases while the place receives more rays than it loses, which it will do for a considerable time after mid-day; in like manner as the tide attains not its highest altitude till the moon has advanced a considerable way to the west of the meridian. The heat of the atmosphere is greatest at the surface of the earth, and seems not to ascend to any great distance above it. The dilatations, for this reason, of the air, produced by the sun, will be found chiefly, if not solely, near the earth. A motion must take place, in all directions, of the adjacent air, to allow the heated air to expand itself. The heated columns extending themselves vertically, will become longer, and at the same time specifically lighter, in consequence of the rarefaction of their inferior parts. The motion of air, till it arises into wind, is not rapid: these lengthened columns, therefore, will take some time to dissipate their summits among the adjacent less rarefied columns that are not so high; at least, they will not do this as fast as their length is increased by the rarefaction of their bases.

The reader, we presume, anticipates the application of this theory to the solution of the phenomenon in question. The barometer on the plain begins to fall a little after morning, because the column of air that supports it becomes specifically lighter on account of the rarefaction arising from the heat of the sun. It continues to fall for the first three quarters of the day; because, during that time, the heat, and consequently the rarefaction, are gradually increasing. It rises again after this period; because the cold, and of course the condensation, coming on, the specific gravity is augmented by the rushing in of the adjacent air. The equilibrium is restored, and the mercury returns to the altitude of the morning.

The barometer on the eminence rises after morning, and continues to do so for three-fourths of the day, for two reasons. The density of the columns of air is greatest near the earth, and decreases as the distance from it increases. The higher, for this reason, we ascend in the atmosphere, we meet with air specifically lighter. But by the rarefaction of the base of the column that supports the mercury of the barometer on the eminence, the denser parts of that column are raised higher than naturally they would be if left to the operation of their own gravity. On this account, the higher barometer is pressed with a weight, nearly as great as it would sustain, were it brought down, in the atmosphere, to the natural place of that denser air now raised above it by the prolongation of the base of the column. The other reason is, that as the rarefaction does not take place at any great distance from the earth, little change is produced in the specific gravity of the portion of the column that presses on the higher barometer, and the summit of that column dissipates itself more slowly than it increases. Thus, we see how this barometer must ascend during the first three-fourths of the day, and pursue a course the reverse of that on the plain. The condensation returning after this time, the denser air subdues, the equilibrium takes place, and the mercury descends to its first position.

43
Render another pair of thermometers necessary.

This phenomenon prompted the idea of a second pair of thermometers, to measure the mean heat of the column of air intercepted between the barometers. These thermometers are extremely delicate and sensible. The tubes are the finest capillary, the glass very thin, and the diameters of the balls only three lines. The balls are insulated, or detached from the scales, which are fixed to the tubes only, by ligatures of fine brass-wire covered with silk. The air, by this contrivance, has free communication with the balls on all sides; and, if the direct rays of the sun be intercepted at some distance by a bit of paper, or even the leaf of a tree, the thermometers will quickly mark the true temperature of the air.

44
Method of computing the altitudes.

The reader, perhaps, will ask here, Could not this end have been gained by the first pair of thermometers? But we must request him to suspend his judgement till we have explained the theory of computing the altitudes from the descents of the mercury. He will

will then find the scales of these thermometers so different, that neither of them could, without much inconveniency, serve the purpose of the other.

The altitudes are computed by logarithms. A table of logarithms contains two series of numbers, running parallel to one another. The first has its terms in geometrical progression, and the second its terms in arithmetical. The natural numbers 1, 2, 3, 4, &c. form the first series; which, though in arithmetical progression when standing detached, are in geometrical in regard of the second series; whose terms are in arithmetical progression, and are called *logarithms*, because they express the distance of their correspondent terms of the geometrical progression from the beginning of the series.

To apply this table to the present purpose: let us suppose the whole atmosphere divided into concentric spherical sections, whose common centre is that of the earth. Suppose also all these sections of equal thickness, namely, 12.497 toises, which is found to be the thickness of the lowest section, and balances a line of mercury, when the barometer stands at 348 lines or 26 inches. Add, then, all these sections together; and we shall have the total altitude of the atmosphere expressed in an arithmetical progression, whose common difference is 12.497 toises. Consequently, in this view, the heights are proportioned to the logarithms.

It remains only to find the descents of the mercury, which measures the weights of the respective sections, in geometrical proportion, in order to justify the application of the logarithmic table to the computation of the altitudes. Now, it is easy to prove, in a very satisfactory manner, that the mean densities of these sections, which are in proportion of their weights, must be in geometrical progression, when the altitudes are in arithmetical; consequently, it is with great propriety and convenience that the logarithms are employed in the computation of the altitudes corresponding to the descents of the mercury. For, to find the vertical distance between two barometers, at different heights, no more is necessary than to look, in a table of logarithms, for the numbers that express in lines, or sixteenths of a line, the altitudes of the two columns of mercury, and take the logarithms of these numbers, whose difference will give this distance accurately, in thousandth parts of a toise. Multiply the toises by 6, which will furnish the altitudes in French feet.

This author made about 500 different observations at the several stations on the mountain of Saleve, which both suggested and verified the computation by logarithms. Many, however, of these observations, produced conclusions that deviated considerably from the results of the actual mensuration, on account of the different temperatures in which they were taken. It was the design of the second pair of thermometers to point out the corrections of these deviations. In settling the scales necessary for this end, the first object was, to mark the temperature of all the observations where the logarithms gave the altitudes exactly, or nearly equal to what they were found to be by levelling. This temperature corresponded to 16¾ on the scale of Reaumur, and to 70 on that of Fahrenheit, and at it was fixed the term 0. The next step was, to determine the corrections of the heights that became necessary, according as the state of the air was warmer or colder than the fixed point. With this view, all the remaining observations were collected, and compared with the different temperatures in which they were taken; and from an attentive examination of these circumstances, it was discovered, that for every 215 feet of height furnished by the logarithms, one foot of correction must be added or subtracted, for every degree of the thermometer, according as it stood above or below the term 0.

The scale of Reaumur did not conveniently express this correction of 1 to 215. The author wished to adopt the ratio of 1 to 1000, in forming a new scale for that purpose; but the divisions would have been too small. He employed, therefore, that of 1 to 500: because, by doubling the degrees of the higher thermometer above or below 0; or, which amounted nearly to the same thing, by doubling the mean heat of the column of air in taking the sum of the degrees of both thermometers, there resulted the ratio of 1 to 1000. The new scale, then, was divided by the following proportion: As 215, the last term of the ratio found by Reaumur's scale, is to 500, the last term of the ratio to be applied on the new scale: so is 80, the parts between the fixed points of the first scale, to 186, the number of parts between the same points on the second. And as 80 is to 186; so is 16¾, the point on Reaumur's scale at which the logarithms give the altitudes without correction, to 39, the point at which they give them on the new scale. The term 0 is placed at this point, 39 at melting ice, and 147 at that of boiling water. To reduce all observations to the same temperature by this scale, nothing more is necessary than to multiply the heights found from the logarithms by the sum of the degrees of both thermometers above or below 0, and to divide the product by 1000. The quotient must be added to, or subtracted from, the logarithmic height, according as the temperature is positive or negative.

45. Specimen of this method of mensuration.

As a specimen of the author's method, we shall now present our readers with the result of his operations at the 15 stations on Saleve. In one column are marked the heights found by levelling, and opposite to them the same heights found by the barometer; to the latter are prefixed the number of observations of which they are the mean.

Stations.	*Heights by Levelling.* Feet.	Inches.	*Numbers of Observations.*	*Heights by Barometer.* Feet.
1	216	2	12	$230\frac{1}{2}$
2	428	10	13	$435\frac{1}{15}$
3	586	0	13	$591\frac{13}{15}$
4	728	8	21	$732\frac{3}{7}$
5	917	0	24	$919\frac{12}{18}$
6	1218	8	27	$1221\frac{7}{17}$
7	1420	0	23	$1418\frac{17}{18}$
8	1800	0	17	$1798\frac{8}{17}$
9	1965	3	17	$1962\frac{2}{7}$
10	2211	0	17	2210
11	2333	0	17	$2331\frac{6}{17}$
12	2582	4	16	$2583\frac{13}{16}$
13	2700	0	15	$2703\frac{6}{15}$
14	2742	0	10	$2741\frac{1}{5}$
15	2626	0	11	$2924\frac{10}{18}$

From this table we presume the reader will be inclined to entertain the most favourable opinion of the abilities

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Barometer. abilities and industry of M. de Luc. Notwithstanding the amazing pains, however, which he has taken to remove every inaccuracy in the barometer, it did not remain entirely free from error; nor in many instances have the observations made by different persons exactly corresponded. Considerable improvements have been suggested by Colonel Roy and Sir George Shuckburgh, &c. (see Phil. Trans. vol. lxvii. and lxviii.); and put in execution, with improvements, by Mr Ramsden, and other ingenious instrument-makers in London. The following is a description of a very portable one constructed by Mr William Jones of Holborn, which, from its principle, comprehends every advantage that M. de Luc's instrument possesses; in many particulars is exempted from the errors to which his is liable; and is not subject to be deranged by carriage or other motion.

46 Description of the most improved barometer yet invented.

Fig. 12. is a representation of the instrument as enclosed in its mahogany case by means of three metallic rings *b b b*: This case is in the form of a hollow cone divided into three arms or legs from *a* to *c*, and is so carved in the inside as to contain steadily the body of the barometer: The arms, when separated, form three firm legs or supports for the barometer when making observations (see fig. 13.): The instrument is suspended at the part *g* of the case, by a kind of improved gimbals; and therefrom, with its own weight, is sufficiently steady in exposed weather. In that part of the frame where the barometer tube is seen (*a e*), there is a long slit or opening made, so that the altitude of the mercury may be seen against the light, and the vernier piece *a* brought down to coincide with the edge of the mercury to the greatest possible exactness. When the instrument is placed on its support, the screw *f* is to be let down in order that the mercury may subside to its proper height; and also a peg at *p* must be loosened, to give admission to the action of the external air upon the mercury contained in the box *b*. The adjustment or mode of observing what is called the *zero*, or 0, division of the column of mercury, is by the mercury being seen in the transparent part of the box *b*; the inside of which is a glass tube or reservoir for the mercury, and an edge piece of metal fixed on the external part of the box. The mercury is to be brought into contact with the edge by turning the screw *f* towards the right or left as necessary. The vernier piece at *a* that determines the altitude of the column of mercury, is to be brought down by the hand to a near contact, and then accurately adjusted by turning the screw *h* at top of the instrument. This barometer has usually two different sorts of scales inserted on it: that on the right at *a e*, is a scale of French inches from 19 to 31, measured from the surface or *zero* of the mercury in the box *b* below, divided into 12th parts or lines, and each line subdivided by the *vernier* into ten parts, so that the height of the column of mercury may be ascertained to the 120th part of a French inch. The scale which is on the other side, or left of observation, is of the same length; but divided into English inches, each of which is subdivided into 20ths of an inch, and the *vernier* subdivides each 20th into 25 parts; so that the height of the mercury is hereby ascertained to the 500th part of an English inch (viz. $20 \times 25 = 500$). But this *vernier* is figured *double* for the conveniency of calculation, viz. the first five divisions are marked 10, the 20 marked 40, and the 25 marked 50; then each exact division is reckoned as the *two thousandth* of an inch, which amounts to the same; for $\frac{1}{500}$ is the same in value as $\frac{2}{1000}$ of an inch. A *thermometer* is always attached to the barometer, and indeed is indispensably necessary: it is fastened to the body at *c*, countersunk beneath the surface of the frame, which makes it less liable to be broken: the degrees of the thermometer are marked on two scales, one on each side, viz. that of Fahrenheit and Reaumur, scales generally known; the freezing point of the former being at 32, and the latter at 0. On the right hand side of these two scales there is a third, called a scale of *correction*; it is placed oppositely to that of Fahrenheit, with the words *add* and *subtract*: it serves as a necessary correction to the observed altitude of the mercury at any given temperature of the air shown by the thermometer. There are several other valuable pieces of mechanism about the instrument that cannot clearly be represented in the figure; but what has already been said, we presume, is sufficient for the reader's general information. For the manner of making the necessary observations, and calculating the necessary particulars deducible therefrom, a full information may be obtained from M. de Luc, *Recherches sur les Modifications de l'Atmosphere*, and the Philos. Trans. vol. lxvii. and lxviii. before cited.

It may be necessary to add here, that by very small additional contrivances to this instrument, Mr Jones renders it equally useful for making observations at sea, with any *marine* barometer that has hitherto been invented.

This article may not be improperly concluded by an observation of Mr Magellan *, relative to a principal cause of error in barometrical measurements. This he states to be owing to the inattention of observers to the *specific gravity* of the mercury with which their barometers were made. If two barometers were both at 30 inches high, and equally circumstanced in every other respect, excepting only the specific gravity of the quicksilver; so that one be filled with the first kind I have tried, viz. whose specific gravity was =13.62 and the other =13.45. In this case, and in all probability many of this kind have often occurred, the error must have been no less than 327 feet; because the heights of the mercurial columns in each barometer must be in the inverse ratio of their specific gravities: viz. 13,45 : 1362 : : 30 : 30,379.

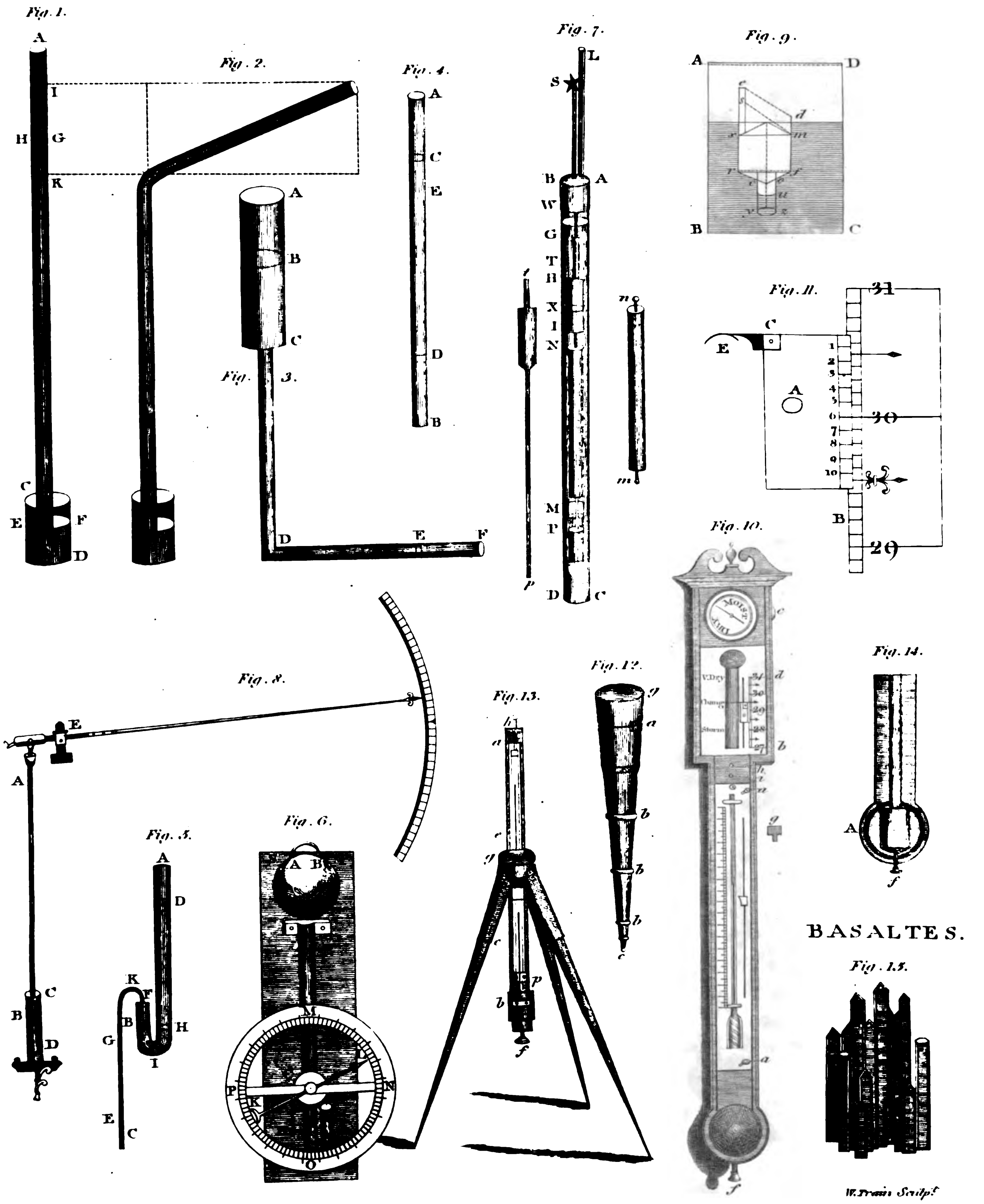
Now the logarithm of 30=4771.21
ditto of 30,379=4825.73

the difference is = 54.52

which difference shows, that there are 54.52 fathoms between one place and another, or 327 feet; though in reality both places are on the same level.

* Magellan's edition of Cronstedt's Mineralogy, Notes on Mercury.

"But if the specific gravity of the mercury, in the two barometers, were as the two above alluded to of Bergman and Fourcroy; viz. one of 14,110, and the other of 13,000, which may happen to be the case, as the heaviest is commonly reputed the purest mercury; on this supposition the error must have amounted to 355,76 toises or above 2134 feet and a half; because 13,000 : 14,110 : : 30 : 32,561, and the difference between



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between the logarithms of 30 and 32,561 is 355,76, which converted into feet gives 2134,5.

A historical account of the invention and progressive improvement of the Barometer, and of its application to the mensuration of heights, will be found under the articles BAROMETER and BAROMETRICAL MEASUREMENTS in the SUPPLEMENT.

BARON, a person who holds a barony. The origin and primary import of this term are much contested.

Menage derives it from the Latin *baro*, which we find used in the pure age of that language for *vir*, a *stout* or *valiant man;* whence, according to this author, it was, that those placed next the king in battles were called *barones*, as being the bravest men in the army; and as princes frequently rewarded the bravery and fidelity of those about them with fees, the word came to be used for any noble person who holds a fee immediately of the king. Isidore, and after him Camden, take the word in its original sense, to signify a *mercenary soldier*. Messieurs of the Port Royal derive it from βαρυς, *weight* or *authority*. Cicero uses the word *baro* for a stupid brutal man; and the old Germans make mention of *buffeting a baron*, i. e. a *villain;* as the Italians use the word *barone* to signify a *beggar*. M. de Marca derives baron from the German *bar*, *man*, or *freeman;* others derive it from the old Gaulish, Celtic, and Hebrew languages; but the most probable opinion is, that it comes from the Spanish *varo*, a *stout*, *noble person;* whence wives used to call their husbands, and princes their tenants, *barons*. In the Salic law, as well as the laws of the Lombards, the word *baron* signifies a *man* in the general; and the old glossary of Philomenes translates baron by ανηρ, *man*.

BARON is more particularly used among us, for a lord or peer of the lowest class; or a degree of nobility next below that of a viscount, and above that of a knight or baronet. In ancient records the word *baron* included all the nobility of England, because regularly all noblemen were barons, though they had also a higher dignity. But it hath sometimes happened, that, when an ancient baron hath been raised to a new degree of peerage, in the course of a few generations the two titles have descended differently; one perhaps to the male descendants, the other to the heirs general; whereby the earldom or other superior title hath subsisted without a barony: and there are also modern instances where earls and viscounts have been created without annexing a barony to their other honours: so that now the rule doth not hold universally that all peers are barons.

The original and antiquity of barons has occasioned great inquiries among our English antiquarians. The most probable opinion is supposed to be, that they were the same with our present lords of manors; to which the name of *court baron* (which is the lord's court, and incident to every manor) gives some countenance. It is said the original name of this dignity in England was *vavassour*, which by the Saxons was changed to *thane*, and by the Normans into *baron*. It may be collected from King John's *magna charta*, that originally all lords of manors, or barons, had seats in the great council or parliament: but such is the deficiency of public records, that the first precept to be found is of no higher date than the 49th year of King Henry III.; which, although it was issued out in the king's name, was neither by his authority nor by his direction: for, not only the king himself, but his son Prince Edward, and most of the nobility who stood loyal to him, were then prisoners in the hands of the rebellious barons; having been so made in the month of May preceding, at the battle of Lewes, and so continued until the memorable battle of Evesham, which happened in August the year following; when, by the happy escape of Prince Edward, he rescued the king and his adherents out of the hands of Simon Mountfort earl of Leicester. It cannot be doubted but that several parliaments were held by King Henry III. and King Edward I.; yet no record is to be found giving any account thereof (except the 5th of King Edward I.), until the 22d year of the reign of the last mentioned king.

Before the 49th of Henry III. the ancient parliaments consisted of the archbishops, bishops, abbots, earls, and barons. Of these barons there were two sorts: the *greater barons*, or the king's chief tenants, who held of him *in capite* by barony; and the *lesser barons*, who held of the first military service *in capite*. The former had summons to parliament by several writs; and the latter (i. e. all those who were possessed of thirteen knights fees and a quarter) had a general summons from the sheriff in each county. Thus things continued till the 49th of Henry III. But then, instead of keeping to the old form, the prevailing powers thought fit to summon, not all, but only those of the greater barons who were of their party; and, instead of the lesser barons who came with large retinues, to send their precepts to the sheriff of each county, to cause two knights in every shire to be chosen, and one or two burgesses for each borough, to represent the body of the people residing in these counties and boroughs; which gave rise to the separation into two houses of parliament. By degrees the title came to be confined to the greater barons, or lords of parliament only; and there were no other barons among the peerage but such as were summoned by writ, in respect of the tenure of their lands or baronies, till Richard II. first made it a mere title of honour, by conferring it on divers persons by his letters patent. See further on this subject the article LAW.

When a baron is called up to the house of peers by writ of summons, the writ is in the king's name, and he is directed to come to the parliament appointed to be held at a certain time and place, and there to treat and advise with his majesty, the prelates, and nobility, about the weighty affairs of the nation. The ceremony of the admission of a baron into the house of peers is thus: He is brought into the house between two barons, who conduct him up to the lord chancellor, his patent or writ of summons being carried by a king at arms, who presents it kneeling to the lord chancellor, who reads it, and then congratulates him on his becoming a member of the house of peers, and invests him with his parliamentary robe. The patent is then delivered to the clerk of the parliament, and the oaths are administered to the new peer, who is then conducted to his seat on the barons bench. Some barons hold their seats by tenure. The first who was raised to this dignity by patent was John de Beauchamp of Holt Castle, created baron of Kidderminster in Worcestershire, to him and his heirs male, by King Richard II. in the 11th year of his reign. He

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invested him with a mantle and cap. The coronation-robes of a baron are the same as an earl's, except that he has only two rows of spots on each shoulder. In like manner, his parliamentary robes have but two guards of white fur, with rows of gold lace. In other respects they are the same as other peers. King Charles II. granted a coronet to the barons. It has six pearls, set at equal distances on the chaplet. His cap is the same as a viscount's. His style is *Right Honourable;* and he is styled by the king or queen, *Right Trusty and Well Beloved.*

Barons by ancient tenure were those who held certain territories of the king, who still reserved the tenure in chief to himself. We also read of *barons by temporal tenure;* who are such as hold honours, castles, manors, as heads of their barony, that is, by grand sergeanty; by which tenure they were anciently summoned to parliament. But at present a baron by tenure is no lord of parliament, till he be called thither by writ.

The barons by tenure after the Conquest, were divided into *majores* and *minores*, and were summoned accordingly to parliament; the *majores* or greater barons, by immediate writ from the king; the *minores*, or lesser barons, by general writ from the high sheriff, at the king's command.

Anciently they distinguished the greater barons from the less, by attributing high, and even sovereign jurisdiction, to the former, and only inferior jurisdiction over smaller matters to the latter.

Barons of the Exchequer, the four judges to whom the administration of justice is committed, in causes between the king and his subjects relating to matters concerning the revenue. They were formerly barons of the realm, but of late are generally persons learned in the laws. Their office is also to look into the accounts of the king, for which reason they have auditors under them. See Exchequer.

Barons of the Cinque-ports are members of the house of commons, elected by the five ports, two for each port. See the article Cinque-ports.

Baron and Feme, in the *English Law*, a term used for husband and wife, in relation to each other: and they are deemed but one person; so that a wife cannot be witness for or against her husband, nor he for or against his wife, except in cases of high treason.

Baron and Feme, in *Heraldry*, is when the coats of arms of a man and his wife are born par pale in the same escutcheon, the man's being always on the dexter side, and the woman's on the sinister; but here the woman is supposed not an heiress, for then her coat must be borne by the husband on an escutcheon of pretence.

BARON, Robert, a dramatic author, who lived during the reign of Charles I. and the protectorship of Oliver Cromwell. He received the earlier parts of his education at Cambridge, after which he became a member of the honourable society of Gray's Inn. During his residence at the university, he wrote a novel called the *Cyprian Academy*, in which he introduced the two first of the dramatic pieces mentioned below. The third of them is a much more regular and perfect play, and was probably written when the author had attained a riper age. The names of them are, 1. *Deorum Dona*, a masque. 2. *Gripus and Hegio*, a pastoral. 3. *Mirza*, a tragedy. Mr Baron had a great intimacy with the celebrated Mr James Howell, the great traveller, in whose collections of Letters * there is one to this gentleman, who was at that time at Paris. To Mr Howell in particular, and to all the ladies and gentlewomen in England in general, he has dedicated his romance.

* Vol. ii. Let. 41.

BARONET, a dignity or degree of honour next beneath a baron, and above a knight; having precedency of all knights excepting those of the Garter, and being the only knighthood that is hereditary.

The dignity of baronet is given by patent, and is the lowest degree of honour that is hereditary. The order was founded by King James I. at the suggestion of Sir Robert Cotton, in 1611, when 200 baronets were created at once; to which number it was intended they should always be restrained: but it is now enlarged at the king's pleasure, without limitation.

They had several considerable privileges given them, with an *habendam* to them and their heirs male. They were allowed to charge their coat with the arms of Ulster, which are, in a field argent, a sinister hand, gules; and that upon condition of their defending the province of Ulster in Ireland against the rebels, who then harassed it extremely: to which end they were each to raise and keep up 30 soldiers at their own expence for three years together, or to pay into the exchequer a sum sufficient to do it; which, at 8d. per day per head, was 1095l. So that, including fees, the expence of this dignity may be about 1200l. sterling. To be qualified for it, one must be a gentleman born, and have a clear estate of 1000l. per annum.

Baronets take place according to the dates of their patents; by the terms of which no honour is to be erected between barons and baronets. The title *Sir* is granted them by a peculiar clause in their patents, though they be not dubbed knights: but both a baronet, and his eldest son, being of full age, may claim knighthood.—The first baronet who was created was Sir Nicholas Bacon of Redgrave in Suffolk, whose successor is therefore styled *Primus Baronetorum Angliæ.*

Baronets of Scotland, called also *Baronets of Nova Scotia.* The order of knights baronets was also designed to be established in Scotland in the year 1621, by king James I. for the plantation and cultivation of the province of Nova Scotia in America; but it was not actually instituted till the year 1625 by his son Charles I. when the first person dignified with this title was Sir Robert Gordon of Gordonstone, a younger son of the earl of Sutherland. The king granted a certain portion of land in Acadia or New Scotland, to each of them, which they were to hold of Sir William Alexander (afterwards earl of Stirling), for their encouragement who should hazard their lives for the good and increase of that plantation, with precedency to them, and their heirs-male for ever, before all knights called *equites aurati*, and all lesser barons called *lairds*, and all other gentlemen, except Sir William Alexander his majesty's lieutenant in Nova Scotia, his heirs, their wives and children; that the title of *Sir* should be prefixed to their Christian name, and *Baronet* added to their surname; and that their own and their eldest sons wives should enjoy the title of *Lady, Madame*, or *Dame.*

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Dame.—His majesty was so desirous of adding every mark of dignity to this his favourite order, that, four years after its institution, he issued a royal warrant, granting them the privilege of wearing an orange ribbon and a medal; which last was presented to each of them by the king himself, according to the words of the warrant. All the privileges of the order, particularly this of wearing the medal, were confirmed at the king's request by the convention of estates in the year 1630; and in order to establish them on the most solid foundation, they were again confirmed by an act of the parliament of Scotland in the year 1633. This mark of distinction fell to the ground with all the other honours of Scotland during the usurpation of the long parliament and of Oliver Cromwell. It continued in general, though not total, disuse after the Restoration. There have been former meetings of the order to revive the use of it, one in the year 1721, and another in 1734. These meetings proved ineffectual, because the proper steps towards its revival were not taken; but, under the auspices of our illustrious monarch George III. such measures were concerted in the year 1775 as have effectually established this honourable dignity.

Baronets of Ireland. This order was likewise instituted by King James I. in the 18th year of his reign, for the same purpose and with the same privileges within the kingdom of Ireland, as he had conferred on the like order in England; for which the Irish baronets paid the same fees into the treasury of Ireland. The first of that kingdom who was advanced to this hereditary dignity was Sir Francis Blundell, then secretary for the affairs of Ireland. Since his time several have been created, no number being limited.

BARONI, Leonora, a celebrated singer and composer, was born at Naples, but spent the greatest part of her life at Rome. She was daughter of Adriana Baroni of Mantua, baroness of Pian-caretta; a lady also distinguished for her musical talents, and for her beauty surnamed the *fair*. Leonora had less beauty than her mother; but excelled her in her profound skill in music, the fineness of her voice, and the charmingness of her manner. She is said by Mr Bayle to have been one of the finest singers in the world. She was, as well as her mother, celebrated by the wits, who strove to excel each other in recording her praises; and in 1639 there was published, at Bracciano, a collection of Latin, Greek, Italian, Spanish, and French poems addressed to her, under this title, *Applausi Poetici alle Glorie della Signora Leonora Baroni*. Among the Latin poems of Milton are no fewer than three entitled *Ad Leonoram Romæ canentem*, wherein this lady is celebrated for her singing, with an allusion to her mother's exquisite performance on the lute. A fine eulogium on this accomplished woman is contained in a discourse on the music of the Italians, printed with the life of Malherbe, and some other treatises at Paris, 1672, in 12mo. This discourse was composed by M. Maugars prior of St Peter de Mac, the king's interpreter of the English language, and besides so famous a performer on the viol, that the king of Spain and several other sovereign princes of Europe desired to hear him. The character given by this person of Leonora Baroni is as follows: She is endowed with fine parts; she has a very good judgment to distinguish good from bad music; she understands it perfectly well, and even composes; which makes her absolute mistress of what she sings, and gives her the most exact pronunciation and expression of the sense of her words. She does not pretend to beauty, neither is she disagreeable or a coquet. She sings with a bold and generous modesty, and an agreeable gravity; her voice reaches a large compass of notes, and is exact, loud, and harmonious; she softens and raises it without straining or making grimaces. Her raptures and sighs are not lascivious; her looks having nothing impudent, nor does she transgress a virgin modesty in her gestures, In passing from one key to another, she shows sometimes the divisions of the enharmonic and chromatic kind with so much art and sweetness, that every body is ravished with that fine and difficult method of singing. She has no need of any person to assist her with a theorbo or viol, one of which is necessary to make her singing complete; for she plays perfectly well herself on both these instruments. In short, I have had the good fortune to hear her sing several times above 30 different airs, with second and third stanzas composed by herself. I must not forget to tell you, that one day she did me the particular favour to sing with her mother and her sister. Her mother played upon the lute, her sister upon the harp, and herself upon the theorbo. This concert, composed of three fine voices, and of three different instruments, so powerfully transported my senses, and threw me into such raptures, that I forgot my mortality, and thought myself already among the angels enjoying the felicity of the blessed."

BARONIUS, Cæsar, a pious and learned cardinal, was born at Sore in 1538. He studied at Rome, and put himself under the discipline of St Philip de Neri. In 1593, he was made general of the congregation of the Oratory by the resignation of the founder Philip de Neri. Pope Clement VIII. made him his confessor, and created him a cardinal in 1596. He was afterwards made librarian to the Vatican; and died in 1605, at 68 years of age. He wrote several works, the principal of which is his *Annales Ecclesiastici*, from A. D. 1. to 1198, in 12 vols folio; which has been abridged by several persons, particularly by Henry Spondæus, Bzovius, and Ludovico Arelio.

BARONY, Baronia, or *Baronagium*, the lordship or fee of a baron, either temporal or spiritual: In which sense *barony* amounts to the same with what is otherwise called *honour*.

A barony may be considered as a lordship held by some service in chief of the king, coinciding with what is otherwise called *grand serjeanty*. Baronies, in their first creation, moved from the king himself, the chief lord of the whole realm, and could be holden immediately of no other lord. For example, the king enfeoffed a man of a great seigneurie in land, to hold to the person enfeoffed and his heirs, of the king and his heirs, by baronial service; to wit, by the service of 20, 40, 60 knights, or of such other number of knights, either more or fewer, as the king by his enfeoffment limited or appointed.—In the ages next after the Conquest, when a great lord was enfeoffed by the king of a large seigneurie, such seigneurie was called a *barony*, but more commonly an *honour*; as, the honour of Gloucestershire, the honour of Wallingford, the honour,

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nour of Lancaster, the honour of Richmond, and the like. There were in England certain honours, which were often called by Norman or other foreign names; this is to say, sometimes by the English and sometimes by the foreign name. This happened when the same person was lord of an honour in Normandy, or some other foreign country, and also of an honour in England. For example, William de Forz, de Force, or de Fortibus, was lord of the honour of Albemarle in Normandy: he was also lord of two honours in England; to wit, the honour of Holderness, and the honour of Skipton in Cravene. These honours in England were sometimes called by the Norman name, the honour of Albemarle, or the honour of the earl of Albemarle. In like manner, the earl of Britannie was lord of the honour of Britannie in France, and also of the honour of Richmond in England: the honour of Richmond was sometimes called by the foreign name, the honour of Britannie, or the honour of the earl of Britannie. This serveth to explain the terms "honour of Albemarle in England," *honor Albemarliæ*, or *comitis Albemarliæ in Anglia; honor Britanniæ*, or *comitis Britanniæ in Anglia*, "the honour of Britannie," or "the earl of Britannie in England." Not that Albemarle or Britannie were in England, but that the same person respectively was lord of each of the said honours abroad and of each of the said honours in England. The baronies belonging to bishops are by some called *regalia*, as being held solely on the king's liberality. These do not consist in one barony alone, but in many: for *tot erant baroniæ, quot majora prædia.*

A barony, according to Bracton, is a right indivisible. Wherefore, if an inheritance be to be divided among coparceners, though some capital messuages may be divided, yet if the capital messuage be the head of a county or barony, it may not be parcelled: and the reason is, lest by this division many of the rights of counties and baronies by degrees come to nothing, to the prejudice of the realm, which is said to be composed of counties and baronies.

BARRA, or BARRAY, island of. See BARRAY.

BARRA, in *Commerce*, a long measure used in Portugal and some parts of Spain, to measure woollen cloths, linen cloths, and serges. There are three sorts: the barra of Valencia, 13 of which make $12\frac{6}{7}$ yards English measure; the barra of Castile, 7 of which make $6\frac{4}{7}$ yards; and the barra of Arragon, 3 of which make $2\frac{4}{7}$ yards English.

BARRABA, DESERT OF; a tract of land in Siberia, lying between the rivers Irtis and Oby, in the province of Tobolsk. It is uninhabited, but not through any deficiency of the soil; for that is excellent for tillage, and part of it might also be laid out in meadows and pastures. It is interspersed with a great number of lakes, which abound with a species of carp called by the neighbouring people *karawschen;* and the country produces great numbers of elks, deer, foxes, ermine, and squirrels. Between the Irtis and Oby are some rich copper mines; particularly on a mountain called *Pictowa*, from the *picta* or white firs that grow upon it. Every hundred weight of the ore found here yields 12 pounds of pure copper; and there is no occasion for digging deep in order to come at it. Most of these ores, besides being very rich in copper, yield a great deal of silver, which affords so much gold as makes rich returns for the trouble and expence of extracting it.

BARRACAN, in *Commerce*, a sort of stuff, not diapered, something like camblet, but of a coarser grain. It is used to make cloaks, surtouts, and such other garments, to keep off the rain.—The cities where the most barracans are made in France are Valenciennes, Lisle, Abbeville, Amiens, and Roan. Those of Valenciennes are the most valued; they are all of wool, both the warp and the woof.

BARRACIDA, a species of pike. See ESOX, ICHTHYOLOGY *Index*.

BARRACKS, or BARACKS, places for soldiers to lodge in, espcially in garrisons.—Barracks, when damp, are greatly prejudicial to the health of the soldiers lodged in them; occasioning dysenteries, intermitting fevers, coughs, rheumatic pains, &c. For which reason, quarter-masters ought to be careful in examining every barrack offered by the magistrates of a place; rejecting all ground-floors in houses that have either been uninhabited, or have any signs of moisture.

BARRATOR, or BARRETOR, in *Law*, a person guilty of barretry. See BARRETRY.

Lambert derives the word *barretor* from the Latin *balatro*, "a vile knave;" but the proper derivation is from the French *barrateur*, i. e. "a deceiver;" and this agrees with the description of a common barretor in my Lord Coke's report, viz. that he is a common mover and maintainer of suits in disturbance of the peace, and in taking and detaining the possession of houses and lands or goods by false inventions, &c. And therefore it was adjudged that the indictment against him ought to be in these words, viz. That he is *communis malefactor, calumniator, et seminator litium et discordiarum inter vicinos suos, et pacis regis perturbator*, &c. And there it is said that a common barretor is the most dangerous oppressor in the law, for he oppresseth the innocent by colour of law, which was made to protect them from oppression.

BARRATRY, in *Law*. See BARRETRY.

BARRATRY, in a shipmaster, is his cheating the owners. If goods delivered on ship-board are embezzled, all the mariners ought to contribute to the satisfaction of the party that lost his goods, by the maritime law; and the cause is to be tried in the admiralty. In a case where a ship was insured against the barratry of the master, &c. and the jury found that the ship was lost by the fraud and negligence of the master, the court agreed, that the fraud was barratry, though not named in the covenant; but that negligence was not.

BARRAUX, a fortress of Dauphiny, belonging to France, now in the department of Isere. It stands in the valley of Gresivaudan, and was built by a duke of Savoy in 1597. The French took it in 1598, and have kept it ever since. It is seated on the river Isere, in E. Long. 5. 10. N. Lat. 45. 0.

BARRAY, or BARRA, one of the Western isles, in the county of Inverness, Scotland; is eight miles in length, and four in breadth. The soil in general is thin and fit only for pasture, but in some places it produces corn and potatoes. The population amounted to 1969 in 1811. The inhabitants are chiefly employed in the cod and ling fishery, which is here very successful.

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In the year 1787 they carried 30,000 ling to the Glasgow market. The fish is carried to market in the same boat in which it is taken, either by going round the mull of Cantire, or drawing the boat by horses across the isthmus of Tarbet. There is a good harbour in the north-east side. Some cattle are reared in the island, and a little kelp is burned on the shore.

BARRE, Louis Francois Joseph de la, of Tournay, author of several works printed at Paris. Amongst others, *Imper. Orientale*, *Recueil des Medailles des Empereurs*, "Memoirs for the history of France," &c. He died in 1738.

BARREL, in *Commerce*, a round vessel, extending more in length than in breadth, made of wood, in form of a little tun. It serves for holding several sorts of merchandise.

Barrel is also a measure of liquids. The English barrel, wine measure, contains the eighth part of a tun, the fourth part of a pipe, and one half of a hogshead; that is to say, it contains $31\frac{1}{2}$ gallons: a barrel, beer-measure, contains 36 gallons; and ale-measure 32 gallons. The barrel of beer, vinegar, or liquor preparing for vinegar, ought to contain 34 gallons, according to the standard of the ale quart.

Barrel also denotes a certain weight of several merchandises, which differ according to the several commodities. A barrel of Essex butter weighs 106 pounds; and of Suffolk butter, 256 pounds. The barrel of herrings ought to contain 32 gallons wine-measure, which amount to about 28 gallons old standard, containing about 1000 herrings. The barrel of salmon must contain 42 gallons; the barrel of eels the same. The barrel of soap must weigh 256 lb.

Barrel, in *Mechanics*, a term given by watchmakers to the cylinder about which the spring is wrapped; and by gunsmiths to the cylindrical tube of a gun, pistol, &c. through which the ball is discharged.

Barrel, in *Anatomy*, a pretty large cavity behind the tympanum of the ear, about four or five lines deep, and five or six wide.

Fire-Barrels. See *Fire-Ship*.

Thundering Barrels, in the military art, are filled with bombs, grenades, and other fire-works to be rolled down a breach.

BARRENNESS, the same with sterility. See Sterility.

BARRETRY, in *Law*, is the offence of frequently exciting and stirring up suits and quarrels between his majesty's subjects, either at law or otherwise. The punishment for this offence, in a common person, is by fine and imprisonment: but if the offender (as is too frequently the case) belongs to the profession of the law, a barretor who is thus able as well as willing to do mischief ought also to be disabled from practising for the future. And indeed it is enacted by statute 12 Geo. I. c. 29. that if any one, who hath been convicted of forgery, perjury, subornation of perjury, or common barretry, shall practise as an attorney, solicitor, or agent, in any suit; the court, upon complaint, shall examine it in a summary way; and, if proved, shall direct the offender to be transported for seven years. Hereunto also may be referred another offence, of equal malignity and audaciousness; that of suing another in the name of a fictitious plaintiff, either one not in being at all, or one who is ignorant of the suit. This offence, if committed in any of the king's superior courts, is left, as a high contempt, to be punished at their discretion: but in courts of a lower degree, where the crime is equally pernicious, but the authority of the judges not equally extensive, it is directed by statute 8 Eliz. c. 2. to be punished by six months imprisonment, and treble damages to the party injured.

BARRICADE, or Barricado, a military term for a fence formed in haste with vessels, baskets of earth, trees, pallisades, or the like, to preserve an army from the shot or assault of the enemy.—The most usual materials for barricades consist of pales or stakes, crossed with batoons, and shod with iron at the feet, usually set up in passages or breaches.

Barricade, in naval architecture, a strong wooden rail, supported by stanchions, extending across the foremost part of the quarter-deck. In a vessel of war the vacant spaces between the stanchions are commonly filled with rope-matts, cork, or pieces of old cable; and the upper part, which contains a double rope-netting above the rail, is stuffed with full hammocks to intercept the motion, and to prevent the execution of small-shot in the time of battle.

BARRIER, in *Fortification*, a kind of fence made at a passage, retrenchment, &c. to stop up the entry thereof. It is composed of great stakes, about four or five feet high, placed at the distance of eight or ten feet from one another, with transums, or overthwart rafters, to stop either horse or foot, that would enter or rush in with violence: in the middle is a moveable bar of wood, that opens or shuts at pleasure. A barrier is commonly set up in a void space, between the citadel and the town, in half moons, &c.

Barriers, signifies that which the French call *jeu de barres*, i. e. *palestra;* a martial exercise of men armed and fighting together with short swords, within certain bars or rails which separated them from the spectators: it is now disused in this country.

BARRING a vein, in *Farriery*, an operation performed upon the veins of a horse's legs, and other parts of his body, with intent to stop the course, and lessen the quantity, of the malignant humours that prevail there.

BARRINGTON, John Shute, Lord Viscount Barrington, a nobleman distinguished for theological learning, was the youngest son of Benjamin Shute, merchant, and was born in 1678. He received part of his education at the university of Utrecht; and, after returning to England, studied law in the Inner Temple. In 1701 he commenced writer in favour of the civil rights of Protestant dissenters, to which body he belonged. At the recommendation of Lord Sommers he was employed to engage the Presbyterians in Scotland to favour the union of the two kingdoms; and in 1708, for this service, was appointed to the place of commissioner of the customs. From this he was removed by the Tory ministry of Queen Anne; but his fortune was, in the mean time, improved by the bequest of two considerable estates; one of them left him by Francis Barrington of Tofts, Esq. whose name he assumed by act of parliament. Mr Barrington now stood at the head of the Dissenters. On the accession of George I. he was returned member of

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parliament for Berwick-upon-Tweed; and in 1720 the king raised him to the Irish Peerage, by the style of Viscount Barrington of Ardglass. He was unfortunately engaged as sub-governor in one of the bubbles of the time, the Harburgh lottery, and underwent the disgrace of expulsion from the house of commons, in 1723; a censure which was thought greatly too severe, and altogether unmerited on his part. In 1725 he published his principal work, entitled *Miscellanea Sacra*, or a new method of considering so much of the History of the Apostles as is contained in Scripture, in an abstract of their history, an abstract of that abstract, and four critical essays; 2 vols. 8vo. This work traces the methods taken by the first preachers of the gospel for propagating Christianity, and explains the several gifts of the Spirit, by which they were enabled to discharge their office. It has always been reckoned a valuable and judicious defence of the Christian cause; and was reprinted with additions and corrections, in 3 vols. 8vo, 1770, by his son, afterwards bishop of Durham. In the same year he published "An Essay on the several Dispensations of God to Mankind, in the Order in which they lie in the Bible, &c." 8vo, 1725. He wrote various other tracts, chiefly on subjects relative to toleration in matters of religion. He died in 1734, in his 56th year, leaving several children, of whom five sons had the uncommon fortune of rising to high stations in the church, the law, the army, and the navy. Lord Barrington was a friend and disciple of Locke, and adopted his sentiments as to the right and advantage of free inquiry, and the value of civil and religious liberty. He contributed greatly to the rising spirit of liberal scriptural criticism among those who wished to render religion rational. He was a man of great moderation, and, though chiefly connected with the Dissenters, he occasionally frequented and communicated with the established church. *Gen. Biog.*

BARRINGTON, *Daines*, fourth son of Lord Viscount Barrington, distinguished as an antiquarian and naturalist, was educated for the profession of the law, and, after possessing various posts, was appointed a Welsh judge in 1757, and afterwards second justice of Chester. He never rose to much eminence at the bar, but he showed his knowledge of the law as an object of liberal study, by a valuable publication entitled "Observations on the Statutes, chiefly the more ancient, from Magna Charta to 21 James I. c. 27.: with an Appendix, being a proposal for new-modelling the Statutes," 4to, 1766. This work has been quoted with great respect by many of our historians and constitutional antiquaries. In 1773 he published an edition of *Orosius*, with Alfred's Saxon version, and an English translation and notes of his own, which met with some severe animadversion from the critics. His "Tracts on the Probability of reaching the North Pole," 1775, 4to, were written in consequence of the northern voyage of discovery undertaken by Captain Phipps (now Lord Mulgrave). He accumulates in them a variety of evidence favourable to his own opinion of the practicability of attaining the object in which that voyage failed; but there is little probability that the attempt will be renewed. Mr Barrington's other writings, which are numerous, are chiefly to be found in the publications of the Royal and Antiquarian Societies, of both of which he was long an assiduous member, and of the latter, vice-president. They relate to a variety of topics in natural history and antiquities, and show great industry and extent of research, though with an occasional leaning to singularity and paradox. Many of his tracts were collected by him in a 4to volume entitled, "Miscellanies on various Subjects," 1781. His "Experiments and Observations on the Singing of Birds," and his "Essay on the Language of Birds," are among the most curious and ingenious of his papers. These, and many others, prove that he was not only deeply conversant in books, but was a very attentive and sagacious observer of nature. In private life he was a man of worth and integrity, unambitious, and devoted to study and literary conversation. He resigned his office of justice of Chester in 1785, and afterwards lived in retirement in his chambers in King's-Bench-Walks, Inner-Temple, associating chiefly with his brother benchers, and amusing himself with superintending the improvements of the gardens. He died March 14. 1800, and was buried in the Temple church.

BARRINGTONIA, See BOTANY *Index*.

BARRISTER, is a counsellor learned in the law, admitted to plead at the bar, and there to take upon him the protection and defence of clients. They are termed *jurisconsulti*; and in other countries called *licentiati in jure*: and anciently barristers at law were called *apprentices* of the law, in Latin *apprenticii juris nobiliores*. The time before they ought to be called to the bar, by the ancient orders, was eight years, now reduced to five; and the exercises done by them (if they were not called *ex gratia*) were twelve grand moots performed in the inns of Chancery in the time of the grand readings, and 24 petty moots in the term times, before the readers of the respective inns: and a barrister newly called is to attend the six (or four) next long vacations the exercise of the house, viz. in Lent and Summer, and is thereupon for those three (or two) years styled a *vacation barrister*. Also they are called *utter barristers*, i. e. pleaders *ouster* the bar, to distinguish them from benchers, or those that have been readers, who are sometimes admitted to plead within the bar, as the king, queen, or prince's counsel are.

BARRITUS is a word of German original, adopted by the Romans to signify the general shout usually given by the soldiers of their armies on their first encounter, after the *classicum* or alarm. This custom, however, of setting up a general shout was not peculiar to the Romans, but prevailed among the Trojans according to Homer, amongst the Germans, the Gauls, Macedonians and Persians. See CLASSICUM.

BARROS, JOHN, a celebrated Portuguese historian, born at Visco in 1496. He was educated at the court of King Emanuel, among the princes of the blood, and made a great progress in Greek and Latin. The Infant John, to whom he attached himself, and became preceptor, having succeeded the king his father in 1521, Barros obtained a place in this prince's household; and in 1522, was made governor of St George del Mina, on the coast of Guinea. Three years after, the king having recalled him to court, made him treasurer of the Indies, and this post inspired him with the thought of writing this history, for which purpose

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Barros, Barrow.

purpose he retired to Pompas, where he died in 1570. His history of Asia and the Indies is divided into decades; the first of which he published in 1552, the second in 1553, and the third in 1563; but the fourth decade was not published till the year 1615, when it appeared by order of King Philip III. who had the manuscript purchased of the heirs of John Barros. Several authors have continued it, so that we have at present 12 decades. He left many other works; some of which have been printed, and others remain in manuscript.

BARROW, Isaac, an eminent mathematician and divine, was the son of Mr Thomas Barrow a linen draper in London, where he was born in 1630. He was at first placed at the Charter-house school for two or three years. There, however, his conduct gave but little hopes of success in the profession of a scholar; for he was extremely fond of fighting, and promoting it among his schoolfellows: but being removed from thence, his disposition took a happier turn; and having soon made great progress in learning, he was admitted a pensioner of Peter-house in Cambridge. He now applied himself with great diligence to the study of all parts of literature, especially to that of natural philosophy. He afterwards turned his thoughts to the profession of physic, and made considerable progress in anatomy, botany, and chemistry; after this he studied chronology, astronomy, and geometry. He then travelled into France and Italy, and in a voyage from Leghorn to Smyrna, gave a proof of his bravery; for the ship being attacked by an Algerine pirate, he remained upon deck, and with the greatest intrepidity fought, till the pirate, perceiving the stout resistance the ship made, sheered off and left her (A).

At Smyrna he met with a most kind reception from Mr Bretton the English consul, upon whose death he afterwards wrote a Latin elegy. From thence he proceeded to Constantinople, where he received the like civilities from Sir Thomas Bendish the English ambassador, and Sir Thomas Dawes, with whom he afterwards preserved an intimate friendship. At Constantinople he read over the works of St Chrysostom, once bishop of that see, whom he preferred to all the other fathers. When he had been in Turkey somewhat more than a year, he returned to Venice. From thence he came home in 1659, through Germany and Holland; and was episcopally ordained by Bishop Brownrig. In 1660, he was chosen to the Greek professorship at Cambridge. When he entered upon this province, he intended to have read upon the tragedies of Sophocles; but he altered his intention, and made choice of Aristotle's rhetoric. These lectures having been lent to a friend who never returned them, are irrecoverably lost. July the 16th 1662, he was elected professor of geometry in Gresham college, by the recommendation of Dr Wilkins, master of Trinity-college, and afterwards bishop of Chester. Upon the 20th of May 1663 he was elected a fellow of the Royal Society, in the first choice made by the council after their charter. The same year the executors of Mr Lucas having, according to his appointment, founded a mathematical school at Cambridge, they fixed upon Mr Barrow for the first professor; and though his two professorships were not inconsistent with each other, he chose to resign that of Gresham college, which he did May the 20th, 1664. In 1669 he resigned his mathematical chair to his learned friend Mr Isaac Newton, being now determined to give up the study of mathematics for that of divinity. Upon quitting his professorship, he was only a fellow of Trinity-college, till his uncle gave him a small sinecure in Wales, and Dr Seth Ward bishop of Salisbury conferred upon him a prebend in his church. In the year 1670 he was created doctor in divinity by mandate; and, upon the promotion of Dr Pearson master of Trinity-college to the see of Chester, he was appointed to succeed him by the king's patent, bearing date the 13th of February 1672. When the king advanced him to this dignity, he was pleased to say, "he had given it to the best scholar in England." His majesty did not speak from report, but from his own knowledge: the doctor being then his chaplain, he used often to converse with him, and in his humorous way, to call him an "unfair preacher," because he exhausted every subject, and left no room for others to come after him. In 1675 he was chosen vice-chancellor of the university. The doctor's works are very numerous, and such as do honour to the English nation. They are, 1. Euclid's Elements. 2. Euclid's Data. 3. Optical Lectures, read in the public school of Cambridge. 4. Thirteen Geometrical Lectures. 5. The Works of Archimedes, the four Books of Apollonius's Conic Sections, and Theodosius's Spherics explained in a new Method. 6. A Lecture, in which Archimedes's Theorems of the Sphere and Cylinder are investigated and briefly demonstrated. 7. Mathematical Lectures, read in the public schools of the university of Cambridge: the above were all printed in Latin: and as to his English works, they are printed together in four volumes folio.—"The name of Dr Barrow (says the reverend and learned Mr Granger) will ever be illustrious

(A) There is another anecdote told of him, which not only showed his intrepidity, but an uncommon goodness of disposition, in circumstances where an ordinary share of it would have been probably extinguished. He was once in a gentleman's house in the country, where the necessary was at the end of a long garden, and consequently at a great distance from the room where he lodged: as he was going to it before day, for he was a very early riser, a fierce mastiff who used to be chained up all day, and let loose at night for the security of the house, perceiving a strange person in the garden at that unseasonable time, set upon him with great fury. The doctor catched him by the throat, threw him, and lay upon him; and whilst he kept him down, considered what he should do in that exigence: once he had a mind to kill him; but he altered this resolution, upon recollecting that it would be unjust, since the dog did only his duty, and he himself was in the fault, for rambling out of his room before it was light. At length he called out so loud, that he was heard by some of the house, who came presently out, and freed the doctor and the dog from the danger they were both in.

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lustrious for a strength of mind and compass of knowledge that did honour to his country. He was unrivalled in mathematical learning, and especially in the sublime geometry; in which he has been excelled only by one man, and that man was his pupil, the great Sir Isaac Newton. The same genius that seemed to be born only to bring hidden truths to light, to rise to the heights or descend to the depths of science, would sometimes amuse itself in the flowery paths of poetry, and he composed verses both in Greek and Latin. He at length gave himself up entirely to divinity; and particularly to the most useful part of it, that which has a tendency to make men wiser and better. He has, in his excellent sermons on the Creed, solved every difficulty and removed every obstacle that opposed itself to our faith, and made divine revelation as clear as the demonstrations in his own Euclid. In his sermons he knew not how to leave off writing till he had exhausted his subject; and his admirable discourse on the duty and Reward of Bounty to the Poor, took him up three hours and a half in preaching. This excellent person, who was a bright example of Christian virtue, as well as a prodigy of learning, died on the 4th of May 1677, in the 47th year of his age; and was interred in Westminster abbey, where a monument, adorned with his bust, was soon after erected, by the contribution of his friends.

BARROWS, in *Ancient Topography*, artificial hillocks or mounts, met with in many parts of the world, intended as repositories for the dead, and formed either of stones heaped up, or of earth. For the former, more generally known by the name of *cairns*, see CAIRNS.—Of the latter Dr Plott takes notice of two sorts in Oxfordshire: one placed on the military ways; the other in the fields, meadows, or woods; the first sort doubtless of Roman erection, the other more probably erected by the Britons or Danes. We have an examination of the barrows in Cornwall by Dr Williams, in the Phil. Trans. N° 458. from whose observations we find that they are composed of foreign or adventitious earth; that is, such as does not rise on the place, but is fetched from some distance.—Monuments of this kind are also very frequent in Scotland. On digging into the barrows, urns have been found in some of them, made of calcined earth, and containing burnt bones and ashes; in others, stone chests containing bones entire; in others, bones neither lodged in chests nor deposited in urns. These tumuli are round, not greatly elevated, and generally at their bases surrounded with a fosse. They are of different sizes; in proportion, it is supposed, to the greatness, rank, and power, of the deceased person. The links or sands of Skail, in Sandwick, one of the Orkneys, abound in round barrows. Some are formed of earth alone, others of stone covered with earth. In the former was found a coffin, made of six flat stones. They are too short to receive a body at full length: the skeletons found in them lie with the knees pressed to the breast, and the legs doubled along the thighs. A bag, made of rushes, has been found at the feet of some of these skeletons, containing the bones, most probably, of another of the family. In one were to be seen multitudes of small beetles; and as similar insects have been discovered in the bag which enclosed the sacred *Ibis*, we may suppose that the Egyptians, and the nation to whom these tumuli did belong, might have had the same superstition respecting them. On some of the corpses interred in this island, the mode of burning was observed. The ashes, deposited in an urn which was covered on the top with a flat stone, have been found in the cell of one of the barrows. This coffin or cell was placed on the ground, then covered with a heap of stones, and that again cased with earth and sods. Both barrow and contents evince them to be of a different age from the former. These tumuli were in the nature of family vaults: in them have been found two tiers of coffins. It is probable, that on the death of any one of the family, the tumulus was opened, and the body interred near its kindred bones.

Ancient Greece and Latium concurred in the same practice with the natives of this island. Patroclus among the Greeks, and Hector among the Trojans, received but the same funeral honours with our Caledonian heroes; and the ashes of Dercennus the Laurentine monarch had the same simple protection. The urn and pall of the Trojan warrior might perhaps be more superb than those of a British leader: the rising monument of each had the common materials from our mother earth.

> The snowy bones his friends and brothers place,
> With tears collected, in a golden vase.
> The golden vase in purple palls they roll'd
> Of softest texture and inwrought with gold.
> Last o'er the urn the sacred earth they spread,
> And rais'd a tomb, memorial of the dead.
>
> *Pope's Homer's Iliad*, xxiv. 1003.

Or, as it is more strongly expressed by the same elegant translator, in the account of the funeral of Patroclus;

> High in the midst they heap the swelling bed
> Of rising earth, memorial of the dead.
>
> Ib. xxiii. 319.

The Grecian barrows, however, do not seem to have been all equally simple. The barrow of Alyattes, father of Crœsus king of Lydia, is described by Herodotus as a most superb monument, inferior only to the works of the Egyptians and Babylonians. It was a vast mound of earth heaped on a basement of large stones by three classes of the people; one of which was composed of girls who were prostitutes. Alyattes died, after a long reign, in the year 562 before the Christian era. Above a century intervened, but the historian relates, that to his time five stones (*ουροι*, *termini* or *stelæ*) on which letters were engraved, had remained on the top, recording what each class had performed; and from the measurement it had appeared, that the greater portion was done by the girls. Strabo likewise has mentioned it as a huge mound raised on a lofty basement by the multitude of the city. The circumstance was six stadia or three quarters of a mile; the height two plethra or two hundred feet; and the width thirteen plethra. It was customary among the Greeks to place on barrows either the image of some animal, or *stelæ*, commonly round pillars with inscriptions. The famous barrow of the Athenians in the plain of Marathon, described by Pausanias, is an instance of the latter usage. An ancient monument in Italy by the Appian-way, called without reason

Barrows.

reason the sepulchre of the Curiatii, has the same number of *termini* as remained on the barrow of Alyattes; the basement, which is square, supporting five round pyramids.—Of the barrow of Alyattes the apparent magnitude is described by travellers as now much diminished, and the bottom rendered wider and less distinct than before, by the gradual increase of the soil below. It stands in the midst of others by the lake Gygæus; where the burying-place of the Lydian princes was situated. The barrows are of various sizes; the smaller made perhaps for children of the younger branches of the royal family. Four or five are distinguished by their superior magnitude, and are visible as hills at a great distance. That of Alyattes is greatly supereminent. The lake it is likely furnished the soil. All of them are covered with green turf; and all retain their conical form without any sinking in of the top.

Barrows, or similar tumuli, are also found in great numbers in America. These are of different sizes, according to Mr Jefferson's* account; some of them constructed of earth, and some of loose stones. That they were repositories of the dead has been obvious to all; but on what particular occasion constructed, was matter of doubt. Some have thought they covered the bones of those who have fallen in battles fought on the spot of interment. Some ascribed them to the custom said to prevail among the Indians, of collecting at certain periods the bones of all their dead, wheresoever deposited at the time of death. Others again supposed them the general sepulchre for towns, conjectured to have been on or near these grounds; and this opinion was supported by the quality of the lands in which they are found (those constructed of earth being generally in the softest and most fertile meadow grounds on river sides), and by a tradition, said to be handed down from the aboriginal Indians, that when they settled in a town, the first person who died was placed erect, and earth put about him, so as to cover and support him; that when another died, a narrow passage was dug to the first, the second reclined against him, and the cover of earth replaced, and so on. "There being one of these barrows in my neighbourhood (says Mr Jefferson), I wished to satisfy myself whether any, and which of these opinions were just. For this purpose I determined to open and examine it thoroughly. It was situated on the low grounds of the Rivanna, about two miles above its principal fork, and opposite to some hills, on which had been an Indian town. It was of a spheroidical form, of about 40 feet diameter at the base, and had been of about 12 feet altitude, though now reduced by the plough to seven and a half, having been under cultivation about a dozen years. Before this it was covered with trees of 12 inches diameter, and round the base was an excavation of five feet depth and width, from whence the earth had been taken of which the hillock was formed. I first dug superficially in several parts of it, and came to collections of human bones, at different depths, from six inches to three feet below the surface. These were lying in the utmost confusion, some vertical, some oblique, some horizontal, and directed to every point of the compass, entangled, and held together in clusters by the earth. Bones of the most distant parts were found together; as, for instance, the small bones of the foot in the hollow of a skull: many skulls would sometimes be in contact, lying on the face, on the side, on the back, top or bottom, so as on the whole to give the idea of bones emptied promiscuously from a bag or basket, and covered over with earth, without any attention to their order. The bones of which the greatest numbers remained, were skulls, jaw-bones, teeth, the bones of the arms, the thighs, legs, feet, and hands. A few ribs remained, some vertebræ of the neck and spine, without their processes, and one instance only of the bone which serves as a base to the vertebral column. The skulls were so tender, that they generally fell to pieces on being touched. The other bones were stronger. There were some teeth which were judged to be smaller than those of an adult; a skull which, on a slight view, appeared to be that of an infant, but it fell to pieces on being taken out, so as to prevent satisfactory examination; a rib, and a fragment of the under-jaw of a person about half-grown; another rib of an infant; and part of the jaw of a child, which had not yet cut its teeth. This last furnishing the most decisive proof of the burial of children here, I was particular in my attention to it. It was part of the right half of the under-jaw. The processes by which it was articulated to the temporal bones were entire; and the bone itself firm to where it had been broken off, which, as nearly as I could judge, was about the place of the eye tooth. Its upper edge, wherein would have been the sockets of the teeth, were perfectly smooth. Measuring it with that of an adult, by placing their hinder processes together, its broken end extended to the penultimate grinder of the adult. This bone was white, all the others of a sand colour. The bones of infants being soft, they probably decay sooner, which might be the cause so few were found here. I proceeded then to make a perpendicular cut through the body of the barrow, that I might examine its internal structure. This passed about three feet from its centre, was opened to the former surface of the earth, and was wide enough for a man to walk through and examine its sides. At the bottom, that is, on the level of the circumjacent plain, I found bones; above these a few stones, brought from a cliff a quarter of a mile off, and from the river one-eighth of a mile off; then a large interval of earth, then a stratum of bones, and so on. At one end of the section were four strata of bones plainly distinguishable; at the other, three; the strata in one part not ranging with those in another. The bones nearest the surface were least decayed. No holes were discovered in any of them, as if made with bullets, arrows, or other weapons. I conjectured that in this barrow might have been a thousand skeletons. Every one will readily seize the circumstances above related, which militate against the opinion that it covered the bones only of persons fallen in battle; and against the tradition also which would make it the common sepulchre of a town, in which the bodies were placed upright, and touching each other. Appearances certainly indicate that it has derived both origin and growth from the accustomary collection of bones, and deposition of them together; that the first collection had been deposited on the common surface of the earth, a few stones put over it, and then a covering of earth; that the second had been laid on this, had covered more or less of it in proportion to the

* *Notes on the State of Virginia*, p. 156.

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the number of bones, and was then also covered with earth, and so on. The following are the particular circumstances which give it this aspect. 1. The number of bones. 2. Their confused position. 3. Their being in different strata. 4. The strata in one part having no correspondence with those in another. 5. The different states of decay in these strata, which seem to indicate a difference in the time of inhumation. 6. The existence of infant bones among them. But on whatever occasion they may have been made, they are of considerable notoriety among the Indians; for a party passing, about thirty years ago, through the part of the country where this barrow is, went through the woods directly to it, without any instructions or enquiry; and having staid about it for some time, with expressions which were construed to be those of sorrow, they returned to the high road, which they had left about half a dozen miles to pay this visit, and pursued their journey. There is another barrow, much resembling this in the low grounds of the south branch of the Shenandoah, where it is crossed by the road leading from the Rock-fish gap to Staunton. Both of these have, within these dozen years, been cleared of their trees and put under cultivation, are much reduced in their height, and spread in width, by the plough, and will probably disappear in time. There is another on a hill in the Blue ridge of mountains, a few miles north of Wood's gap, which is made up of small stones thrown together. This has been opened and found to contain human bones as the others do. There are also many others in other parts of the country."

Barrows, in the salt-works, are wicker cases, almost in the shape of a sugar-loaf, wherein the salt is put to drain.

BARRULET, in *Heraldry*, the fourth part of the bar, or the one half of the closset; an usual bearing in coat-armour.

BARRULY, in *Heraldry*, is when the field is divided bar-ways, that is, across from side to side, into several parts.

BARRY, Girald, commonly called *Giraldus Cambrensis*, i. e. *Girald of Wales*, a historian and ecclesiastic in the reigns of Henry II. and Richard I. was born at the castle of Mainarper, near Pembroke, A. D. 1146. By his mother he was descended from the princes of South Wales; and his father, William Barry, was one of the chief men of that principality. Being a younger brother, and intended for the church, he was sent to St David's, and educated in the family of his uncle, who was bishop of that see. He acknowledges, in his history of his own life and actions, that in his early youth he was too playful; but being severely reproached for it by his preceptors, he became a very hard student, and greatly excelled all his school-fellows in learning. When he was about 20 years of age, he was sent, A. D. 1166, for his further improvement, to the university of Paris; where he continued for three years, and became, according to his own account, a most excellent rhetorician; which rendered him very famous. On his return into Britain, he entered into holy orders, and obtained several benefices both in England and Wales. Observing, with much concern, that his countrymen, the Welch, were very backward in paying the tithes of wool and cheese, which he was afraid would involve them in eternal damnation, he applied to Richard archbishop of Canterbury, and was appointed his legate in Wales for rectifying that disorder, and for other purposes. He executed this commission with great spirit; excommunicating all, without distinction, who refused to save their souls by surrendering the tithes of their cheese and wool. Not satisfied with enriching, he also attempted to reform, the clergy; and dilated the archdeacon of Brecon to the archbishopric, for the unpardonable crime of matrimony; and the poor old man, refusing to put away his wife, was deprived of his archdeaconry; which was bestowed upon our zealous legate. In discharging the duties of this new office, he acted with great vigour, which involved him in many quarrels; but, if we may believe himself, he was always in the right, and always victorious. His uncle, the bishop of St David's, dying A. D. 1176, he was elected his successor by the chapter: but this election having been made without the permission, and contrary to the inclination of Henry II. our author prudently declined to insist upon it, and went again to Paris to prosecute his studies, particularly in the civil and canon law, and theology. He speaks with great raptures of the prodigious fame he acquired by his eloquent declamations in the schools, and of the crowded audiences who attended them, who were at a loss to know whether the sweetness of his voice, the beauty of his language, or the irresistible force of his arguments, were most to be admired. Having spent about four years at Paris, he returned to St David's; where he found every thing in confusion; and the bishop being expelled by the people, he was appointed administrator by the archbishop of Canterbury, and governed the diocese in that capacity to A. D. 1184, when the bishop was restored. About the same time he was called to court by Henry II. appointed one of his chaplains, and sent into Ireland A. D. 1185, with Prince John. By this prince he was offered the united bishoprics of Fernes and Leighlin, but declined them; and employed his time in collecting materials for his Topography of Ireland, and his History of the conquest of that island. Having finished his Topography, which consisted of three books, he published it at Oxford, A. D. 1187, in the following manner, in three days. On the first day he read the first book to a great concourse of people, and afterwards entertained all the poor of the town; on the second day he read the second book, and entertained all the doctors and chief scholars; and, on the third day, he read the third book, and entertained the young scholars, soldiers, and burgesses. "A most glorious spectacle! (says he) which revived the ancient times of the poets, and of which no example had been seen in England." He attended Baldwin archbishop of Canterbury, in his progress through Wales, A. D. 1186, in preaching a croisade for the recovery of the Holy Land; in which, he tells us, he was far more successful than the primate; and particularly, that the people were prodigiously affected with his Latin sermons, which they did not understand, melting into tears, and coming in crowds to take the cross. Although Henry II. as our author assures us, entertained the highest opinion of his virtues and abilities; yet he would never advance him to any higher dignity in the church, on account of his relation to the princes and great men of Wales. But on the accession of Richard I. (A. D. 1189), his projects of preferment became

became better: for he was sent by that prince into Wales to preserve the peace of that country, and was even joined in commission with William Longchamp, bishop of Ely, as one of the regents of the kingdom. He did not, however, improve this favourable opportunity: refusing the bishopric of Bangor in A. D. 1190, and that of Landaff the year after, having fixed his heart on the see of St David's, the bishop of which was very old and infirm. In A. D. 1192, the state of public affairs, and the course of interest at court, became so unfavourable to our author's views, that he determined to retire. At first he resolved to return to Paris to prosecute his studies; but meeting with some difficulties in this, he went to Lincoln, where William de Monte read lectures in theology with great applause. Here he spent about six years in the study of divinity, and in composing several works. The see of St David's, which had long been the great object of his ambition, became vacant, A. D. 1198, and brought him again upon the stage. He was unanimously elected by the chapter; but met with so powerful an adversary in Hubert archbishop of Canterbury (who opposed his promotion with great violence), that it involved him in a litigation which lasted five years, cost him three journeys to Rome, at a great expence, and in which he was at last defeated, A. D. 1203. Soon after this he retired from the world, and spent the last 17 years of his life in a studious privacy, composing many books, of which we have a very correct catalogue in the Biographia Britannica. That Girald of Wales was a man of uncommon activity, genius, and learning, is undeniable; but these and his other good qualities were much tarnished by his insufferable vanity.

Barry, *James*, an eminent British painter. See Supplement.

Barry, in *Heraldry*, is when an escutcheon is divided bar-ways, that is, across from side to side, into an even number of partitions, consisting of two or more tinctures, interchangeably disposed; it is to be expressed in the blazon by the word *barry*, and the number of pieces must be specified; but if the divisions be odd, the field must be first named, and the number of bars expressed.

Barry-Bendy is when an escutcheon is divided evenly, bar and bend-ways, by lines drawn transverse and diagonal, interchangeably varying the tinctures of which it consists.

Barry-Pily is when a coat is divided by several lines drawn obliquely from side to side, where they form acute angles.

BARSA, in *Ancient Geography*, an island on the coast of France, in the English channel, (Itinerary): *Basepool* according to some; but according to others, *Bardsey*.

BARSALLI, a kingdom of Africa, bordering on the river Gambia, inhabited by a tribe of negroes called *Jaloffs*. The government of this kingdom is a most despotic monarchy: all people being obliged to prostrate themselves on the earth when any of the royal family makes his appearance. In time of war, every soldier has his share of the booty, and the king but a certain proportion, which is moderate, considering that if he pleased he might keep the whole. The kingdom is divided into a number of provinces, over which governors called *bumeys* are appointed by the king. These bumeys are absolute within their jurisdiction; but they seldom carry their prerogative so far as to incur the dislike of the people, which would quickly prove fatal to them. The Mahometan religion is professed by the king and his court; though little regard is paid to that part of the impostor's creed which forbids the use of wine; for the king cannot live without brandy, nor is he ever more devout than when he is drunk. When his majesty is in want of brandy or other necessaries, he sends to beg of the governor of James-fort that he will despatch a boat with the merchandise he has occasion for; and to purchase this he plunders the neighbouring towns, and seizes a certain number of his subjects, whom he sells for slaves to the Europeans in exchange for their commodities. This is his method of supplying himself if he happens to be at peace with his neighbours; for which reason the people are never so happy as when at war; and hence they pursue war with great vigour, and continue it with obstinacy.—The general dress of the people is a kind of loose calico surplice, that hangs down below the knee; which they sometimes plait about the waist in a very agreeable manner. They wear a great number of gold trinkets in their hair, ears, noses, and round their necks, arms, and legs; but the women especially are fond of these ornaments. The king of Barsalli, whom Moor saw in 1732, had a prodigious number of women: but when he went abroad he was seldom attended by more than two, who seemed to be dressed out in the whole finery and jewels of the seraglio. He had likewise a number of brethren; but it was seldom that he deigned to speak to them: if ever he did them that honour, they were forced to treat him with the same respect as other subjects, and fall prostrate on the earth the moment they came into his presence, notwithstanding they were the presumptive heirs of the crown. It is indeed usual for the king's children to dispute the right of succession with his brethren, and the longest sword generally carries away the prize.

BARSANTI, Francisco, an eminent musical performer and composer, was born at Lucca about the year 1690. He studied the civil law in the university of Padua; but, after a short stay there, chose music for his profession. Accordingly, he put himself under the tuition of some of the ablest masters in Italy; and having attained to a considerable degree of proficiency in the science of practical composition, took a resolution to settle in England, and came thither with Geminiani, who was also a Luccese, in the year 1714. He was a good performer on the hautboy, and also on the flute; in the former capacity he found employment in the opera band, and in the latter derived considerable advantages by teaching. He published, with a dedication to the earl of Burlington, six solos for a flute with a thorough-bass, and afterwards six solos for a German flute and a bass. He also made into sonatas, for two violins and a bass, the first six solos of Geminiani. He continued many years a performer at the opera house: at length reflecting that there was a prospect of advantage for one of his profession in Scotland, he went thither; and, with greater truth than the same is asserted of David Rizzio, may be said to have meliorated the music of this country, by collecting and making basses to a great number of the most popular Scots tunes. About the year 1750 Bar-

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santi returned to England; but being advanced in years, he was glad to be taken into the opera band as a performer on the tenor violin; and in the summer season into that of Vauxhall. At this time he published 12 concertos for violins; and shortly after, Sei Antifone, in which he endeavoured to imitate the style of Palestrina, and the old composers of motets; but from these publications so little profit resulted, that, towards the end of his life, the industry and economy of an excellent wife, whom he had married in Scotland, and the studies and labours of a daughter, whom he had qualified for the profession of a singer, but who is now an actress at Covent-Garden, were his chief support.

BARTAS, William de Salluste du, a French poet, who lived in the 16th century. He was employed by Henry IV. of France, in England, Denmark, and Scotland; and commanded a troop of horse in Gascony, under the marshal de Martignan. He was a Calvinist; and died in 1560, aged 46. He wrote a great number of poems; the most famous of which are, 1. The Week, or the Creation of the World, in seven books. 2. The Poem of Judith; and, 3. The battle of Ivry, gained by Henry IV. in 1590. Du Bartas wrote in a bombast style.

BARTAR, or Truck, is the exchanging of one commodity for another. The word comes from the Spanish *barator*, to deceive or circumvent in bargaining, perhaps because those who deal this way usually endeavour to overreach one another.

To transact properly, the price of one of the commodities and an equivalent quantity of the other, must be found either by practice or by the rule of three.

Quest. 1. How many pounds of cotton, at 9d. per lb. must be given in bartar for 13 C. 3 Q. 14 lb. of pepper, at 2l. 16s. per C.?

First, Find the price or value of the commodity whose quantity is given as follows:

	C.	Q.	lb.		L.	s.
	13	3	14	at	2	16
	26					
2l.	10	8				
16s.	1	8				
2Q.		14				
1Q.		7				
14lb.						
	L.38	17				

Secondly, Find how much cotton, at 9d. per lb. 38l. 17s. will purchase as under:

```
   d.  lb.   L.  s.
If 9 : 1 :: 38  17
             20
           ----
            777
             12
           ----
        9)9324(        C.  Q.
   Ans. 1036lb.=9  1
```

If the above question be wrought decimally, the operation may stand as follows:

```
     C.   L.      C.
If 1 : 2.8 :: 13.875
                 2.8
             -------
              111000
              27750
             ------- lb.   C. Q.
    .0375)38.8500(1036=9  1 Ans.
          37.5...
          -----
           1350
           1125
           -----
            2250
            2250
```

The value or price of the goods received and delivered in bartar being always equal, it is obvious that the product of the quantities received and delivered, multiplied in their respective rates, will be equal.

Hence arises a rule which may be used with advantage in working several questions; namely, Multiply the given quantity and rate of the one commodity, and the product divided by the rate of the other commodity quotes the quantity sought; or divided by the quantity quotes the rate.

Quest. 2. How many yards of linen, at 4s. per yard, should I have in bartar for 120 yards of velvet, at 15s. 6d.?

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Yds.   Sixp.         Sixp.   Yds.
120×    31 = 3720, and 8)3720(459 Ans.
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BARTH, or Bart, John, a brave fisherman of Dunkirk, who rose to the rank of an admiral; and is celebrated for his signal valour and naval exploits, in the annals of France. He died in 1702, aged 51.

BARTHELEMY, John James, a celebrated literary character, born at Cassis, a little sea-port on the shores of the Mediterranean, January 1716.

At twelve years of age he was sent to school at Marseilles. Being admitted into the college of the oratory, he was put under the care of Father Renaud, a person of taste and wit, who soon discovered similar qualities in his pupil, and became uncommonly attentive to his progress. M. de Visclede, a man of letters, and friend to the former, also concurred with him in his endeavours, and young Barthelemy's career soon became equally rapid and brilliant.

He had resolved to dedicate himself to the church; but, in order to prepare for this, it became necessary to change his place of residence, for M. de Belzunce, then bishop of Marseilles, being actuated by a narrow jealousy, refused to admit the students of the oratory to holy orders. Barthelemy, therefore, quitting his old masters with regret, found himself under the necessity of studying philosophy and theology with the Jesuits.

As he had not at first the good fortune to fall into able hands, he determined to follow a private plan of education, independent of the professors. He accordingly applied himself to the ancient languages, and was indefatigable in obtaining a knowledge of the Greek, Hebrew, Chaldean, and Syriac. His passion for learning had, however, nearly cost him his life, for he fell dangerously ill, and did not recover his strength until he had entered the seminary where he received the *tonsure*.

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Barthelemy.

In this retreat, he dedicated his leisure hours to the study of Arabic. A young Maronite, who had been educated at Rome, afforded him his assistance, and enabled him not only to read, but even to speak it. On this, his new friend proposed to him to render all the services in his power to the Maronites, Armenians, and other catholic Arabians, who were but slightly acquainted with the language of the country in which they resided: in other words, he wished that he would announce the word of God to them in their native tongue, and accordingly presented him with some Arabic sermons, composed by a Jesuit, who belonged to the *propaganda*.

Barthelemy got one or two of them by heart, and pronounced them in a spacious hall belonging to the seminary, to the entire satisfaction of his oriental auditors.

His reputation now rose high, and he began to be considered as a youth of uncommon promise, when a trifling incident occurred which tended not a little to increase it. Ten or twelve of the principal merchants of Marseilles one day introduced a person to him who had implored their charity on the exchange, observing that he was by birth a Jew, and had been raised, on account of his great learning, to the dignity of a rabbin; but having perceived, in consequence of his studies, that the Christian was the true religion, he had become a convert. He at the same time added, that he was profoundly instructed in the oriental languages, and demanded to be put to the proof, by being confronted with some learned man.

Barthelemy, not then 21 years of age, was immediately pitched upon. It was in vain he assured them, that although he could read, he was unable to speak the languages in question; they pressed him to enter into conversation with the native of the east; and the stranger himself entreated that the conference might immediately commence.

The challenge was at length accepted, and the foreigner began the contest, from which Barthelemy retired with the character of a prodigy of eastern erudition.

Barthelemy having now finished his education at the seminary, retired to Aubagne, and spent some time in the bosom of his family, by all the members of which he was greatly beloved. He was accustomed, however, to repair frequently to Marseilles, on purpose to visit the academicians, and other learned men residing there. Among those to whom he attached himself in a particular manner, was a M. Cary, the possessor of a fine cabinet of medals and a valuable collection of books, which were quite analogous to the favourite subject of his pursuits and studies. They spent whole days together in conversing on literary subjects; after which, Barthelemy, as if insatiable of knowledge, would retire to the Minims, where Father Sigaloux, a correspondent of the academy of sciences, was employed in making astronomical observations. In these labours the young abbé became his associate, for he was ambitious of improving in every kind of knowledge.

But he began at length to perceive, that in order to render his studies profitable, it would be necessary to circumscribe them, as mediocrity of knowledge, the inevitable result of a diversity of applications, was but little preferable to ignorance itself. Occupied with these sentiments, he repaired to Paris in 1744, with a view to devote himself entirely to literature. He was furnished with a letter to M. de Boze, keeper of the medals, and perpetual secretary of inscriptions and belles lettres. This learned man, so estimable in every point of view, received him with great politeness, and introduced him to the acquaintance of the most distinguished members of the three academies, who dined twice a-week at his apartments. Mixing with society of this kind, Barthelemy became more deeply enamoured than ever with a love of letters, and a respect for those who cultivated them.

M. de Boze, in the mean time, carefully studied the character and disposition of the young man, and at length favoured him with his friendship, and even with his confidence; at least he conferred as much of these as was possible for a man of so much circumspection and reserve.

As the increasing age, and declining health, of M. de Boze would not permit him to apply any longer with the intense investigation necessary for the completion of the cabinet of medals, he had entertained some thoughts of associating M. de Bastie, a learned antiquary belonging to the academy of inscriptions, as a partner in his labours. That gentleman lost the appointment, however, in consequence of an unlucky expression, and Barthelemy was selected a few months afterwards: this nomination was approved of by M. Bignon the librarian, and Maurepas the minister of the department. From that moment the abbé dedicated both his days and nights to the study of those medals which his colleague had been prevented, by his infirmities, from arranging.

Amidst his multiplied occupations, Barthelemy began to enjoy a mode of life so conformable to his taste and his talents, when he beheld with affright a new career present itself. In the course of his journey to the capital he had seen M. de Bausset, then a canon, at Aix. They were friends and countrymen; for M. de Bausset was born at Aubagne, where his family had been long established. As he was a young man of considerable expectations, he had promised that Barthelemy should become his vicar-general the moment he himself was decorated with the mitre. Such a flattering offer was not to be rejected; and as the canon was now nominated to the bishopric of Bezieres, he did not fail to remind his old acquaintance of their mutual engagement. The sorrow of the medalist on this occasion was too great to be concealed: he was, however, too scrupulous an observer of his word to break his promise; but the prelate, who saw and felt for the embarrassment of Barthelemy, immediately desisted from his importunities.

On the death of M. de Boze, keeper of the cabinet of medals, in 1753, Barthelemy, who had been his colleague during seven years, of course expected to succeed him in that honourable situation. One person, however, started as a candidate; but notwithstanding the abbé, relying on the justice of his pretensions, took no step whatever to obtain the appointment, yet the zeal of his friends rendered all solicitations on his part unnecessary, for they were both numerous and powerful. M. de Malesherbes, whose unfortunate and tragical death all worthy men deplore; M. de Stainville,

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Barthelemy. ville, afterwards a duke and minister; and M. de Gontaut, brother of the last Marshal de Biron, supported his pretensions, and he was accordingly nominated successor to his friend in 1753.

M. de Stainville, afterwards better known during his administration by the title of duke de Choiseul, in 1754 was oppointed ambassador to Rome, Madame de Stainville, a lady both young and beautiful, being passionately attached to learning and learned men, conceived a particular regard for the abbé, and it was proposed that he should occupy a place in their carriage, on this occasion, and make the tour of Italy along with them. Such a proposition could not fail to be highly flattering; but he was obliged, from principles of duty, to refrain for a time from complying with their wishes. He set out soon after, however, and arrived in November at Rome, where he and his companion were received and treated in the kindest manner by the French plenipotentiary, who lived in a magnificent style. Pope Benedict XIV. who then wore the tiara, being a learned man himself, did not fail to distinguish Barthelemy by the most courteous reception. But his stay at Rome was not long, for he was desirous of visiting Naples, rendered particularly interesting to an antiquary, at that period, by the recent discoveries made in its neighbourhood. He and his fellow-traveller were occupied during a whole month in admiring the curiosities of that capital, and in studying ancient literature; after which they took a journey of 30 leagues, to behold the monuments of Grecian architecture, still existing on the site of the ancient city of Pæstum.

The spacious apartments of the palace of Portici, containing the antiquities of Herculaneum and Pompeii, were still more interesting, and excited a far greater degree of curiosity in the breasts of the French philosophers. There they beheld an immense quantity of paintings, statues, busts, vases, and utensils of every kind; objects peculiarly calculated to engage their attention and excite their applause. It was not, however, without a certain mixture of grief and surprise that they noticed the four or five hundred manuscripts, saved from the ruins of Herculaneum, lying in the same forlorn state in which they were discovered. Two or three only had been unrolled, of which the learned Mazocchi has given an explanation: as these contained nothing important, the operation was abandoned.

But Barthelemy was not so easily discouraged, for he unceasingly solicited, he almost condescended to intrigue, with a view to engage the possessors of these treasures to turn them to the best advantage. He, at length, perceived his labours about to be crowned with success a few years afterwards, but he was finally disappointed by the death of the marquis Caraccioli, the minister of Naples, who had entered most cordially into his views.

Another subject about this time also engaged the attention of the abbé. He was exceedingly desirous of presenting the learned men of France with a specimen of the ancient writing employed in the Greek manuscripts. He accordingly addressed himself, on this subject, to his friend Mazocchi, and also to M. Paderno, who superintended the treasures of Portici: both, however, replied that they were expressly enjoined not to communicate any thing. On this he solicited permission to look, for a few minutes only, on a page of a manuscript which had been cut from top to bottom since its discovery. It contained 28 lines, and Barthelemy read it over six different times with extreme attention; after this he retired to a corner and transcribed the precious fragment, on a piece of paper, from memory. He then returned, and having made a mental collation between the copy and the original he corrected two or three trifling errors that had escaped his attention. Barthelemy.

Having thus rendered himself master of a *fac-simile* of the MS. which related to the persecution of the Greek philosophers during the time of Pericles, he transmitted the literary plunder in the course of that very day to the academy of belles lettres, strictly enjoining secrecy, however, that Mazocchi and Paderno might escape all manner of blame.

M. de Stainville having been appointed ambassador to the court of Vienna, in 1757, the abbé accompanied his lady thither. On his arrival he found that his friend and protector had made certain engagements with the French ministry, on purpose to gratify his passion for antiquities. In consequence of this he had leave to visit Greece and the sea-ports of the Mediterranean, at the king's expence, where he was to amass new treasures, and return with them to his native country by Marseilles. But, notwithstanding all the attractions that this project presented, his scrupulous attachment to his duty prevailed over his passion for knowledge; as he deemed it highly improper that the cabinet of medals should be so long shut.

At length, towards the end of 1758, M. de Stainville, now become duke de Choiseul, was nominated minister for foreign affairs in the room of the abbé de Bernis, who had retired with a cardinal's hat. No sooner did this event take place, than both he and his lady determided to provide for their friend. They accordingly requested Barthelemy to state the sum that would make him easy for life, and he instantly mentioned 6000 livres a-year; blushing at the same time at the largeness of the demand.

As the purse of the nation was now open to the patron, he distributed his favours with a liberal hand; and it must be owned that, on this occasion, an object worthy of remuneration presented itself in the person of the learned abbé. Accordingly, in 1759, he presented him with a pension on the archbishopric of Alby; in 1765 he conferred on him the treasurership of St Martin de Tours, and in 1768 he made him secretary-general to the Swiss guards. In addition to these the abbé also enjoyed a pension of 5000 livres on the Mercury. His income was now very large, but he employed it nobly; for he distributed the surplus, which was considerable, among indigent men of letters.

In 1771 M. de Choiseul was disgraced, being succeeded in his office by his enemy the duke d'Aiguillon, and exiled to his estate at Chanteloupe. On this occasion he was forsaken as usual by the courtiers, who had basked in the sunshine of his favour; but he was not deserted by the grateful antiquary, who instantly repaired thither to pay his respects; nay, when the king demanded the duke's resignation of the post of colonel-general of the Swiss guards, the abbé, with a spirit

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Barthelemy.

spirit that does honour to his memory, insisted on sending in his own resignation of the secretaryship; but the ex-minister interfered, and prevailed upon him not to deliver it up without an indemnification, which should be sanctioned by the great seal, and authorized by letters patent enregistered in parliament.

Barthelemy was now in possession of more than 1200l. sterling per annum; of this he distributed between three and four hundred in the manner before related: the remainder was not dissipated in pomp and ostentation, but employed in such a manner as to enable him to enjoy philosophic ease. He also educated and established three nephews in life, one of whom has been successively ambassador and director: he at the same time supported the rest of his family in Provence, and selected a noble library, which he disposed of some years before his death.

After having thus possessed an ample income during more than twenty years, the abbé Barthelemy found himself, towards the latter end of his existence, reduced to live on a pittance calculated merely to furnish the indispensable necessaries of life, in consequence of the suppression of places and appointments that ensued immediately after the revolution. He was never heard, however, to complain; nay, he did not seem to perceive the change; and, while he was still permitted by his age and infirmities to walk from one end of Paris to the other, to pay his respects to Madame de Choiseul, he seemed to the full as happy as before.

In 1788 appeared his celebrated work, entitled *Voyage du jeune Anacharsis en Greece, dans le milieu du quatrieme siecle avant l'ere Chretienne.* He had begun it in 1757, and, during an uninterrupted succession of 30 years, occupied his leisure hours in bringing it to maturity.

His hero, a young Scythian, descended from the famous philosopher Anacharsis, whose name he bears, is supposed to repair to Greece, for his instruction in his early youth, and, after making a tour of her republics, her colonies, and her islands, he returns to his native country and writes this book, in his old age, after the hero of Macedon had overturned the Persian empire. In the manner of modern travellers, he gives an account of the customs, government, and antiquities, of the country he has visited; a copious introduction supplies whatever may be wanting in respect to historical details; while various dissertations on the music of the Greeks, on the literature of the Athenians, and on the economy, pursuits, ruling passions, manners and customs, of all the surrounding states, afford ample gratification to the reader of taste.

In 1789 the author became a candidate for a chair in the French academy; and such was the reputation he had obtained by his labours, that this learned body became particularly anxious to enrol him among its members; he was accordingly elected by acclamation. The speech delivered by the Abbé on his inauguration has been equally celebrated for its simplicity and modesty.

In 1790 M. de St Priest, minister of the department of Paris, made him an offer of the place of librarian to the king, then vacant by the resignation of M. le Noir. This was, at that period, a very flattering proposal, but it was not accepted; for the Abbé imagined that it might interfere with his literary occupations, and therefore, after expressing his gratitude, he declined the intended favour.

In the mean time, while Barthelemy was thus refusing one of the most honourable offices that a man of letters could at that time aspire to, he did not neglect the department which had so long been confided to his charge. His ardour, in respect to every thing that concerned the cabinet of medals, remained unabated and unaltered through life, and he now found means to have his nephew, Barthelemy Courçy, associated with him in his labours. This grand collection had received a considerable increase, and been embellished with a number of fine specimens since it was confided to his care. To enrich it still more, he carried on a correspondence, not only with the various provinces of France, but also with all parts of Europe.

In the mean time, the health of the learned medallist declined daily, and, in 1792, his strength began to fail him. Towards the beginning of the next year he became subject to fainting fits, which deprived him of the exercise of his faculties for several hours together. Being naturally calm and courageous, he did not appear, however, to be in the least affected by these accidents, but his friends considered them as symptoms of a speedy dissolution.

He was now seventy-eight years of age, sixty of which had been spent in literary toils, when an event occurred, calculated to excite the most bitter indignation. On the 30th August, 1793, this feeble old man was denounced as an aristocrat, and his nephew and several other young men employed about the library were included in the supposed guilt. The accusation proceeded from a person of the name of Duby, a clerk in the library, and was conveyed in a letter written by him to a person of the name of Chrétien, a pastry-cook, who happened to be a member of the section, before which it was first read, and then transmitted to the municipality. It ought not to be omitted here that Duby did not know Chrétien, or Chrétien Duby, and that Barthelemy was not acquainted with either of them!

A warrant was immediately issued against the supposed culprits, and this was signified by the officers of justice to the Abbé, who happened to be at Madame de Choiseul's, on the morning of the 2d of September. On this he instantly arose, and, without discovering any symptoms of fear, took his leave of that lady, and was conducted to the Magdelonettes, where he found his nephew Courçy. Such, however, was the respect paid to his virtue and his talents, even within the walls of a prison, that, on entering the gate, he was received with every expression of regard by the inhabitants of this dreary mansion, and the gaoler, whose name was Vanbertrand, paid the utmost attention to him. He was accordingly lodged in a little apartment along with his relation, and in the course of that evening he received a visit from Madame de Choiseul, who had taken care to intimate the event to the government. No sooner was the committee informed that the Abbé Barthelemy had been included in the order that was meant only to extend to some of the subalterns employed in the library, than orders were instantly issued for his release, and we are assured by his friend the duke de Nivernois, that the clerks in the public offices displayed the utmost zeal in forwarding the necessary papers for his liberation:

Barthelemy

beration: accordingly at eleven o'clock at night he was awaked from his sleep, and conducted to the house of his fair friend.

But the attention of the government did not stop here; for in a few weeks afterwards, the place of national librarian being vacant by the death of Carra, and the resignation of Chamfort, who had held it jointly, it was offered to the Abbé, with the most flattering marks of attention. His age and infirmities, however, afforded but too good a pretext for his refusal.

In 1794 his approaching dissolution was apparent to every one but himself, for his fainting fits became longer and more frequent; however, as he did not retain any remembrance of them, he occupied his time as usual; in other words, he devoted all his hours to friendship and literature.

He had now reached the 80th year of a life which had been entirely spent in a laborious and incessant application to study, which had secretly weakened the springs of existence. The rigour of the winter of 1795, against which he had adopted no precautions, is supposed to have hastened the catastrophe; this did not occur, however, until the spring.

On the 25th of April he dined with Madame de Choiseul. In the course of the night he became so weak that he was unable to ring his bell; and in the morning, when his servant entered, he was found with his feet in the bed and his head on the floor, entirely deprived of sensation. After being replaced, his recollection returned, but he grew gradually worse, and he was carried off without experiencing any pain, April 30. 1795.

He retained full possession of all his senses until the very last moment. At one o'clock he read Horace as if nothing extraordinary had occurred; but his hands turning cold, in consequence of the approach of death, became unable to support the book, which fell to the ground. His head soon after was seen to incline on one side, he appeared to sleep, and it was believed by his nephew and his attendants that this was really the case; but it was soon discovered that his respiration had ceased, and that this learned man was no more!

Thus died, without any of the usual struggles that accompany death, John James Barthelemy, one of the greatest ornaments of his age, regretted by all his relations as if he had been their common father, whose life presented an example, and whose works form a model for literary men. In person he was above the middle size, and, if we are to give credit to his admirers, his countenance displayed an air of antiquity wonderfully correspondent to his studies. His bust, carved by the chissel of Houdon, is allowed to be a masterpiece of art, and that able sculptor has contrived to infuse into the physiognomy a mixture of the mildness, simplicity, good-nature, and grandeur, so visible in the original.

BARTHEZ, Paul Joseph, an eminent French physician. See Supplement.

Barthius.

BARTHIUS, Gaspar, a very learned and copious writer, born at Custrin in Brandenburg, the 22d of June 1576. Mr Baillet has inserted him in his *Enfans Celebres;* where he tells us, that at 12 years of age he translated David's Psalms into Latin verse of every measure, and published several Latin poems. Upon the death of his father (who was professor of civil law at Francfort, counsellor to the elector of Brandenburg, and his chancellor at Custrin), he was sent to Gotha, then to Eisenach, and afterwards, according to custom, went through all the different universities in Germany. When he had finished his studies, he travelled into Italy, France, Spain, and England. He studied the modern as well as ancient languages, and his translations from the Spanish and French show that he was not content with a superficial knowledge. Upon his return to Germany, he took up his residence at Leipsic, where he led a retired life, his passion for study having made him renounce all sort of employment. He wrote a vast number of books; the principal of which are, 1. His *Adversaria*, a large volume in folio; the second and third volumes of which he left in manuscript. 2. A Translation of Æneas Gazæus. 3. A large volume of Notes upon Claudian, in 4to. 4. Three large volumes upon Statius; &c. He died at Leipsic, in 1658, aged 71.

Bartholinus.

BARTHOLINUS Caspar, a learned physician and anatomist in the 17th century, was born at Malmoe, a town in the province of Schonen, which then belonged to Denmark. At three years of age he had such a quick capacity, that in 14 days he learned to read; and in his 13th year he composed Greek and Latin orations, and pronounced them in public. When he was about 18 he went to the university of Copenhagen, and afterwards studied at Rostock and Wirtemberg. He next set out upon his travels; during which he neglected no opportunity of improving himself at the different universities to which he came, and everywhere receiving marks of respect. He was in 1613 chosen professor of physic in that university, which he enjoyed 11 years; when, falling into a dangerous illness, he made a vow, that if it should please God to restore him, he would solely apply himself to the study of divinity. He recovered, and kept his word; and soon after obtained the professorship of divinity, and the canonry of Roschild. He died on the 13th of July 1629, after having written several small works chiefly on metaphysics, logic, and rhetoric.

Bartholinus, *Thomas*, a celebrated physician, son of the former, was born at Copenhagen in 1616. After studying some years in his own country, he in 1637 went to Leyden, where he studied physic during three years. He then travelled into France; and resided two years at Paris and Montpelier, in order to improve himself under the famous physicians of those universities. Afterwards going to Italy, he continued three years at Padua; and at length went to Basil, where he obtained the degree of doctor of philosophy. Soon after, he returned to Copenhagen; where in 1647 he was appointed professor of the mathematics; and next year was nominated to the anatomical chair, an employment better suited to his genius and inclination; which he discharged with great assiduity for 13 years, and distinguished himself by making several discoveries with respect to the lacteal veins and lymphatic vessels. His close application, however, having rendered his constitution very infirm, he, in 1661, resigned his chair; but the king of Denmark allowed him the title of *honorary professor*. He now retired to a little estate he had purchased at Hagested, near Copenhagen, where he hoped to have spent the remainder of his days in peace and tranquillity: but his house being burnt in 1650,

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1560, his library, with all his books and manuscripts, was destroyed. In consideration of this loss the king appointed him his physician with a handsome salary, and exempted his land from all taxes; the university of Copenhagen also appointed him their librarian; and, in 1675, the king did him the honour to give him a seat in the grand council of Denmark. He wrote, 1. *Anatomia Caspari Bartholini Parentis, novis Observationibus primum locupletata*, 8vo. 2. *De Monstris in Natura et Medicina*, 4to. 3. *De Armillis Veterum, præsertim Danorum, Schedion*, 8vo; and several other works. This great man died on the 4th of December 1680.

St BARTHOLOMEW'S DAY, a festival of the Christian church, celebrated on the 24th of August. St Bartholomew was one of the twelve apostles; and is esteemed to be the same as Nathanael, one of the first disciples that came to Christ.

It is thought this apostle travelled as far as India, to propagate the gospel; for Eusebius relates, that a famous philosopher and Christian, named *Pantænus*, desiring to imitate the apostolical zeal in propagating the faith, and travelling for that purpose as far as India, found there, among those who yet retained the knowledge of Christ, the gospel of St Matthew, written, as the tradition asserts, by St Bartholomew, one of the twelve apostles, when he preached the gospel in that country. From thence he returned to the more northern and western parts of Asia, and preached to the people of Hierapolis; then in Lycaonia; and lastly at Albania, a city upon the Caspian sea, where his endeavours to reclaim the people from idolatry were crowned with martyrdom, he being (according to some writers) flayed alive, and crucified with his head downwards.—There is mention made of a Gospel of St Bartholomew, in the preface to Origen's Homilies on St Luke, and in the preface to St Jerome's Commentary on St Matthew: but it is generally looked upon as spurious, and is placed by Pope Gelasius among the apocryphal books.

BARTHOLOMEW, *St*, one of the Caribbee islands, belonging to the French, but ceded by them to Sweden in 1785. It is about 24 miles in compass, and has a good haven. W. Long. 62. 15. N. Lat. 18. 16.

BARTHOLOMITES, a religious order founded at Genoa in the year 1307; but the monks leading very irregular lives, the order was suppressed by Pope Innocent X. in 1650, and their effects were confiscated. In the church of the monastery of this order at Genoa is preserved the image which it is pretended Christ sent to King Abgarus. See ABGARUS.

BARTOLOCCI, JULIUS, a learned monk, and professor of Hebrew at Rome, was born at Celeno, in 1613; and distinguished himself by writing an excellent Hebrew and Latin catalogue of the Hebrew writers and writings, in 4 vols folio, a continuation of which was performed by Imbonati his disciple. He died in 1687.

BARTOLOMEO, FRANCISCO, a celebrated painter, born at Savignano, a village 10 miles from Florence, in the year 1469, was the disciple of Cosimo Rosselli, but was much more beholden to the works of Leonardo da Vinci for his extraordinary skill in painting. He was well versed in the fundamentals of design. Raphael, after quitting the school of Perugino, applied to this master; and under him studied the rules of perspective, with the art of managing and uniting his colours. In the year 1500, he turned Dominican friar; and some time after was sent by his superiors to the convent of St Martin, in Florence. He painted both portraits and histories; but his scrupulous conscience would hardly ever suffer him to draw naked figures, though nobody understood them better. He died in 1517, aged 48.

BARTON, a town of Lincolnshire, seated on the river Humber, where there is a considerable ferry to pass over into Yorkshire. Population 2204 in 1811. W. Long. 0. 10. N. Lat. 53. 40.

BARTSIA, PAINTED CUP. See BOTANY *Index*.

BARUCH, THE PROPHECY OF, one of the apocryphal books, subjoined to the canon of the Old Testament. Baruch was the son of Neriah, who was the disciple and amanuensis of the prophet Jeremiah. It has been reckoned part of Jeremiah's prophecy, and is often cited by the ancient fathers as such. Josephus tells us, Baruch was descended of a noble family; and it is said in the book itself, that he wrote this prophecy at Babylon; but at what time is uncertain. It is difficult to determine in what language this prophecy was originally written. There are extant three copies of it; one in Greek, the other two in Syriac; but which of these, or whether any one of them, be the original, is uncertain.

BARULES, in church history, certain heretics, who held, that the Son of God had only a phantom of a body; that souls were created before the world, and that they lived all at one time.

BARUTH, an ancient town of Turkey, in Syria, with a Christian church of the Nestorian persuasion. It is situated in a fine fertile soil, but is inconsiderable now to what it was formerly. E. Long. 34. 40. N. Lat. 33. 30.

BARUTH, an Indian measure, containing 17 gantans: It ought to weigh about three pounds and a half English avoirdupois.

BARYTONUM, in the Greek grammar, denotes a verb, which having no accent marked on the last syllable, a grave accent is to be understood. In Italian music, *barytona* answers to our common pitch of bass.

BAS CHEVALIER. See BACHELOR.

BAS-Relief. See *BASSO-Relievo*.

BAS, *James Philip le*, a modern French engraver, by whom we have some excellent prints. His great force seems to lie in landscapes and small figures, which he executed in a superior manner. His style of engraving is extremely neat; but yet he proves the freedom of the etching, and harmonizes the whole with the graver and dry point. We have also a variety of pretty vignettes by this artist. He flourished about the middle of the present century; but we have no account of the time of his birth or death.

1 Name, derivation, &c.

BASALTES, (from *basal*, "iron," or *βασανιζω*, *diligenter examino*), in *Natural History*, a heavy, hard stone, chiefly black or green, consisting of prismatic crystals, the number of whose sides is uncertain. The English miners call it *cockle*; the German *schoerl*. Its specific gravity is to that of water as 3000 or upwards to 1000. It frequently contains iron: and consists either of particles of an indeterminate figure, or of a sparry, striated, or fibrous texture. It has a flinty hardness, is insoluble by acids, and is fusible by fire.

Basaltes. The following is an analysis of some basaltes by Mr Bergman; and as the resemblance of it to lava will be frequently mentioned in the succeeding part of this article, we shall here contrast this analysis with that of lava by the same author.

2 Comparative analysis of basaltes and lava.

Basaltes, 100 parts contains		Lava, 100 parts contains	
Siliceous earth	50	Siliceous earth	49
Argillaceous	15	Argillaceous	35
Calcareous	8	Calcareous	4
Magnesia	2	Iron	12
Iron	25		

Dr Kennedy, an ingenious chemist, analyzed several species of basalt, whinstone, and lava, of which the following are the results.

Phil. Tran. Edin. vol. v.

Basalt from Staffa contains, in 100 parts,

Silex	48
Argil	16
Oxyd of iron	16
Lime	9
Moisture and other volatile matter	5
Soda, about	4
Muriatic acid, about	1
	99

Whinstone of Salisbury rock near Edinburgh contains, in 100 parts,

Silex	46
Argil	19
Oxyd of iron	17
Lime	8
Moisture and other volatile matter	4
Soda, about	3.5
Muriatic acid, about	1
	98.5

Whinstone from Caltonhill near Edinburgh contains, in 100 parts,

Silex	50
Argil	18.5
Oxyd of iron	16.75
Carbonate of lime	3
Moisture and other volatile matter	5
Soda, about	4
Muriatic acid, about	1
	98.25

Lava from Catania, Mount Ætna, contains, in 100 parts,

Silex	51
Argil	19
Oxyd of iron	14.5
Lime	9.5
Soda, about	4
Muriatic acid, about	1
	99

Lava from Sta Venere, Ætna, contains, in 100 parts, Basaltes.

Silex	50.75
Argil	17.5
Oxyd of iron	14.25
Lime	10
Soda, about	4
Muriatic acid, about	1
	97.5

The most remarkable property of this substance is its figure, being never found in strata, like other marbles, but always standing up in the form of regular angular columns, composed of a number of joints, one placed upon, and nicely fitted to another, as if formed by the hands of a skilful workman. See Plate LXXXV. fig. 15.

3 Basaltes, where found.

Basaltes was originally found in columns in Ethiopia, and fragments of it in the river Tmolus, and some other places. We now have it frequently, both in columns and small pieces, in Spain, Russia, Poland, near Dresden, and in Silesia; but the noblest store in the world seems to be that called the Giant's Causeway in Ireland and Staffa, one of the western isles of Scotland *. Great quantities of basaltes are likewise found in the neighbourhood of Mount Ætna in Sicily, of Hecla in Iceland, and of the volcano in the island of Bourbon. These are the only three active volcanoes in whose neighbourhood it is to be met with; but it is also found in the extinguished volcanoes in Italy, though not in the neighbourhood of Vesuvius.

* See Giant's Causeway and Staffa.

4 Of the Giant's Causeway in Ireland.

In Ireland the basaltes rises far up the country, runs into the sea, crosses at the bottom, and rises again on the opposite land. In Staffa the whole end of the island is supported by natural ranges of pillars, mostly above 50 feet high, standing in natural colonnades, according as the bays and points of land have formed themselves, upon a firm basis of solid unformed rock. Above these, the stratum, which reaches to the soil or surface of the island, varies in thickness, as the island itself is formed into hills or valleys, each hill, which hangs over the valleys below, forming an ample pediment. Some of these, above 60 feet in thickness from the base to the point, are formed by the sloping of the hill on each side, almost into the shape of those used in architecture.

The pillars of the Giant's Causeway have been very particularly described and examined. The most accurate account of them is to be met with in a work entitled, "Letters concerning the northern coast of the county of Antrim;" from which the following particulars relative to the present subject are extracted.

5 Particular account of the pillars.

"1. The pillars of the Causeway are small, not very much exceeding 1 foot in breadth and 30 in length; sharply defined, neat in their articulation, with concave or convex terminations to each point. In many of the capes and hills they are of a larger size; more imperfect and irregular in their figure and articulation, having often flat terminations to their joints. At Fairhead they are of a gigantic magnitude, sometimes exceeding 5 feet in breadth and 100 in length; oftentimes apparently destitute of joints altogether. Through many parts of the country, this species of stone is entirely rude and unformed, separating in loose blocks; in

Plate LXXXVI. fig. 1.

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Basaltes. in which state, it resembles the stone known in Sweden by the name of *trappe*.

"2. The pillars of the Giant's Causeway stand on the level of the beach; from whence they may be traced through all degrees of elevation to the summit of the highest grounds in the neighbourhood.

"3. At the Causeway, and in most other places, they stand perpendicular to the horizon. In some of the capes, and particularly near Usbet harbour, in the isle of Bagherry, they lie in an oblique position. At Doon point in the same island, and along the Balintoy shore, they form a variety of regular curves.

"4. The stone is black, close, and uniform; the varieties of colour are blue, reddish, and gray; and of all kinds of grain, from extreme fineness to the coarse granulated appearance of a stone which resembles imperfect granite, abounding in crystals of schorl, chiefly black, though sometimes of various colours.

"5. Though the stone of the Giant's Causeway be in general compact and homogeneous; yet it is remarkable, that the upper joint of each pillar, where it can be ascertained with any certainty, is always rudely formed and cellular. The gross pillars also in the capes and mountains frequently abound in these air-holes through all their parts, which sometimes contain fine clay, and other apparently foreign bodies: and the irregular basaltes beginning where the pillars cease, or lying over them, is in general extremely honey-combed; containing in its cells crystals of zeolite, little morsels of fine brown clay, sometimes very pure steatite, and in a few instances bits of agate.

6 Account of those in Staffa.

Sir Joseph Banks observes, that the bending pillars of Staffa differ considerably from those of the Giant's Causeway. In Staffa they lie down on their sides, each forming the segment of a circle; and in one place, a small mass of them very much resembles the ribs of a ship. Those of the Giant's Causeway which he saw, ran along the face of a high cliff, bent strangely in the middle, as if unable, at their first formation, while in a soft state, to support the mass of incumbent matter.

7 Rocks of the Cyclops described.

The rocks of the Cyclops, in the neighbourhood of Ætna, exhibit very magnificent basaltic pillars. A general view of them is given on Plate LXXXVI. fig. 2. where *a*, *b*, *c*, are the three principal rocks; *e* is the extremity of an island, one half of which is composed of lava, on a base of basaltes, of no uncommon nature; above which there is a crust of pozzolana, combined with a certain white calcareous matter, which is pretty hard and compact; and which, as it is composed by the action of the air, appears like a piece of knotty porous wood. That rock, at some former period, became so hard as to split; and the clefts were then filled up with a very hard and porous matter like scoriæ. This matter afterwards acquiring new hardness, also split, leaving large interstices, which in their turn have been filled up with a species of compound yellow matter. The island was formerly inhabited; and there still remains a flight of steps leading from the shore to the ruins of some houses which appear to have been hewn in the rock.

The rock *b* has the straightest and most regular columns of any. It is represented distinctly in Plate LXXXVII. fig. 1. and likewise a general view of *c* and *d*, with the foot of Ætna leading to Catanea. These basaltic columns, at first view, seem to resemble those of the Giant's Causeway, and others commonly met with: but on a nearer inspection, we find a remarkable difference; being assembled in groups of five or six about one, which serves as their common centre. They are of various sizes and forms; some square, others hexagonal, heptagonal, or octagonal. One half of this rock is composed of perpendicular columns; the other of another species of basaltes disposed in inclined, and almost rectilinear, layers. These are in contact with the columns, and are as closely connected with them as they are with one another. The layers are longer at the base than towards the top of the rock. It is further to be remarked, that most of these layers are subdivided as they rise upwards; so that towards these upper extremities, one layer presents to the eye sometimes one, sometimes two, and sometimes three, divisions. The fragments of basaltes taken off from these layers are of a rhomboidal figure, because the layers break obliquely.

These layers, though inclined towards the base, become almost perpendicular towards the upper part of the rock, where they appear united in a point, and overtop most of the visible and elevated parts of the prismatic columns. These columns terminate in such a manner as to form a kind of staircase. They appear even to rise under a species of clay with which they are covered at one extremity, till they reunite themselves with the point which is formed by the most elevated parts of the layers of basaltes beside them.

This extraneous matter with which these columns are covered, and of which the summit of this pyramid consists, appears to be of the same species with the former, composing the upper part of the island already described.

The basaltes of that island has one particularity, viz. that it is full of small crystals of about the size of peas. These appear no less beautiful than rock-crystal; but they are much softer, and yield even to the action of the air. We see here large fragments of basaltes which were formerly full of crystals, but destroyed by time. They are now not unlike a sponge, from the great number of holes which appear all over their surface. Those pieces of basaltes which contain most of these crystals are not so hard as those which contain fewer of them.

8 Basaltes on the promontory of the Castel d'Iaci described.

The promontory of Castel d'Iaci, which terminates the basis of Ætna, is almost entirely composed of basaltes, but of a kind very different from the former. It consists of a great number of cylinders, from the diameter of six inches to that of twenty feet. Some of these are solid, others hollow like cannon: some extended in layers, others similar to carrots of tobacco consisting of a number of pieces squeezed together. Some of these cylinders are straight, others curved into a variety of forms. Some look like globes enclosed in the rocks; and in the fractures of these globes we perceive the strata of which they are composed.

Fig. 2. represents the basaltes at the foot of this promontory on the south side. The little mounts into which it appears to be collected, are sometimes only one French foot in diameter, sometimes six. They are composed of small prisms or needles, or of cubic trapezoids, and consist of a matter distinguished by the name of *dirty lava*. It is made up of pozzolana, consolidated

Basaltes. solidated by a certain liquid, which, while it has communicated solidity to the pozzolana, has at the same time suffered that substance to shrink considerably, in such a manner as to leave large chinks between the pieces of basaltes, which are thus formed by the operation of the liquid on the pozzolana. It appears also to have insinuated itself into the clay with which the promontory is covered; which is become hard in its turn, and which has also split into chinks that appear to contain a kind of hard matter.

These descriptions and figures will serve to give an idea of the appearance of the basaltes, which is now generally accounted a kind of marble. Wallerius considers it as a species of the corneous or horn-rock; and Cronstedt enumerates it among those substances which he calls *garnet earths*. The largest block of this stone that ever was seen, was placed according to Pliny, by Vespasian in the temple of Peace. It represented the figure of Nilus, with 16 children playing about it, denoting as many cubits of the rise of the river. The statue of Memnon, in the temple of Serapis at Thebes, which sounded at the rising of the sun, was also made of the same material, if we may believe this author. Most of the Egyptian figures are likewise made of basaltes. Some of the ancients call it *lapis Lydius*, from Lydia, where it seems it was formerly found in greatest abundance. The moderns denominate it the *touchstone*, as being used for the trial of gold and silver.

9 Basaltes used in different ancient works.

10 Substances mixed with basaltes.

Various substances are found intermixed with basaltes; of which Mr Hamilton, in the letters above-mentioned, enumerates the following: 1. Extensive layers of red ochre, varying in all degrees from a dull ferruginous colour to a bright red, answering very well for coarse painting. 2. Veins of iron ore, sometimes very rich, commonly of a very brown or reddish cast, at other times of a blue colour. 3. Steatites, generally of a greenish soapy appearance, more rarely of a pure white, and raising an imperfect saponaceous froth when agitated with water. 4. Zeolite, of a bright and pure white colour; in masses, varying in weight from a grain to a pound; generally disposed in cavities of the cellular basaltes; often affecting a crystallization, in which the fibres proceed as rays from a centre; and in some instances have a beautiful spangled appearance, resembling that of thistle-down. The most remarkable property of this substance is, that with any of the mineral acids, but especially with that of nitre, it forms a gelatinous mixture in the course of a few hours. 5. Peperino stone, a friable matrix of indurated clay and iron, studded with little bits of zeolite or other substances; and which is often of a reddish burnt colour. 6. Pumice-stone of a black colour, containing iron not entirely dephlogisticated, but still acting on the magnetical needle.

11 Of the nature of basaltes.

12 Mr Hamilton's state of the arguments concerning it.

These substances are met with among the basaltes of the Giant's Causeway in Ireland. In other places its attendants may perhaps vary according to circumstances. The basaltes itself has been considered by some as a crystallization from water; but others strenuously maintain that it is only a species of lava, and in defence of these opinions very considerable disputes have been carried on. The following is a state of the arguments on both sides from Mr Hamilton's treatise already mentioned.

In support of the volcanic origin of the basaltes it has been argued,

1. That it agrees almost entirely with lava in its elementary principles, in its grain, the species of the foreign bodies it includes, and all the diversities of its texture.

2. The iron of the basaltes is found to be in a metallic state, capable of acting on the magnetical needle, which is also the case with that found in compact lava.

3. The basaltes is fusible *per se;* a property which it has in common with lavas.

4. The basaltes is a foreign substance superinduced on the original limestone-soil of the country, in a state of softness capable of allowing the flints to penetrate considerably within its lower surface.

5. Those extensive beds of red ochre which abound among our basaltes are supposed to be an iron earth reduced to that state by the powerful action of heat; for such a change may be produced on iron in our common furnaces, provided there be a sufficient afflux of fresh air; and the basaltes itself, in such circumstances, is easily reducible to an impure ochre. This is also found to take place in the living volcanoes, particularly within their craters; and is therefore supposed to afford a presumptive argument of the action of fire in the neighbourhood of basaltes.

6. Though zeolite is not yet proved to be the actual production of a volcano, yet its presence is always supposed to give countenance to this hypothesis; because zeolite is found in countries where the action of subterraneous fire is still visible, and where there is reason to believe that the whole soil has been ravaged by that principle. Thus it abounds in Iceland, where the flames of Hecla yet continue to blaze; and in the isle of Bourbon, where there is still a volcano in force. It is therefore supposed to arise from the decomposition of the products of a volcano, where the fires have been long extinct.

7. Crystals of schorl appear in great plenty among many kinds of our basaltes; and these, though not absolutely limited to volcanic countries, yet being found in great abundance among the Italian lavas, in circumstances exactly corresponding to those of our basaltes, are thought to supply a good probable argument in the present case.

8. The peperino stone is thought to be undoubtedly of a volcanic origin. It has frequently the burnt and spongy appearance of many of the volcanic products; and that of the Giant's Causeway agrees exactly with the peperino of Iceland and Bourbon.

9. Puzzolane earth is met with among the basaltes of France; and there is very little reason to doubt that our basaltes, if pulverized, would agree with it in every respect; that is, it would produce a fine sharp powder, containing the same elementary parts, and probably agreeing with it in its valuable uses as a cement. This earth is also found in the Canary islands, which are thought to have other marks of fire; it is met with in all the volcanized parts of Italy, and is never found excepting where there are other evident marks of fire.

10. Pumice-stone is universally allowed to be produced by fire, and indeed bears the resemblance of a cinder

Basaltes. der so obviously, that one must be instantly convinced of its original. This is also found among the basaltes of Ireland.

11. There are three living volcanoes, within whose neighbourhood the basaltes and most of its usual attendant fossils have been observed, viz. Ætna in Sicily, Hecla in Iceland, and the island of Bourbon on the coast of Africa. To which it may be added, that it is found throughout all the volcanized parts of Italy, though not anywhere immediately in the neighbourhood of Vesuvius. Sir William Hamilton, however, informs us, that in the year 1779 he "picked up some fragments of large and regular crystals of close-grained lava or basalt; the diameter of which, when the prisms are complete, might have been eight or nine inches." He observes, that Vesuvius does not exhibit any lavas regularly crystallized, and forming what are called *Giants Causeways*, except a lava that ran into the sea, near Torre del Græco, in the year 1631, which has a small degree of such an appearance. As the fragments of basaltes which he found on this mountain, however, had been evidently thrown out of the crater in their proper form, he puts the question, "May not lavas be more ready to crystallize within the bowels of a volcano than after their emission? And may not many of the Giants Causeways already discovered be the nuclei of volcanic mountains, whose lighter and less solid parts may have been worn away by the hand of time?" Mr Faujas de St Fond gives an example of basalt columns placed deep within the crater of an extinguished volcano.

13 Of the basaltes thrown out by Vesuvius.

12. It is well ascertained by experience, that there are vast beds of pyrites dispersed through the interior parts of the earth at all depths; and it is also a certain fact, that this compound substance may be decompounded by the accidental effusion of water, in such a manner as to become hot, and at last to burn with great fury. This accession of pyrites is by many supposed to be the true origin of the volcanic fire; and an argument for this is, that the present volcanoes do pour forth great quantities of the component parts of pyrites, particularly sulphur, iron, and clay. Now, among the superinduced substances of the county of Antrim, and the same may probably be said of every other basaltic country, it is certain that the quantity of iron and clay diffused through almost every species of fossil, amounts to more than one half of the whole material; so that two of the principal elements of the pyrites are still found there, reduced in many instances to a slag or scoria. The third principle, viz. the sulphur, cannot be expected to remain; because sulphur is totally consumed by combustion; and what might perhaps escape and be sublimed would no doubt have since perished by decomposition, in consequence of being exposed to the air.

14 Glass sometimes appears in the form of prismatic crystals.

13. Another argument, which to Sir William Hamilton appears very convincing, is, that glass sometimes takes on the appearance of prisms, or crystallizes in cooling. He received some specimens of this kind from Mr Parker of Fleet-street, who informed him that a quantity of his glass had been rendered unserviceable by taking such a form. Some of these were in laminæ, which may be easily separated, and others resemble basaltic columns in miniature, having regular faces. "Many of the rocks of lava in the island of Ponza (says he) are, with respect to their configurations, strikingly like the specimens of Mr Parker's glass above mentioned; none being very regularly formed basaltes, but all having a tendency towards it. Mr Parker could not account for the accident that occasioned his glass to take the basaltic form; but I have remarked, both in Naples and Sicily, that such lavas as have run into the sea are either formed into regular basaltes, or have a great tendency towards such a form. The lavas of Mount Ætna, which ran into the sea near Jaci, are perfect basaltes; and a lava that ran into the sea from Vesuvius, near Torre del Græco in 1631, has an evident tendency to the basaltic form."

15 Lavas which run into the sea have a tendency to run into basaltes.

16 Arguments in opposition to the volcanic theory.

In opposition to these arguments it is urged, that in many of the countries where basaltes most abound, there are none of the characteristics of volcanic mountains. They assert, therefore, that the basaltes is a fossil, very extensively spread over the surface of the earth; and that, where it is found in the neighbourhood of volcanic mountains, we ought to suppose these to be accidentally raised on a basaltic soil rather than to have created it. But the advocates for the volcanic system are not much embarrassed with this argument. According to them, the basaltes has been formed under the earth itself, and within the bowels of these very mountains; where it could never have been exposed to view until, by length of time or some violent shock of nature, the incumbent mass must have undergone a very considerable alteration, such as should go near to destroy every exterior volcanic feature. In support of this it may also be observed, that the promontories of Antrim do bear evident marks of some very violent convulsion, which has left them in their present situation; and that the island of Bagherry, and some of the Western isles of Scotland, do really appear like the surviving fragments of a country, great part of which might have been buried in the ocean. It is further added, that though the exterior volcanic character be in a great measure lost in the basaltic countries; yet this negative evidence can be of little weight, when we consider, that the few instances where the features have been preserved afford a sufficient answer to this objection. Thus the Montagne de la Coupe in France still bears the marks of its having been formerly a volcano: and this mountain is observed to stand on a base of basaltic pillars, not disposed in the tumultuary heap into which they must have been thrown by the furious action of a volcanic eruption, tearing up the natural soil of the country; but arranged in all the regularity of a Giant's Causeway, such as might be supposed to result from the crystallization of a bed of melted lava, where rest and a gradual refrigeration contributed to render the phenomenon as perfect as possible.

17 Answered.

18 Mr Ferber's argument from the crystals found in black lava.

To these arguments stated by Mr Hamilton we shall add another from Mr Ferber: viz. That at the time he went from Rome to Ostia they were paving the road with a species of black lava. In some of the broken pieces he observed little empty holes, of the bigness of a walnut, incrusted all around their sides by white or amethystine, semipellucid, pointed, or truncated pyramidal crystallizations, entirely resembling the agate nodules or geodes, which are commonly filled with quartz crystallizations. There was no crack or fissure

in

Basaltes.

in the ambient compact lava; the crystal sherls were pretty hard, and might rather be called *quartz*. Some fine brownish dust lay in the rest of the holes, as impalpable and light as ashes. He tells us also, that in the greatest part of the Paduan, Veronese, and Vicentine lavas, we meet with an infinite quantity of white polygonal sherl crystallizations, whose figure is as regular, and still more polygonal, than the basaltes.

19 Mr Bergman's theory.

These may be considered as the principal arguments in favour of the volcanic theory of basaltes. On the other hand, the late celebrated Mr Bergman expresses himself to the following purpose.

"Ten years ago it was a general opinion, that the surface of the earth, together with the mountains, had been produced by moisture. It is true that some declared fire to be the first original cause, but the greater number paid little attention to this opinion. Now, on the contrary, the opinion that subterraneous fire had been the principal agent gains ground daily; and every thing is supposed to have been melted, even to the granite. It is not improbable, that both the fire and water have contributed their share in this operation; though in such a proportion, that the force of the former extends much farther than the latter; and, on the contrary, that the fire has only worked in some parts of the surface of the earth. It cannot be doubted that there has been some connection betwixt the basaltic pillars and subterraneous fire; as they are found in places where the marks of fire are yet visible; and as they are even found mixed with lava, tophus, and other substances produced by fire.

20 Both fire and water contribute to form basaltes.

21 Of the methods by which mineral crystals are naturally formed.

"As far as we know, nature makes use of three methods to produce regular forms in the mineral kingdom. 1. That of crystallization or precipitation; 2. The crusting or settling of the external surface of a liquid mass while it is cooling; and, 3. The bursting of a moist substance while it is drying.

"The first method is the most common; but to all appearance, nature has not made use of it in the present case. Crystals are seldom or never found in any quantity running in the same direction; but either inclining from one another, or, what is still more common, placed towards one another in sloping directions. They are also generally separated a little from one another when they are regular. The nature of the thing requires this, because the several particles of which the crystals are composed must have the liberty of obeying that power which affects their constitution. The basaltic columns, on the contrary, whose height is frequently from 30 to 40 feet, are placed parallel to one another in considerable numbers, and so close together that the point of a knife can hardly be introduced between them. Besides, in most places, each pillar is divided into several parts or joints, which seem to be placed on one another. And indeed it is not uncommon for crystals to be formed above one another in different layers, while the solvent has been visibly diminished at different times: but then the upper crystals never fit so exactly upon one another as to produce connected prisms of the same length or depth in all the strata taken together; but each stratum, separately taken, produces its own crystals.

"Precipitation, both in the wet and dry way, requires that the particles should be free enough to arrange themselves in a certain order; and as this is not practicable in a large melted mass, no crystallizations appear, excepting on its surface or in its cavities. Add to this, that the basaltes in a fresh fracture do not show a plain smooth surface under the microscope; but appear sometimes like grains of different magnitude, and at other times resemble fine rays running in different directions, which does not correspond with the internal structure of crystals.

"Hence the opinion of basaltes being formed by crystallization either in the wet or dry method must become less probable; but it must not be omitted, that the spars exhibit a kind of crystallization, which at first sight resembles a heap of basaltes, but upon a closer examination a very great difference is to be found. The form of the spar is everywhere alike, but the basaltes differ from one another in size and the number of their sides. The former, when broken, consists of many small unequal cubes; but the basalt does not separate in regular parts, &c. &c.

"Nature's second method of producing regular forms is that of crusting the outer surface of a melted mass. By a sudden refrigeration, nature, to effect this purpose, makes use of polyhedrous and irregular forms. If we suppose a considerable bed which is made fluid by fire, and spread over a plain, it evidently appears, that the surface must first of all lose the degree of heat requisite for melting, and begin to congeal. But the cold requisite for this purpose likewise contracts the uppermost congealed stratum into a narrower space; and consequently causes it to separate from the remaining liquid mass, as the side exposed to the air is already too stiff to give way. In this manner a stratum is produced, running in a parallel direction with the whole mass; others are still produced by the same cause in proportion as the refrigeration penetrates deeper. Hence we may very plainly see how a bed may be divided into strata. In the same manner the refrigeration advances on the sides; which consequently divides the strata into polyhedrous pillars, which can hardly ever be exactly square, as the strongest refrigeration in the inner parts of the mass advances almost in a diagonal line from the corners. If we add to this, that a large mass cannot be equal through its composition, nor everywhere liquid in the same degree, it will be easy to discover the cause of several irregularities. If the depth of the bed be very considerable in proportion to its breadth, prismatic pillars without cross divisions will be formed at least lengthwise from the uppermost surface downwards.

"The third way is perfectly similar to the preceding in its effect; but it is different from it by the mass being soaked in water, and by the bursting of it asunder, being the effect of the contraction while it is drying. If we suppose such a bed to be spread over a level space, the drying advances in the same manner as the refrigeration in the former case. This separation into strata properly happens when a considerable quantity of clay enters into the whole composition, because the clay decreases more than any other kind of earth in drying.

"It is most probable, therefore, that the pillars have been produced out of the basaltic substance while it was yet soft, or at least not too hard to be softened by exhalations. If we therefore suppose a bed to be spread over a place where a volcano begins to work, it

22 How the basaltes have been formed, according to this theory.

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it is evident that a great quantity of the water always present on such occasions must be driven upwards in exhalations or vapours; which, it is well known, possess a penetrating softening power, by means of which they produce their first effect: but when they are increased to a sufficient quantity, they force this tough moist substance upwards: which then gradually falls, and during this time bursts in the manner above described.

23 Reasons for supposing that the basaltes has not been melted.

"The reasons for this supposition are as follows: 1. We do not find the internal substance of the basaltes melted or vitrified; which, however, soon happens by fusion; and for which only a very small degree of fire is requisite. It is of consequence very hard to explain how this substance could have been so fluid that no traces of bubbles appear in it; and yet, when broken, seem dull and uneven. Lava is seldom vitrified within; but the greater number of bubbles and pores which are found in the whole mass, are more than sufficient proofs, that it has not been perfectly melted to its smallest parts, but has only been brought to be near fluid. Secondly, the basaltes so much resemble the finer trapp, both in their grain and original composition, that they can hardly be distinguished in small fragments."

24 Mr Kirwan's opinion.

Mr Kirwan is of opinion, that the basaltes owe their origin both to fire and water: they seem to have been at first a lava; but this, while immersed in water, was so diffused or dissolved in it with the assistance of heat, as to crystallize when cold, or coalesce into regular forms. That basaltes is not the effect of mere fusion he concludes from comparing its form with its texture. Its form, if produced by fusion, ought to be the effect of having flowed very thin; but in that case its texture should be glassy: whereas it is merely earthy and devoid of cavities. Hence we may understand how it comes to pass that lava perfectly vitrified, and even water, have been found enclosed in basaltes.

25 Mr Houel's theory.

Mr Houel, in his *Voyage Pittoresque*, is at considerable pains to account for the origin of the different species of basaltes he met with in the neighbourhood of Ætna. "Some modern writers (says he) attribute the configuration of the basaltes to the sudden cooling of the lava, in consequence of the effects produced upon it by the coldness of sea-water, when it reaches the sea in a state of fusion. They suppose that the shock, which it then receives, is the cause of those different configurations which this substance assumes; the most remarkable of which have been already mentioned. This assertion, however, seems to be ill founded. By considering the basaltic rock, the first of the Cyclops represented in the plate, we find that the pile is not in its original state, and that the series of columns is at present incomplete. It is very probable, that the species of clay found there, and which is extraneous to the basaltes, has by some means taken possession of its place; and it likewise appears, that not one of the basaltes here described is entire.

"It seems, incredible, however, that a mass of matter reduced by fire to a state of liquefaction, and flowing into the sea, should be suddenly changed into regular figures by the shock of coming into contact with cold water; and that all the figures which are thus formed should be disposed in the same manner with regard to one another. For if we suppose that the water made its way into the cavity of the lava at the instant when it retreated backwards, then might the same quantity of water penetrate into the most remote parts of the mass; and by that means prolong the cavity which it had begun to form when it first entered the mass. The water then being lodged within this burning mass, and being in a state of dilatation, would have expelled whatever opposed it, and swelled the whole mass in such a manner as to form much larger interstices than those which appear between the basaltic columns; since these are everywhere in close contact with one another. Besides, how could the sudden cooling of the lava divide the upper part and sides of such an enormous mass as exactly as if they had been cast in a mould made on purpose?

"It remains also for those who adopt the hypothesis in question to explain how the shock occasioned by the cold water should make itself felt beyond a certain depth; since the very first moment it comes into contact with the liquid lava, it must cease to be cold; for the lava cannot but communicate to it a greater degree of heat than it communicates of cold in return, as the water is more easily penetrable by the burning lava than the mass of lava by the surrounding water. But farther, if at the first moment after the lava enters the water it were cooled and contracted, the water would soon prevent, by the contraction of its whole surface, any continuation of the effect which it had first occasioned.

"This seems to be the great difficulty: for how is it thus possible for the water to extend its influence to the centre of any very considerable mass? and even supposing it to act at the centre, how could it be able to fix the common centre of all the different columns?

"Let us next consider what a degree of ebullition must take place in the water when it receives such a vast quantity of lava heated not only more intensely than common fire, but than red-hot iron! Though that mass, 100 fathoms in diameter, were to proceed from the bottom of the sea; or though it were immersed in it, the degree of ebullition would still be the same; and it is difficult to conceive what shock can be occasioned by a cold which does not exist, on a mass which burns, or causes to boil, whatever comes near it.

"One peculiarity attending the basaltes is, that it remains fixed in the recess which it has once occupied. Another, not less essential, is its power of dividing itself in the midst of any one of its hardest parts, and to form two distinct pieces, one of which is always concave, and the other convex; a division which seems the most singular curiosity of the whole.

"A third peculiarity might still be found in the interior part of these columns, if we were to meet with any that had suffered more by the lapse of time than those already described; but it is impossible for all this to be effected by water. How can water, which is everywhere the same, and which may be expected always to produce the same effects, produce such a variety on basaltes by mere contact?

"The cause of all these varieties, therefore, seems to be this, that these lavas are originally composed of materials extremely different in their natures, and from which such a variety of effects naturally proceed. The

Basaltes. same species of matter, when actuated by the same cause, will constantly produce the same effects. This variety of effects therefore is much less owing to the influence of the water, than to the variety of materials of which those lavas are composed; and these are combined in different forms and quantities, according to the nature and quantity of the various materials which have been reduced by the volcano to a state of fusion.

"The form of the basaltes therefore proceeds from two causes. One of them, viz. the cooling, belongs indifferently to every species, independent of its meeting with water. The other is the diversity of the quantities and of the materials of which the lava is composed. From these causes alone proceed all the beauties and varieties which are beheld with admiration in this class of bodies. These take place, from the most irregular fractures in the lava, to those which display the greatest exactness and symmetry. Every new erupted lava differs from those which preceded it, and from those which will follow. In the various principles of these lavas we must seek for the causes of those cavities discoverable in the basaltes, and for the causes which produce those basaltes, at the time when the matter of which it is composed contracted itself, and consolidated all its parts. In the act of condensation, it appears to have formed various foci, around which we may distinguish the line which sets bounds to the power of each of them; and this is the line which marks the spaces intervening between the different pieces: because all of them are possessed of the same attractive force. The first emitted by the lava, at the time the basaltes is formed, produces upon it the same effect that is produced by the evaporation of the aqueous moisture from those bodies where water forms a part of the original constitution; which bodies harden in proportion as they become dry, by reason of the approach of their constituent parts to one another. The abstraction of fire produces the same effect upon basaltes, by suffering its component parts to come into closer union.

"A new proof of this theory is deducible from the form of the basaltes represented Plate LXXXVII. fig. 2. The insterstices there are pretty numerous; because the lava being of that species denominated *dirty*, and consisting of parts, most of which have but little solidity, they have left much larger spaces between them at their contraction. From this want of solidity we may perceive how much the basaltic mass lost of the fire by which it was dilated while in a state of fusion.

"The void spaces left by the contraction of the basaltes, are filled with a spongy matter, which by drying has also left large interstices: and these have been filled in their turn with a kind of yellow matter similar to that which covers the promontory of Castel d'Iaci.

"Whatever variety of forms we meet with among the basaltes, and whatever divisions and subdivisions may be observable among these varieties, they are owing, 1. To the minuteness; 2. To the homogeneous nature; or, 3. To the diversity among the particles which compose the basaltes. Among the varieties already enumerated, we find reddish, earthy, soft and porous substances, together with the zeolite crystals. We see others extremely hard and compact, very finely grained, and containing likewise schoerl and zeolite crystals. Others are very hard and dense, wich appear to be a mixture of small gray and white bodies; and of each of these colours many different shades, from light to darker, containing also zeolite crystals. Lastly, we find some consisting of a matter similar to clay, mixed with round black sand.

Basaltes || Base.

"It may be objected, that the late eruptions of Ætna afford no basaltes, nor have they any divisions similar to those above mentioned. But to this we may reply, that if they afford neither such basaltes, nor such regular divisions, the reason is, that neither their quantity, nor the ingredients of which they are composed, are such as are necessary for the production of basaltes: and for a proof of this we may refer to lavas of the most remote antiquity, which have no more resemblance to basaltes than those that are more modern.

"Lastly, an argument, to which no plausible reply can be made, that the basaltes are not formed by seawater, is, that in the year 1669, the lava of Mount Ætna ran into the sea for two leagues and a half, without having the least appearance of being converted into basaltes."

BASAN, or BASHAN, in *Ancient Geography*, a territory beyond Jordan, mentioned in Scripture. By Josephus, Eusebius, and Jerome, it is called *Batanæa*. On the entering of the Israelites into the land of Canaan, the whole of the country beyond Jordan, from that of the Moabites, or Arabia, as far as Mount Hermon and Lebanon, was divided into two kingdoms, viz. that of Sihon king of the Amorites, and of Og king of Basan or *Bashan*; the former to the south, and the latter to the north. The kingdom of Sihon extended from the river Arnon and the country of Moab, to the river Jabbok; which running in an oblique course from the east, was at the same time the boundary of the Ammonites, as appears from Numb. xxi. 24. and Deut. ii. 37. and iii. 16. The kingdom of Sihon fell to the lot of the Reubenites and Gadites, and Basan to the half-tribe of Manasseh. To this was annexed a part of the hilly country of Gilead, and the district of Argob; yet so that Basan continued to be the principal and greatest part: but, after the Babylonish captivity, Basan was subdivided; so that only a part was called *Batanea* or *Basan*, another *Trachonitis*, a third *Auranitis* or *Ituræa*, and some part also *Gaulonitis*; but to settle the limits of each of these parts is a thing now impossible.—Bashan was a country famous for its pastures and breed of large cattle.

BASARTSCHIK, a considerable town of Romania, in Turkey in Europe. It is pretty well built, and hath clean and broad streets; has a great trade; and is situated on the river Meritz, in E. Long. 24. 30. N. Lat. 41. 49.

BASARUCO, in commerce, a small base coin in the East Indies, being made only of very bad tin. There are, however, two sorts of this coin, a good and a bad; the bad is one-sixth in value lower than the good.

BASE, in *Geometry*, the lowest side of the perimeter of a figure: Thus, the base of the triangle may be said of any of its sides, but more properly of the lowest, or that which is parallel to the horizon. In rectangled

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Fig. 2.

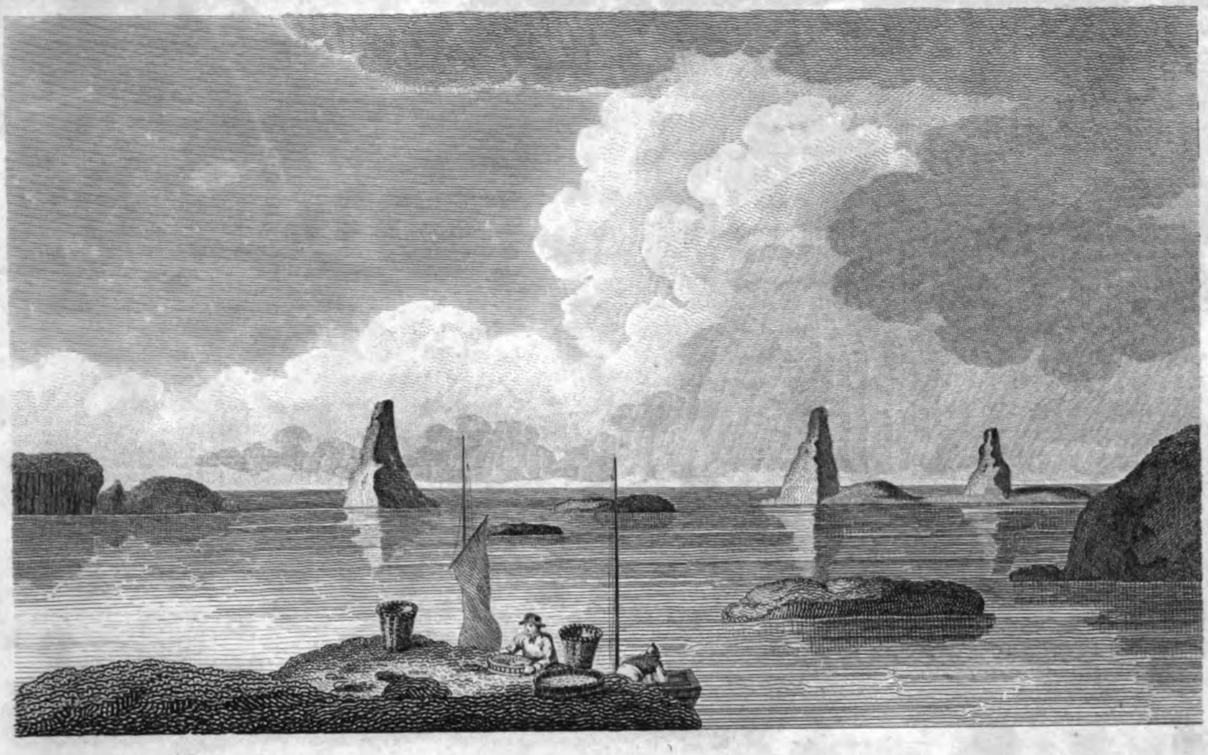

Fig. 1.

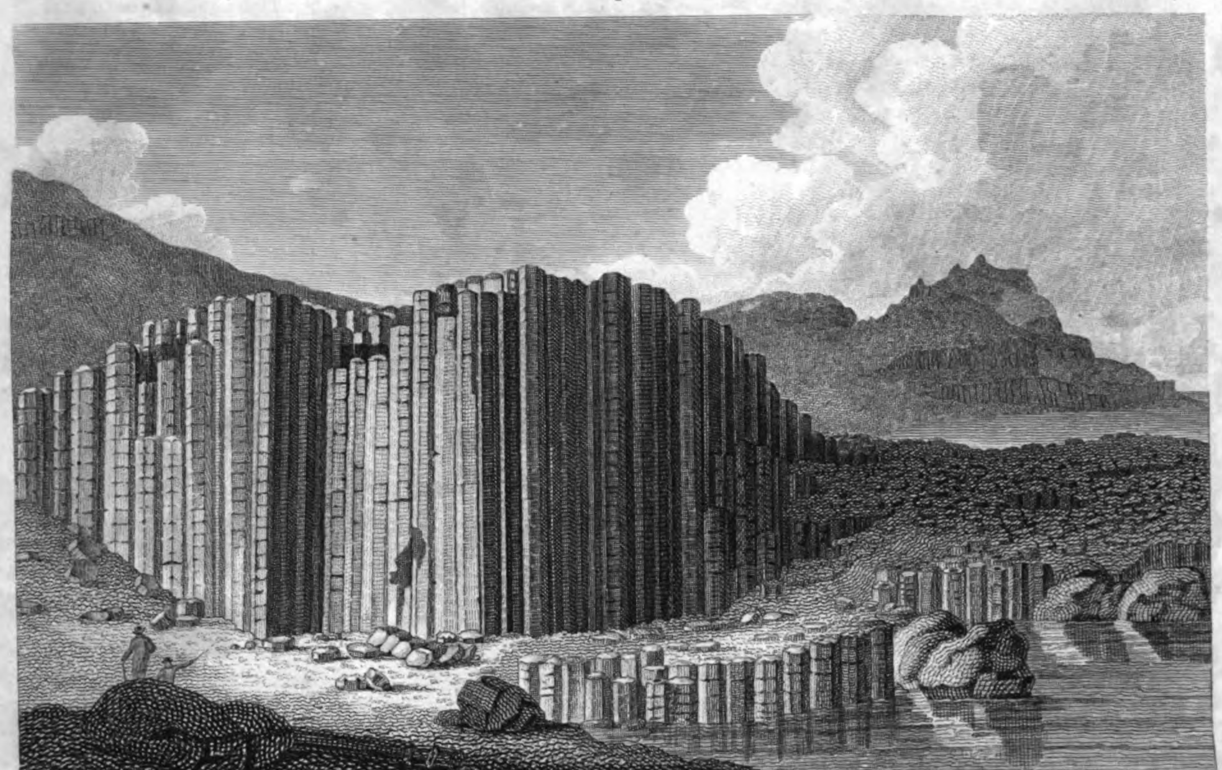

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Fig. 1.

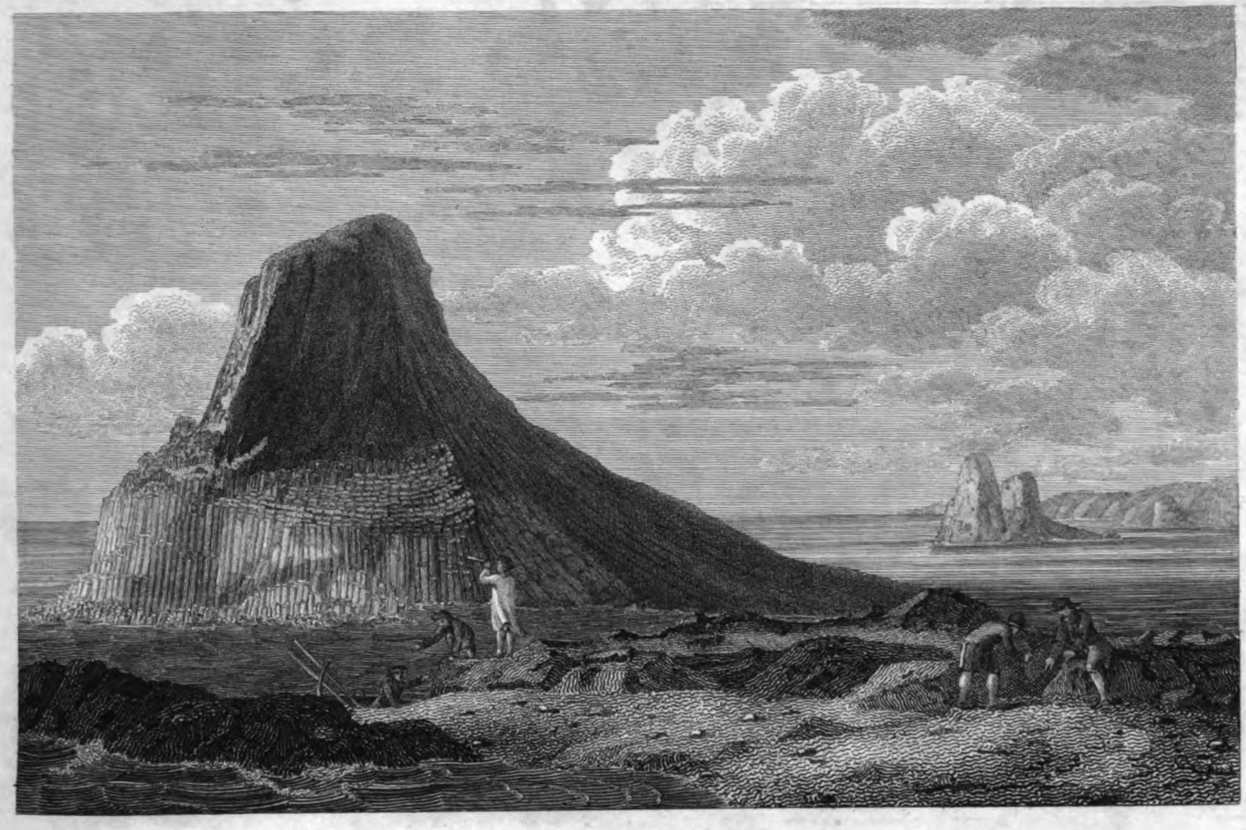
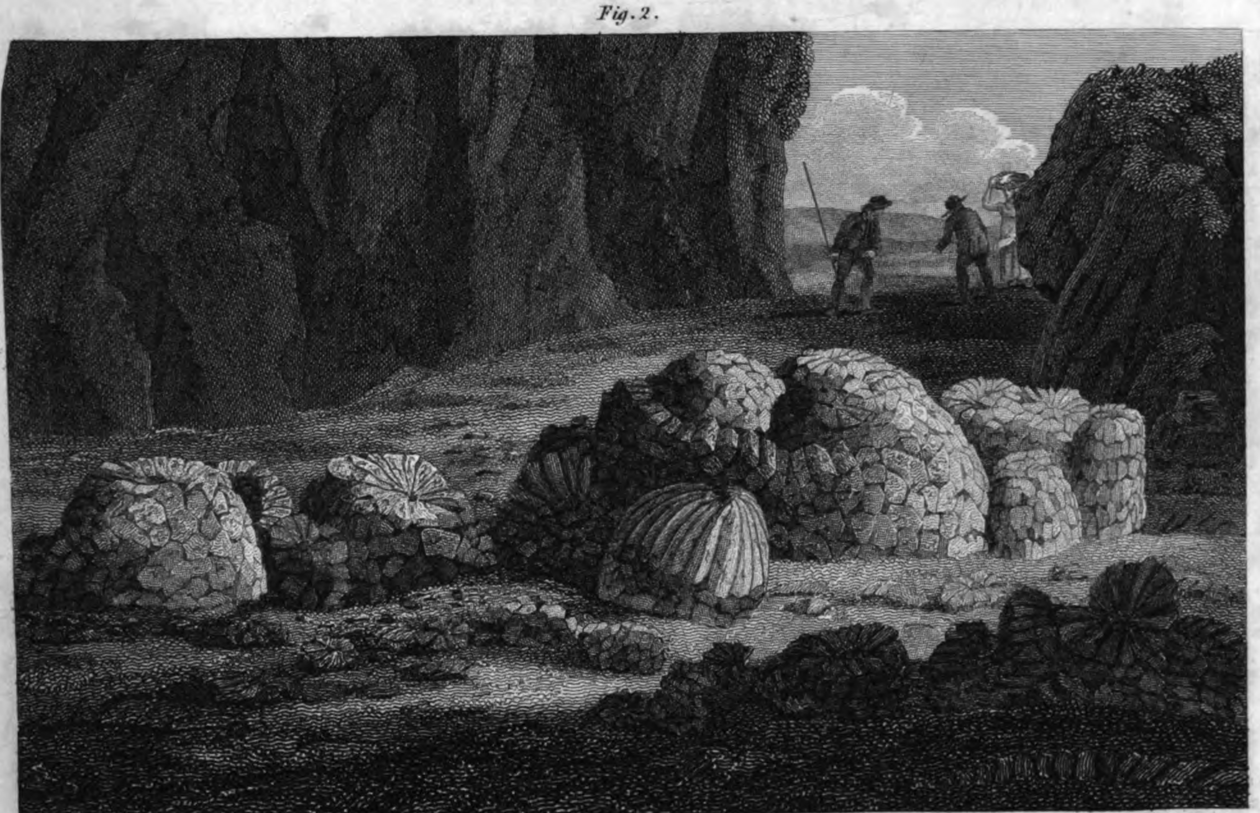


Fig. 2.



Lizars sculp.

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led triangles, the base is properly that side opposite to the right angle.

Base of a Solid Figure, the lowest side, or that on which it stands.

Base of a Conic Section, a right line in the hyperbola and parabola, arising from the common intersection of the secant plane and the base of the cone.

Base, in *Architecture*, is used for any body which bears another, but particularly for the lower part of a column and pedestal.—The ancients, in the early times of architecture, used no bases. The Doric columns in the temple of Minerva at Athens have none, but stand immediately upon the floor of the porch. Columns came afterwards to be supported on square pieces called *plinths*, and after that on pedestals. When we see a column, of whatsoever order, on a pedestal, the base is that part which comes between the top of the pedestal, and the bottom of the shaft of the column; when there is no pedestal, it is the part between the bottom of the column and the plinth: some have included the plinth as a part of the base; but it is properly the piece on which the base stands, as the column stands upon that.—The pedestal also has its base, as well as the column, and the pilaster. The base of columns is differently formed in the different orders; but in general it is composed of certain spires or circles, and was thence in early times called the *spire of a column*. These circles were in this case supposed to represent the folds of a snake as it lies rolled up; but they are properly the representations of several larger and smaller rings or circles of iron, with which the trunks of trees, which were the ancient columns, were surrounded to prevent their bursting: these were rude and irregular, but the sculptor who imitated them in stone found the way to make them elegant.

Base, in *Fortification*, the exterior side of the polygon, or that imaginary line which is drawn from the flanked angle of a bastion to the angle opposite to it.

Base, in *Gunnery*, the least sort of ordnance, the diameter of whose bore is $1\frac{1}{4}$ inch, weight 200 pounds, length 4 feet, load 5 pounds, shot $1\frac{5}{8}$ pound weight, and diameter $1\frac{1}{8}$ inch.

Base, in *Chemistry*. See Basis.

Base, in *Law*. *Base estate*, such as base tenants have in their hands. *Base tenure*, the holding by villenage, or other customary services; as distinguished from the higher tenures *in capite*, or by military service. *Base fee*, is to hold in fee at the will of the lord, as distinguished from soccage tenure. *Base court*, any court not of record.

BASEDOW, John Bernard, a celebrated German writer upon ethics and religion. See Supplement.

BASELLA, Climbing Nightshade. See Botany *Index*.

BASEMENT, in *Architecture*. See Architecture.

BASHARIANS, a sect of Mahometans, being a branch or subdivision of the Motazalites. The Basharians are those who maintain the tenets of Bashar Ebn Motamer, a principal man among the Motazalites, who varied, in some points, from the general tenets of the sect, as carrying man's free agency to a great length, and even to the making him independent.

BASHAW, a Turkish governor of a province, city, or other district.

A bashaw is made with the solemnity of carrying a flag or banner before him, accompanied with music and songs, by the mirialem, an officer on purpose for the investiture of bashaws. *Bashaw*, used absolutely, denotes the prime vizier; the rest of the denomination being distinguished by the addition of the province, city, or the like, which they have the command of; as the bashaw of Egypt, of Palestine, &c. The bashaws are the emperor's sponges. We find loud complaints among Christians of their avarice and extortion. As they buy their governments, every thing is venal with them. They live in their governments in a style of princely splendour and profusion. When glutted with wealth, the emperor frequently makes them a present of a bowstring, and becomes heir to all their spoils.

BASIL, St, the Great, one of the most learned and eloquent doctors of the church, was born at Cæsarea, in Cappadocia, about the year 328; and went to finish his studies at Athens, where he contracted a strict friendship with St Gregory Nazianzen. He returned to his native country in 355, where he taught rhetoric. Some time after, he travelled into Syria, Egypt, and Libya, to visit the monasteries of these countries; and the monastic life so much suited his disposition, that upon his return home he resolved to follow it, and he was the first institutor thereof in Pontus and Cappadocia. His reputation became so great, that, upon the death of Eusebius bishop of Cæsarea, in 370, he was chosen his successor. It was with some difficulty that he accepted of this dignity; and no sooner was he raised to it, than the emperor Valens began to persecute him because he refused to embrace the doctrine of the Arians. Being at length let alone, he began to use his utmost endeavours to bring about a reunion betwixt the eastern and western churches, who were then much divided about some points of faith, and in regard to Melefius and Paulinus two bishops of Antiochia. But all his efforts were ineffectual, this dispute not being terminated till nine months after his death. Basil had a share in all the disputes which happened in his time in the east in regard to the doctrine of the church; and died the first of January, 379.—There have been several editions of his works in Greek and Latin. The best is that of Father Garnier, printed in Greek and Latin, in three volumes folio. St Basil's style is pure and elegant, his expressions are grand and sublime, and his thoughts noble and full of majesty. Erasmus places him among the greatest orators of antiquity.

Basil, a canton of Switzerland, which joined the confederacy in 1501. It is bounded on the south by the canton of Solothurn; on the north by part of the margravate of Baden Dourlach, and the territory of Rheinfelden; on the east by Frickthal; and on the west by part of Solothurn, the diocese of Basil, and the Sundgare; being upwards of 20 miles in length, and about 18 in breadth. It contains 270 square English miles, and had a population of 49,200 in 1815. It is entirely Protestant. The lower parts of it afford corn and wine, and pasture; but the mountains are barren. Here are many medicinal springs and baths, and the air is wholesome and temperate. Both men and women for the most part wear the French dress; but the language commonly spoken is the High Dutch, though the French is also much used. The government is aristocratical; and its revenues arise chiefly from secularized abbeys, and imposts on goods carried through the country, to and from France, Italy, and Germany. Besides the military establishment of the city of Basil, there are two provincial regiments, consisting each of ten companies, and a troop of dragoons.—The places of most note are Basil the capital, Wallenburg, St Jacob, Neue-Haus, &c.

BASIL, the capital of the canton of that name, is the largest city in all Switzerland, and contains about 15,000 inhabitants. Its environs are exceedingly beautiful, consisting of a fine level tract of fields and meadows. The city is divided into two parts by the Rhine, over which there is a handsome bridge. It is thought by some to have risen on the ruins of the old Augusta Rauracorum. For its name of *Basilia* it is indebted to Julian the Apostate, who would have it so called in honour of his mother Basilina. It is fortified with walls, moats, towers, and bastions, and contains several churches, besides the cathedral, which is an old Gothic structure; a commandery of the order of St John, and another of the Teutonic order; a public granary and arsenal; a stately townhouse, in which is an exquisite piece of the sufferings of Christ, by Holbein, and a statue of Munatius Plancus, a Roman general, who about 50 years before Christ, built the ancient city of Augusta Rauracorum; an university which was founded in 1459, and has a curious physic-garden, library, and museum; a gymnasium; a stately palace, belonging to the margrave of Baden-Dourlach; besides a chamber of curiosities, several hospitals, &c. In the arsenal is shown the armour in which Charles the Bald lost his life, with the furniture of his horse, and the kettle-drums and trumpets of his army. On the staircase of the council-house, is a picture of the last judgement, in which, though drawn before the Reformation, popes, cardinals, monks, and priests, are represented in the torments of hell. Over-against the French church, on a long covered wall, is painted the dance of death; where the king of terrors is represented as mixing with all ranks and ages, and complimenting them, in German verses, on their arrival at the grave. St Peter's square, planted with elm and lime trees, makes a pleasant walk; but a spot regularly planted with trees, close by the river, and near the minster, makes still a finer, as commanding a most beautiful and extensive prospect. The celebrated Erasmus died here in 1536, in the 70th year of his age, and was buried in the great church. He left his library and cabinet of rarities to one Amberbach, a learned lawyer of this city, of whose heirs they were purchased by the university. Besides this cabinet, there are several other curious private ones. The clocks of this city go an hour faster than elsewhere, except at Constance; a circumstance which some ascribe to the famous councils held there, when it was thought the best expedient to bring the fathers early to the assembly, for the quicker despatch of business; but others say, that, in Basil, it was owing to an assault being defeated by that means. About 400 years ago, according to the story, the city was threatened with an assault by surprise. The enemy was to begin the attack when the large clock of the tower at one end of the bridge should strike one after midnight. The artist who had the care of the clock, being informed that this was the expected signal, caused the clock to be altered, and it struck two instead of one; so the enemy, thinking they were an hour too late, gave up the attempt: and in commemoration of this deliverance, all the clocks in Basil have ever since struck two at one o'clock, and so on. But this practice is said now to be abolished. They show, by way of confirmation, a head, which is placed near to this patriotic clock, with the face turned to the road by which the enemy was to have entered. This same head lolls out its tongue every minute, in the most insulting manner possible. This was originally a piece of mechanical wit of the famous clockmaker's who saved the town. He framed it in derision of the enemy, whom he had so dexterously deceived. It has been repaired, renewed, and enabled to thrust out its tongue every minute for these four hundred years, by the care of the magistrates, who think so excellent a joke cannot be too often repeated. Trade still flourishes here, especially in silk, ribbons, and wines; and the police is under excellent regulations. Most of the offices are bestowed by lot among well qualified persons. No person, without the city, must wear lace of gold or silver. All young women are prohibited from wearing silks; and the nearest relations only are to be invited to a marriage-feast. For the government of the city there are several councils or colleges, and officers. Of the last, the two burgomasters, and two wardens of trades, are the chief. The great council is composed of the representatives of the several companies of the greater and lesser city. Basil was the see of a bishop till the Reformation; but though there is one that still bears the title, he has now no jurisdiction here, and lives at Porentru, near the Upper Alsace. The two Buxtorffs, father and son, and the famous painter Holbein, were natives of this place. The council held here, in 1431, sat in the vestry of the cathedral.

BASIL. See OCYMUM, BOTANY *Index*.

BASIL, among joiners, the sloping edge of a chissel, or of the iron of a plane, to work on soft wood: they usually make the basil 12 degrees, and for hard wood 18; it being remarked, that the more acute the basil is, the better the instrument cuts; and the more obtuse, the stronger, and fitter it is for service.

BASILEUS, Βασιλευς, a title assumed by the emperors of Constantinople, exclusive of all other princes, to whom they give the title *rex*, "king." The same quality was afterwards given by them to the kings of Bulgaria, and to Charlemagne, from the successors of which last they endeavoured to wrest it back again.

The title *basileus* has been since assumed by other kings, particularly the kings of England, *Ego Edgar totius Angliæ basileus confirmavi*. Hence also the queen of England was entitled *Basilea* and *Basilissa*.

BASILIAN MONKS; religious of the order of St Basil. That saint, having retired into a desert, in the province of Pontus, founded a monastery for the convenience of himself and his numerous followers: and for the better regulation of this new society, he drew up in writing the orders and rules he would have them follow. This new order soon spread all over the east; nor was it long before it passed into the west. The rule of St Basil was approved by Pope Liberius, the same year

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year in which it was written and published; and afterwards by several other popes; and, in these last ages, by Pope Gregory XIII. who approved the abridgement made of it by Cardinal Bessarion, in the pontificate of Eugenius IV.—Some authors pretend, that St Basil, before he died, saw himself the spiritual father of more than 90,000 monks, in the east only. But this order, which flourished so greatly for more than three centuries, was afterwards considerably diminished by heresy, schism, and a change of empire. The greatest storm it felt, was in the reign of Constantine Copronymus; who persecuted the monks of St Basil, imprisoning some, and banishing others; insomuch that the monasteries were abandoned and spoiled of all their goods.

The historians of this order tell us, that it has produced 1805 bishops; and beatified, or acknowledged as saints, 3010 abbots, 11,805 martyrs, and an infinite number of confessors and virgins. They likewise place among the religious of the order of St Basil 14 popes, some cardinals, and a very great number of patriarchs, archbishops, and bishops. This order likewise boasts of several emperors and empresses, kings and queens, princes and princesses, who have embraced its rule.

This order was introduced in the west in 1057; and was reformed in 1569, by Pope Gregory XIII. who united the religious of this order in Italy, Spain, and Sicily, into one congregation; of which the monastery of St Saviour at Messina is the chief, and enjoys preeminence over the rest. Each community has its particular rule, besides the rule of St Basil, which is very general, and prescribes little more than the common duties of a Christian life.

BASILIC, or Basilica, in the ancient architecture, denotes a kind of public hall or court of judicature, where the princes or magistrates sat to administer justice. The word is originally Greek, βασιλικη, *q. d. royal house, palace.*

The basilics consisted of a great hall, with ailes, porticoes, tribunes, and tribunals. The bankers too had one part of the basilica allotted for their residence. The scholars also went thither to make their declamations, according to the testimony of Quintilian. In after-times the denomination *basilica* was also given to other buildings of public use, as town-houses, exchanges, burses, and the like. The Roman *basilicæ* were covered, by which they were distinguished from the *fora*, which were public places open to the air. The first basilica was built at Rome by Cato the elder, whence it was called *Porcia;* the second was called *Opimia;* the third was that of Paulus, built with a great expence, and with much magnificence, whence it was called by some *regia Pauli;* another was built by Julius Cæsar, called *basilica Julia;* of which Vitruvius tells us he had the direction. There were others also, to the number of eighteen or twenty. The *basilica Julia* not only served for the hearing of causes, but for the reception and audience of foreign ambassadors. It was supported by a hundred marble pillars in four rows, and enriched with decorations of gold and precious stones. In it were 13 tribunals or judgment-seats, where the prætors sat to despatch causes.

Basilic is also used, in ecclesiastical writers, for a church. In which sense, the name frequently occurs in St Ambrose, St Austin, St Jerome, Sidonius Apollinaris, and other writers of the fourth and fifth centuries. It is thought that the name was thus applied, from many of the ancient churches having been formed of the Roman halls mentioned in the preceding article. In reality, on the conversion of Constantine, many of the ancient *basilicæ* were given to the church, and turned to another use, viz. for Christian assemblies to meet in, as may be collected from that passage of Ausonius, where speaking to the emperor Gratian, he tells him, the *basilicæ*, which heretofore were wont to be filled with men of business, were now thronged with votaries praying for his safety. By which he must needs mean, that the Roman halls or courts were turned into Christian churches: and hence, we conceive, the name *basilicæ* came to be a general name for churches in after ages.

Basilic is chiefly applied, in modern times, to churches of royal foundation; as those of St John de Lateran, and St Peter of the Vatican at Rome, founded by the emperor Constantine.

Basilics were also little chapels built by the ancient Franks over the tombs of their great men, so called, as resembling the figure of the sacred *basilicæ*, or churches. Persons of inferior condition had only *tumbæ* or *porticuli* erected over them. By an article in the Salic law, he that robbed a *tumba* or *porticulus*, was to be fined fifteen *solidi;* but he that robbed a basilica, thirty *solidi.*

Basilics, in literary history, a name supposed to have been given by the emperor Leo to a collection of laws in honour of his father Basilius Macedo, who began it in the year 867, and in the execution chiefly made use of Sabbathius Protospatharius, who carried the work as far as 40 books. Leo added 20 books more, and published the work in 880. The whole, 30 years after, was corrected and improved by Constantine Porphyrogenitus, son of Leo; whence many have held him the author of the Basilica. Six books of the Basilica were translated into Latin in 1557, by Gentian Hervetus. An edition of the Greek Basilics, with a Latin version, has been since published at Paris, in 1647, by Annib. Fabrottus, in 7 volumes. There are still wanting 19 books, which are supposed to be lost. Fabrottus has endeavoured to supply in some measure the defect from the synopsis of the Basilica, and the glosses; of which several had been made under the succeeding emperors, and contained the whole Justinian law, excepting the superfluities, in a new and more consistent order, together with the later constitutions of the emperors posterior to Justinian.

BASILICA, in *Anatomy*, the interior branch of the axillary vein, running the whole length of the arm.

BASILICATA, a territory of Italy, bounded on the north by the Otranto, Bari, and Capitanata; on the west by the Principato, and a small part of the Tuscan sea; on the south by Calabria; and on the east by the gulf of Taranto. It is watered by several rivers: but as it is almost all occupied by the Apennine mountains, it is neither very populous nor fertile; however it produces enough to maintain its inhabitants, and has a small quantity of cotton. The principal towns,

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towns are Cirenza the capital, Mesi, Tursi, Rapollo, Muro, Lavello, Tracarico, Monte Pelose, and Veneso, which are all episcopal sees.

BASILICI, a denomination given in the Greek empire to those who carried the emperor's orders and commands.

BASILICON, in *Pharmacy*, a name given to several compositions to be found in ancient medicinal writers. At present it is confined to three officinal ointments, distinguished by the epithets black, yellow, and green. See PHARMACY.

BASILIDIANS, ancient heretics, the followers of Basilides, an Egyptian, who lived near the beginning of the second century. He was educated in the Gnostic school, over which Simon Magus presided; with whom he agreed that Christ was a man in appearance, that his body was a phantom, and that he gave his form to Simon the Cyrenian, who was crucified in his stead. We learn from Eusebius, that this heresiarch wrote 24 books upon the gospel, and that he forged several prophets; to two of which he gave the names *Barcaba* and *Barcoph*. We have still the fragment of a Basilidian gospel. His disciples supposed there were particular virtues in names: and taught with Pythagoras and Plato, that names were not formed by chance, but naturally signified something.—Basilides, to imitate Pythagoras, made his disciples keep silence for five years.

In general, the Basilidians held much the same opinions with the Valentinians, another branch of the Gnostic family. They asserted, that all the actions of men are necessary; that faith is a natural gift, to which men are forcibly determined, and should therefore be saved though their lives were ever so irregular. Irenæus and others assure us, they acted consistently with their principles; committing all manner of villanies and impurities, in confidence of their natural election. They had a particular hierarchy of divine persons, or Æons. Under the name *Abraxas*, they are said to have worshipped the supreme God, from whom as a principle, all other things proceeded. There are several gems still subsisting, inscribed with the name *Abraxas*, which were used by the Basilidians as amulets against diseases and evil spirits. See ABRASAX and ABRAXAS.

BASILIPPUM, in *Ancient Geography*, a town of Bætica in Spain; now *Cantillana*, a citadel of Andalusia, above Seville, on the Guadalquivir.

BASILISCUS, in *Zoology*, the trivial name of a species of lacerta. See LACERTA, ERPETOLOGY *Index*.

BASILISK, a fabulous kind of serpent, said to kill by its breath or sight only. Galen says, that it is of a colour inclining to yellow; and that it has three little eminences upon its head, speckled with whitish spots, which have the appearance of a sort of crown. Ælian says, that its poison is so penetrating, as to kill the largest serpents with its vapour only; and that if it but bite the end of any man's stick, it kills him. It drives away all other serpents by the noise of its hissing. Pliny says, it kills those who look upon it.—The generation of the basilisk is not less marvellous, being said to be produced from a cock's egg, brooded on by a serpent. These, and other things equally ridiculous, are related by Matthiolus, Galen, Dioscorides, Pliny, and Erasistratus. Hirchmayer and Vander Wiel have given the history of the basilisk, and detected the folly and imposture of the traditions concerning it.—In some apothecaries shops there are little dead serpents shown, which are said to be basilisks. But these seem rather to be a kind of small bird, almost like a cock, but without feathers: its head is lofty, its wings are almost like a bat's, its eyes large, and its neck is very short. As to those which are shown and sold at Venice, and in other places, they are nothing but little thornbacks artificially put into a form like that of a young cock, by stretching out their fins, and contriving them with a little head and hollow eyes; and this, Calmet says, he has in reality observed in a supposed basilisk, at an apothecary's shop at Paris, and in another at the Jesuits of Pont-a-Mousson.

BASILISK, in military affairs, a large piece of ordnance, thus denominated from its resemblance to the supposed serpent of that name. The basilisk throws an iron ball of 200 pounds weight. It was much talked of in the time of Solyman emperor of the Turks, in the wars of Hungary; but seems now out of use. Paulus Jovius relates the terrible slaughter made by a single ball from one of these basilisks in a Spanish ship; after penetrating the boards and planks in the ship's head, it killed above 30 men. Maffeus speaks of basilisks made of brass, which were drawn each by 100 yoke of oxen. —Modern writers also give the name *basilisk* to a much smaller and sizeable piece of ordnance, which the Dutch make 15 feet long, and the French only 10. It carries 48 pounds.

BASILIUS, surnamed the *Macedonian*, emperor of the Greeks. He was a common soldier, and of an obscure family in Macedonia, and yet raised himself to the throne: for having pleased the emperor Michael by his address in the management of his horses, he became his first equerry, and then his great chamberlain. He at length assassinated the famous Bardas, and was associated to the empire in 849. He held the eighth general council at Constantinople; deposed the patriarch Photius, but in 858 restored him to the patriarchate; and declared against the popes, who refused to admit him into their communion. He was dreaded by his enemies the Saracens, whom he frequently vanquished; and loved by his subjects, for his justice and clemency. He died in 886. Under his reign the Russians embraced Christianity, and the doctrine of the Greek church. He ought not to be confounded with Basilius the Younger, who succeeded Zemisces in 975, and after a reign of 50 years died in 1025.

BASINGSTOKE, a corporation town of Hampshire in England, and a great thoroughfare on the western road. It is seated on a small brook, and had 2656 inhabitants in 1811. W. Long. 1. 10. N. Lat. 51. 20.

BASIOGLOSSUS, a muscle arising from the base of the os hyoides. See ANATOMY, *Table of the Muscles*.

BASIS, or BASE, in *Geometry*. See BASE.

BASIS, or *Base*, in *Chemistry*. Any body which is dissolved by another body, which it receives and fixes, and with which it forms a compound, may be called the *basis* of that compound. Thus, for example, the basis of neutral salts are the alkaline, earthy, and metallic matters which are saturated by the several acids, and form with them these neutral salts. In this sense it is that these neutral salts are called *salts with earthy bases*,

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bases, salts with alkaline bases, salts with metallic bases; also the appellations *basis of alum, basis of nitre, basis of Glauber's salt, basis of vitriol,* &c. signify the argillaceous earth, which, with the sulphuric acid, forms alum; the vegetable alkali, which, with the nitric acid, forms nitre; the mineral alkali, which with the sulphuric acid, forms Glauber's salts; and the metal, which with the sulphuric acid, forms a sulphate; because these substances are supposed to be fixed, unactive, and only yielding to the action of the acids, which they fix, and to which they give a body and consistence.

Basis, among physicians, denotes the principal ingredients in compound medicines.

BASKERVILLE, John, an eminent artist, especially in letter-founding and printing, of the 18th century. He was born in 1706 at Woverley in Worcestershire, and was heir to an estate of about 60l. a-year; the whole of which income he allowed to his parents till their deaths. In his early years he conceived a love for fine writing and cutting in stone; and being brought up to no particular profession, he commenced writing-master in Birmingham when about 20 years of age. The improvements in different manufactures there soon drew his attention, and he applied to the japan business, which he carried on for a long time with distinguished excellence and success. In 1750 he applied himself to letter-founding, the bringing of which to perfection cost him much labour and expence. In a few years he proceeded to printing: and his first work was an edition of Virgil in royal quarto, which now sells for three guineas. In a short time he obtained leave from the university of Cambridge to print a Bible in royal folio, and editions of the Common Prayer in three sizes: for which he paid a large sum to the university. He afterwards printed Horace, Terence, Catullus, Lucretius, Juvenal, Sallust, and Florus, in royal quarto; Virgil in octavo; and several books in duodecimo. He published likewise some of the English classics. The best testimonies of the merit of these performances are themselves; and Mr Baskerville's name is deservedly ranked among those who, in modern times, have brought the art of printing to its greatest perfection. Not meeting, however, with that encouragement from the booksellers which he expected, he set up his letter-foundery for sale a little before his death. He died without issue in July 1776.

BASKET, an utensil made of twigs interwoven together, in order to hold fruit, earth, &c. As a measure, it denotes an uncertain quantity; as, a basket of medlars is two bushels, of asafœtida from 20 to 50 pounds weight. The ancient Britons were noted for their ingenuity in making baskets, which they exported in large quantities. These baskets were of very elegant workmanship, and bore a high price; and are mentioned by Juvenal among the extravagant expensive furniture of the Roman tables in his time.

> *Adde et bascaudas et mille escaria.*
>
> Add baskets, and a thousand other dishes.

That these baskets were manufactured in Britain, we learn from the following epigram of Martial:

> *Barbara de pictis veni bascauda Britannis,*
> *Sed me jam mavult dicere Roma suam.*
>
> A basket I, by painted Britons wrought,
> And now to Rome's imperial city brought.

See Basket-making, Supplement.

Baskets of Earth, in the military art, in French *corbeillers*, are placed on the parapet of a trench, filled with earth. They are about a foot and a half high, about a foot and a half in diameter at the top, and 8 or ten inches at bottom; so that, being set together, there is a sort of embrasures left at their bottoms, through which the soldiers fire, without exposing themselves.

Basket-Fish, a species of sea-star. See Asterias.

Basket-Salt, that made from salt-springs; being purer, whiter, and composed of finer grains than the common brine-salt. See Salt.

BASKING-shark, or *Sun-Fish of the Irish.* See Squalus.

BASNAGE, James, a learned and accomplished author, and pastor of the Walloon church at the Hague, was born at Rouen in Normandy, August 8. 1653. He was the son of Henry Basnage, one of the ablest advocates in the parliament of Normandy. At 17 years of age, after he had made himself master of the Greek and Latin authors, as well as the English, Spanish and Italian languages, he went to Geneva, where he began his divinity studies under Mestrezat, Turretin, and Tronchin; and finished them at Sedan, under the professors Jurieu and Le Blanc de Beaulieu. He then returned to Rouen, where he was received as minister, September 1676; in which capacity he remained till the year 1685, when the exercise of the Protestant religion being suppressed at Rouen, he obtained leave of the king to retire to Holland. He settled at Rotterdam, and was a minister pensionary there till 1691, when he was chosen pastor of the Walloon church of that city. In 1709 Pensionary Heinsius got him chosen one of the pastors of the Walloon church at the Hague, intending not only to employ him in religious but in state affairs. He was employed in a secret negociation with Marshal d'Uxelles, plenipotentiary of France at the congress of Utrecht; and he executed it with so much success, that he was afterwards entrusted with several important commissions, all which he discharged in such a manner as to gain a great character for his abilities and address; a celebrated modern writer has therefore said of him, that he was fitter to be minister of state than of a parish. The Abbé du Bois, who was at the Hague in 1716, as ambassador plenipotentiary from his most Christian majesty, to negociate a defensive alliance between France, England, and the States General, was ordered by the duke of Orleans, regent of France, to apply himself to M. Basnage, and to follow his advice; they accordingly acted in concert, and the alliance was concluded in January 1717. He kept an epistolary correspondence with several princes, noblemen of high rank, and ministers of state, both Catholic and Protestant, and with a great many learned men in France, Italy, Germany, and England. The Catholics esteemed him no less than the Protestants; and the works he wrote, which are mostly in French, spread his reputation almost all over Europe: among these are, 1. The History of the religion of the Reformed Churches. 2. Jewish Antiquities. 3. The History of the Old and New Testament;

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Testament; and many others. He died September 22. 1723.

Basnage, *Henry, Sieur de Beauval*, second son to Henry Basnage, and brother to James mentioned in the last article. He applied himself to the study of the law, and was admitted advocate in the parliament of Rouen in the year 1679. He did not follow the bar immediately upon his admission; but went to Valencia, where he studied under M. de Marville. Upon his return from thence, he practised with great reputation till the year 1687, when the revocation of the edict of Nantz obliged him to fly to Holland, where he composed the greatest part of his works, and died there the 29th of March 1710. His chief work is *Histoire des Ouvrages des Sçavans*. Rotterd. 24 vol. in duodecimo. This work was begun in the month of September 1687, and continued till June 1709. When he arrived in Holland, Mr Bayle, through indisposition, had been obliged to drop his *Nouvelles de la Republique des Lettres*, which induced Mr Basnage to undertake a work of the same kind under a different title.

BASON, in *Hydraulics*, a reservoir of water, used for various purposes: thus we say, *The bason of a jet d'eau, the bason of a fountain*, and likewise *the bason of a port or harbour*.

Bason, in Jewish antiquities, the laver of the tabernacle, made of the brass looking-glasses belonging to those devout women who watched and stood centinels at the door of the tabernacle.

Bason, or *Dish*, among glass-grinders. These artificers use various kinds of basons, of copper, iron, &c. and of various forms, some deeper, others shallower, according to the focus of the glasses that are to be ground. In these basons it is that convex glasses are formed, as concave ones are formed on spheres or bowls.

Glasses are worked in basons two ways. In the first, the bason is fitted to the arbor or tree of a lathe, and the glass (fixed with cement to a handle of wood) presented and held fast in the right hand within the bason, while the proper motion is given by the foot to the bason. In the other, the bason is fixed to a stand or block, and the glass with its wooden handle moved. The moveable basons are very small, seldom exceeding five or six inches in diameter; the others are larger, sometimes above ten feet diameter. After the glass has been ground in the bason, it is brought smoother with grease and emery; and polished first with tripoli, and finished with paper cemented to the bottom of the bason.

Bason, among hatters, is a large round shell or case, ordinarily of iron, placed over a furnace; wherein the matter of the hat is moulded into form. The hatters have also basons for the brims of hats, usually of lead, having an aperture in the middle, of a diameter sufficient for the largest block to go through.

BASQUES, a small territory of France, towards the Pyrenean mountains. It comprehends Labourd, Lower Navarre, and the district of Soule, which, with Bearn, form the department of the Lower Pyrenees.

BASS, the lowest in the four parts of music: of uncertain etymology; whether from the Greek word βασις, "a foundation;" or from the Italian adjective *basso*, signifying "low." Of all the parts it is the most important, and it is upon this that the chords proper to constitute a particular harmony are determined. Hence the maxim among musicians, that when the bass is properly formed, the harmony can scarcely be bad.

Basses are of different kinds. Of which in their order.

Thorough-Bass is the harmony made by the bass-viols, or theorbos, continuing to play both while the voices sing and the other instruments perform their parts, and also filling up the intervals when any of the other parts stop. It is played by figures marked over the notes, on the organ, spinet, harpsichord, &c. and frequently simply and without figures on the bass-viol and bassoon.

Counter-Bass is a second or double bass, where there are several in the same concert.

Bass-Viol, a musical instrument of the like form with that of a violin, but much larger. It is struck with a bow as that is; has the same number of strings; and has eight stops, which are subdivided into semistops. Its sound is grave, and has a much nobler effect in a concert than that of the violin.

Bass, *Isle of*, a rock, about a mile in circumference, in the mouth of the frith of Forth, at a small distance from the town of North Berwick in East Lothian. It is steep and inaccessible on all sides, except to the south-west; and even there it is with great difficulty that a single man can climb up with the help of a rope or ladder. It was formerly kept as a garrison. A party of King James's adherents surprised it at the Revolution, and it was the last place in the three kingdoms that submitted to the new government; upon which its fortifications were ordered to be neglected. In summer, this remarkable rock, which rises to a great height above the water, in form of a cone, is quite covered with sea-fowl which come hither to breed. The chief of these are the solan geese *, which arrive in June, and retire in September. It also contains a small warren for rabbits, and affords pasture for a few sheep. The force of the tides has now almost worn a hole quite through this rock. W. Long. 2. 15. N. Lat. 56. 3.

* See Pelecanus, Ornithology Index.

BASSAN, Giacomo de Pont, or Le Bassan, a celebrated Venetian painter, was born in 1510. His subjects generally were peasants and villagers, busy at their different rural occupations, according to the various seasons of the year; cattle, landscapes, and historical designs; and in all those subjects the figures were well designed, and the animals and landscapes have an agreeable resemblance of simple nature. His compositions cannot boast of much elegance or grandeur of taste, not even those which are historical; but they have abundance of force and truth. His local colours are very well observed, his carnations are fresh and brilliant, and the chiaro-scuro and perspective well understood. His touch is free and spirited; and the distances in his landscapes are always true, if not sometimes too dark in the nearer parts. His works are spread all over Europe: many of them were purchased by Titian; and there are several in the French king's cabinet, the royal palace, and the Hotel de Toulouse. They are more readily known than those of most other painters; from the similitude of characters and countenances in the figures and animals; from the taste in the buildings, utensils, and draperies; and, besides

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from a violet or purple tint that predominates in every one of his pictures. But the genuine pictures of his hand are not so easily ascertained; because he frequently repeated the same design, and his sons were mostly employed in copying the works of their father, which he sometimes retouched. As he lived to be very old, he finished a great number of pictures; yet, notwithstanding his application and years, the real pictures of Giacomo are not commonly met with. Many of those which are called originals by purchasers as well as dealers, being at best no more than copies by the sons of Bassan, who were far inferior to him; or perhaps by some painter of still meaner abilities. But the true pictures of Giacomo always bear a considerable price if they happen to be undamaged. He died in 1592, aged 82.—Francis and Leander, his sons, distinguished themselves in the same art; but inheriting a species of lunacy from their mother, both came to an untimely end.

BASSINI, Giovanni Battista, maestro di cappella of the cathedral church of Bologna, about the middle of the last century, was a very voluminous composer of music, having given to the world no fewer than 31 different works. He is equally celebrated both as a composer for the church and for concerts; and was besides a celebrated performer on the violin, and, as it is said, taught Corelli on that instrument. His compositions consist of masses, psalms, motets with instrumental parts, and sonatas for violins; his fifth opera in particular, containing 12 sonatas for two violins and a bass, is most esteemed; it is written in a style wonderfully grave and pathetic, and abounds with evidences of great learning and fine invention. The first and third operas of Corelli are apparently formed after the model of this work. Bassani was one of the first who composed motets for a single voice, with accompaniments of violins; a practice which is liable to objection, as it assimilates church-music too nearly to that of the chamber; and of his sol-motets it must be confessed that they differ in style but little from opera airs and cantatas; two operas of them, viz. the eighth and thirteenth, were printed in London by Pearson above 50 years ago, with the title of *Harmonia Festiva.*

BASSANTIN, James, a Scotch astronomer, son of the laird of Bassantin in Mers, was born in the reign of James IV. He was educated at the university of Glasgow, travelled through Germany and Italy, and then fixed his abode in the university of Paris, where he taught mathematics with great applause. Having acquired some fortune in this occupation, in 1562 he returned to Scotland, where he died in the year 1568. From his writings, he appears to have been no contemptible astronomer, considering the times; but, like most of the mathematicians of that age, he was not a little addicted to judicial astrology. Sir James Melvil, in his Memoirs, says that his brother Sir Robert, when he was exerting his abilities to reconcile the two queens Elizabeth and Mary, met with one Bassantin, a man learned in the high sciences, who told him, "that all his travel would be in vain; for, said he, they will never meet together; and next, there will never be any thing but dissembling and secret hatred for a while, and at length captivity and utter wreck to our queen from England." He added, "that the kingdom of England at length shall fall, of right, to the crown of Scotland: but it shall cost many bloody battles; and the Spaniards shall be helpers, and take a part to themselves for their labour." Sir James Melvil is an author of credit; therefore it is probable that our astrologer ventured to utter his prediction: but, as it proved true only in part, either he misunderstood the stars, or they deceived the astrologer. His works are, 1. *Astronomia Jacobi Bassantini Scoti, opus absolutissimum, &c. ter editum Latinè et Gallicè.* Genev. 1599. fol. This is the title given it by Tornæsius, who translated it into Latin from the French, in which language it was first published. 2. *Paraphrase de l'Astrolabe, avec un amplification de l'usage de l'Astrolabe.* Lyons 1555. Paris 1617, 8vo. 3. *Mathematic. genethliaca.* 4. *Arithmetica.* 5. *Musica secundum Platonem.* 6. *De Mathesi in genere.*

BASSE, or Bass, a town of the French Netherlands, in the county of Flanders, on the confines of Artois, remarkable on account of the many sieges it has sustained; but its fortifications are now demolished. It is seated on a canal which runs as far as Deule. E. Long. 3. 0. N. Lat. 50. 53.

Basse Terre, part of the island of St Christopher's, one of the Caribbee islands, formerly occupied by the French, but ceded to Great Britain by the treaty of Utrecht in 1713.

BASSET, or Basette, a game with cards, said to have been invented by a noble Venetian, for which he was banished. It was first introduced in France by Signior Justiniani, ambassador of Venice, in 1674. Severe laws were made against it by Louis XIV. to elude which they disguised basset under the name of *pour et contre*, that is, "for and against," which occasioned new arrêts and prohibitions of parliament. The parties concerned in it are, a dealer or banker; his assistant, who supervises the losing cards; and the punter, or any one who plays against the banker.

Besides these, there are other terms used in this game: as, 1. The *fasse* or *face*, which is the first card turned up by the tailleur belonging to the pack, by which he gains the value of half the money laid down on every card of that sort by the punters. 2. The *couch*, or first money which every punter puts on each card; each person that plays having a book of 13 several cards before him, on which he may lay his money, more or less, at discretion. 3. The *paroli*; which is, when a punter having won the first stake, and having a mind to pursue his good fortune, crooks the corner of his card, and lets his prize lie, aiming at a *sept et le va*. 4. The *masse*; when having won the first stake, the punter is willing to venture more money on the same card. 5. The *pay*; when the punter having won the first stake, be it a shilling, half crown, guinea, or whatever he laid down on his card, and not caring to hazard the paroli, leaves off, or *goes the pay*; in which case, if the card turns up wrong, he loses nothing, having won the couch before; whereas, if it turn right, he by this adventure wons double the money staked. 6. The *alpiew*; much the same with paroli, and used when a couch is won by turning up or crooking the corner of the winning card. 7. *Sept et le va*, the first great chance or prize, when the punter, having won the couch, makes a paroli, and goes on to a second chance; so that if his winning card turns up again, it comes to *sept et le va*, which is seven times

times as much as he laid down on his card. 8. *Quinze et le va* is the next higher prize, when the punter having won the former, is resolved to push his fortune, and lay his money a second time on the same card by crooking another corner; in which case, if it comes up, he wins fifteen times the money he laid down. 9. *Trent et le va* is the next higher prize, when the punter, crooking the fourth corner of his winning card, if it turn up, wins 33 times the money he first staked. 10. *Soixant et le va* is the highest prize, and entitles the winner to 67 times his first money; which, if it were considerable, stands a chance to break the bank; but the bank stands many chances first of breaking the punter. This cannot be won but by the tailleur's dealing the cards over again.

The rules of the game of basset are as follow: 1. The banker holds a pack of 52 cards, and having shuffled them, he turns the whole pack at once, so as to discover the last card; after which he lays down all the cards by couples. 2. The punter has his book of 13 cards in his hand, from the king to the ace; out of these he takes one card, or more at pleasure, upon which he lays a stake. 3. The punter may, at his choice, either lay down his stake before the pack is turned, or immediately after it is turned, or after any number of couples are down. 4. Supposing the punter to lay down his stake after the pack is turned, and calling 1, 2, 3, 4, 5, &c. the places of those cards which follow the card in view, either immediately after the pack is turned, or after any number of couples are drawn. Then, 5. If the card upon which the punter has laid a stake comes out in any even place, except the first, he wins a stake equal to his own. 6. If the card upon which the punter has laid a stake come out in any even place, except the second, he loses his stake. 7. If the card of the punter comes out in the first place, he neither wins nor loses, but takes his own stake again. 8. If the card of the punter comes out in the second place, he does not lose his whole stake, but only one half; and this is the case in which the punter is said to be *faced*. 9. When the punter chooses to come in after any number of couples are down, if his card happens to be but once in the pack, and is the last of all, there is an exception from the general rule; for though it comes out in an odd place, which should entitle him to win a stake equal to his own, yet he neither wins nor loses from that circumstance, but takes back his own stake.

This game has been the object of mathematical calculations. M. de Moivre solves this problem; to estimate at basset the loss of the punter under any circumstance of cards remaining in the stock when he lays his stake, and of any number of times that his card is repeated in the stock. From this solution he has formed a table showing the several losses of the punter in whatsoever circumstances he may happen to be. From this table it appears, 1. That the fewer the cards are in the stock, the greater is the loss of the punter. 2. That the least loss of the punter, under the same circumstances of cards remaining in the stock, is when the card is but twice in it; the next greater when but three times; still greater when four times; and the greatest when but once. The gain of the banker upon all the money adventured at basset is 15s. 3d. per cent.

BASSET, *Peter*, a gentleman of good family, was chamberlain or gentleman of the privy chamber to King Henry V. a constant attendant on that brave prince, and an eye-witness of his most glorious actions both at home and abroad; all which he particularly described in a volume, entitled, *The Acts of King Henry V.* which remains in MS. in the college of heralds.

BASSETING, in the coal mines, denotes the rise of the vein of coal towards the surface of the earth, till it come within two or three feet of the surface itself. This is also called by the workmen *cropping*; and stands opposed to *dipping*, which is the descent of the vein to such a depth that it is rarely, if ever, followed to the end.

BASSIA. See BOTANY *Index*.

BASSO-RELIEVO, or BAS-RELIEF; a piece of sculpture, where the figures or images do not protuberate, jet, or stand out, far above the plane on which they are formed.—Whatever figures or representations are thus cut, stamped, or otherwise wrought, so that not the entire body, but only part of it, is raised above the plane, are said to be done in *relief* or *relievo*; and when that work is low, flat, and but little raised, it is called *low relief*. When a piece of sculpture, a coin, or a medal, has its figure raised so as to be well distinguished, it is called *bold*, and we say its *relief is strong*.

BASSOON, a musical instrument of the wind-sort, blown with a reed, furnished with 11 holes, and used as a bass in a concert of hautboys, flutes, &c. To render this instrument more portable, it is divided into two parts, whence it is called a *faggot*. Its diameter at bottom is nine inches, and its holes are stopped like those of a large flute.

BASSORA, BALSORA, or *Basrah*, a city between Arabia and Persia, situated in the extremity of the deserts of Irak, a little to the west of the Tigris, in about 57° east longitude, and 30° north latitude. It was built by the command of the caliph Omar, in the 15th year of the Hegira, for the sake of carrying on more commodiously an extensive commerce between the Syrians, Arabians, Persians, and Indians. It contains 50,000 or 60,000 inhabitants; and stands upon a thick stony soil, as the word *basra* imports, about a day and a half's journey from one of the mouths of the Tigris, where it empties itself into the Persian gulf, denominated likewise from this town the *Bay of Basra*. The circumjacent tract is looked upon by the Arabs to be one of the most delightful spots in Asia, and even as one of the most beautiful gardens in the world; however, the hot winds that frequently blow there are very troublesome to travellers, and sometimes overwhelm them with sand driven by the force of these winds out of the neighbouring deserts. The city is inhabited by Jacobites, Nestorians, Jews, Mahometans, and Chaldean Christians, commonly called *Christians of St John*, which last are pretty numerous here.

The abbé Raynal values the merchandise annually brought to Bassora at 525,000l.: of which the English furnish 175,000l.; the Dutch 87,500l.; and the Moors, Banians, Armenians, and Arabs, furnish the remainder. "The cargoes of these nations (says he) consist of rice, sugar; plain, striped, and flowered muslins from Bengal; spices from Ceylon and the Molucca islands; coarse white and blue cottons from Coromandel; cardamom, pepper, sanders wood, from Malabar; gold and silver stuffs, turbans, shawls, indigo, from

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Bassora, Bastard.

from Surat; pearls from Baharen, and coffee from Mocha; iron, lead, and woollen cloth, from Europe. Other articles of less consequence are imported from different places. Some of these commodities are shipped on board small Arabian vessels; but the greater part is brought by European ships, which have the advantage of a considerable freight.

"This merchandise is sold for ready money; and passes through the hands of the Greeks, Jews, and Armenians. The Banians are employed in changing the coin current at Bassora, for that which is of higher value in India.

"The different commodities collected at Bassora are distributed into three channels. One half of them goes to Persia, whither they are conveyed by the caravans; there being no navigable river in the whole empire. The chief consumption is in the northern provinces, which have not been so much ravaged as those of the south. Both of them formerly made their payments in precious stones, which were become common by the plunder of India. They had afterwards recourse to copper utensils, which had been exceedingly multiplied from the great abundance of copper mines. At last they gave gold and silver in exchange, which had been concealed during a long scene of tyranny, and are continually dug out of the bowels of the earth. If they do not allow time for the trees that produce gum, and have been cut, to make fresh shoots; if they neglect to multiply the breed of goats which afford such fine wool, and if the silks, which are hardly sufficient to supply the few manufactures remaining in Persia, continue to be so scarce;—in a word, if this empire does not rise again from its ashes, the mines will be exhausted, and this source of commerce must be given up.

BASTARD, a natural child, or one begotten and born out of lawful wedlock.

Blackst. Comment.

The civil and canon laws do not allow a child to remain a bastard, if the parents afterwards intermarry; and herein they differ most materially from our law; which, though not so strict as to require that a child shall be *begotten*, yet makes it an indispensable condition that it shall be *born*, after lawful wedlock. And the reason of our law is surely much superior to that of the Roman, if we consider the principal end and design of establishing the contract of marriage, taken in a civil light; abstractedly from any religious views, which has nothing to do with the legitimacy or illegitimacy of the children. The main end and design of marriage, therefore, being to ascertain and fix upon some certain person, to whom the care, the protection, the maintenance, and the education of the children, should belong; this end is undoubtedly better answered by legitimating all issue born after wedlock, than by legitimating all issue of the same parties, even born before wedlock, so as wedlock afterwards ensues: 1. Because of the very great uncertainty there will generally be, in the proof that the issue was really begotten by the same man; whereas, by confining the proof to the birth, and not to the begetting, our law has rendered it perfectly certain, what child is legitimate, and who is to take care of the child. 2. Because, by the Roman law, a child may be continued a bastard, or made legitimate, at the option of the father and mother, by a marriage *ex post facto;* thereby opening a door to many frauds and partialities, which by our law are prevented. 3. Because by those laws a man may remain a bastard till 40 years of age, and then become legitimate by the subsequent marriage of his parents; whereby the main end of marriage, the protection of infants, is totally frustrated. 4. Because this rule of the Roman law admits of no limitation as to the time, or number of bastards to be so legitimated; but a dozen of them may, 20 years after their birth, by the subsequent marriage of their parents, be admitted to all the privileges of legitimate children. This is plainly a great discouragement to the matrimonial state; to which one main inducement is usually not only the desire of having children, but also the desire of procreating lawful heirs. Whereas, our constitution guards against this indecency, and, at the same time, gives sufficient allowance to the frailties of human nature. For if a child be begotten while the parents are single, and they will endeavour to make an early reparation for the offence, by marrying within a few months after, our law is so indulgent as not to bastardize the child, if it be born, though not begotten, in lawful wedlock; for this is an incident that can happen but once; since all future children will be begotten, as well as born, within the rules of honour and civil society.

From what has been said it appears, that all children born before matrimony are bastards by our law: and so it is of all children born so long after the death of the husband, that by the usual course of gestation, they could not be begotten by him. But this being a matter of some uncertainty, the law is not exact as to a few days. But if a man dies, and his widow soon after marries again, and a child is born within such a time as that by the course of nature it might have been the child of either husband: in this case he is said to be more than ordinarily legitimate; for he may, when he arrives to years of discretion, choose which of the fathers he pleases. To prevent this, among other inconveniences, the civil law ordained that no widow should marry *infra annum luctus;* a rule which obtained so early as the reign of Augustus, if not of Romulus; and the same constitution was probably handed down to our early ancestors from the Romans, during their stay in this island; for we find it established under the Saxon and Danish governments.

As bastards may be born before the coverture or marriage-state is begun, or after it is determined, so also children born during wedlock may in some circumstances be bastards. As if the husband be out of the kingdom of England (or as the law loosely phrases it, *extra quatuor maria*) for above nine months, so that no access to his wife can be presumed, her issue during that period shall be bastards. But generally during the coverture, access of the husband shall be presumed, unless the contrary shall be shown; which is such a negative as can only be proved by shewing him to be elsewhere; for the general rule is, *præsumitur pro legitimatione*. In a divorce *à mensa et thoro*, if the wife breeds children, they are bastards; for the law will presume the husband and wife conformable to the sentence of separation, unless access be proved: but in a voluntary separation by agreement, the law will suppose access, unless the negative be shown. So also, if there is an apparent impossibility of procreation on the part of the husband, as if he be only eight years old, or the like, there the issue of the wife shall be bastard. Likewise, in

Bastard.

in case of divorce in the spiritual court *à vinculo matrimonii*, all the issue born during the coverture are bastards; because such divorce is always upon some cause that rendered the marriage unlawful and null from the beginning.

As to the *duty* of parents to their bastard children, by our law, it is principally that of maintenance. For though bastards are not looked upon as children to any civil purposes, yet the ties of nature, of which maintenance is one, are not so easily dissolved; and they hold indeed as to many other intentions; as particularly that a man shall not marry his bastard sister or daughter. The method in which the English law provides maintenance for them is as follows: When a woman is delivered, or declares herself with child, of a bastard, and will by oath before a justice of the peace charge any person having got her with child, the justice shall cause such person to be apprehended, and commit him till he gives security, either to maintain the child, or appear at the next quarter sessions to dispute and try the fact. But, if the woman dies, or is married, before delivery, or miscarries, or proves not to have been with child, the person shall be discharged; otherwise the sessions, or two justices out of sessions, upon original application to them, may take order for the keeping of the bastard, by charging the mother or the reputed father with the payment of money or other sustentation for that purpose. And if such putative father, or lewd mother, run away from the parish, the overseers, by direction of two justices, may seize their rent, goods, and chattels, in order to bring up the said bastard child. Yet such is the humanity of our laws, that no woman can be compulsively questioned concerning the father of her child till one month after her delivery; which indulgence is, however, very frequently a hardship upon parishes, by giving the parents opportunity to escape.

As to the *rights* and *incapacities* which appertain to a bastard: The former are very few, being only such as he can *acquire*; for he can *inherit* nothing, being looked upon as the son of nobody, and sometimes called *filius nullius*, sometimes *filius populi*. Yet he may gain a surname by reputation, though he has none by inheritance. All other children have their primary settlement in their father's parish; but a bastard in the parish where born, for he hath no father. However, in case of fraud, as if a woman either be sent by order of justices, or comes to beg as a vagrant, to a parish which she does not belong to, and drops her bastard there, the bastard shall, in the first case, be settled in the parish from whence she was illegally removed; or in the latter case, in the mother's own parish, if the mother be apprehended for her vagrancy. Bastards also, born in any licensed hospital for pregnant women, are settled in the parish to which the mothers belong.—The *incapacity* of a bastard consists principally in this, that he cannot be heir to any one; for being *nullius filius*, he is therefore of kin to nobody, and has no ancestor from whom an inheritable blood can be derived: Therefore, if there be no other claimant upon an inheritance than such illegitimate child, it shall escheat to the lord. And as bastards cannot be heirs themselves, so neither can they have any heirs but those of their own bodies. For as all collateral kindred consists in being derived from the same common ancestor, and as a bastard has no legal ancestor, he can have no collateral kindred; and consequently can have no legal heirs, but such as claim by a lineal descent from himself. And therefore, if a bastard purchases land, and dies seized thereof without issue, and intestate, the land shall escheat to the lord of the fee. A bastard was also, in strictness, incapable of holy orders; and though that were dispensed with, yet he was utterly disqualified from holding any dignity in the church, but this doctrine seems now obsolete; and in all other respects there is no distinction between a bastard and another man. And really any other distinction but that of not inheriting, which civil policy renders necessary, would, with regard to the innocent offspring of his parent's crimes, be odious, unjust, and cruel, to the last degree; and yet the civil law so boasted of for its equitable decisions, made bastards in some cases incapable even of a gift from their parents. A bastard may, lastly, be made legitimate, and capable of inheriting, by the transcendant power of an act of parliament, and not otherwise; as was done in the case of John of Gaunt's bastard children, by a statute of Richard II.

As to the *punishment* for having bastard children: By the statute of 18 Eliz. c. 3. two justices may take order for the punishment of the mother and reputed father; but what that punishment shall be is not therein ascertained: though the cotemporary exposition was, that a corporeal punishment was intended. By statute 7 Jac. I. c. 4. a specific punishment (viz. commitment to the house of correction) is inflicted on the woman only. But in both cases it seems that the penalty can only be inflicted, if the bastard becomes chargeable to the parish; for otherwise the very maintenance of the child is considered as a degree of punishment. By the last mentioned statute the justices may commit the mother to the house of correction, there to be punished and set on work for one year: and in case of a second offence, till she find sureties never to offend again.

He that gets a bastard in the hundred of Middleton in Kent, forfeits all his goods and chattels to the king *.

If a bastard be got under the umbrage of a certain oak in Knollwood in Staffordshire, belonging to the manor of Terley castle, no punishment can be inflicted, nor can the lord nor the bishop take cognizance of it †.

It is enacted by statute 21 Jac. I. c. 27. that if any woman be delivered of a child, which, if born alive, should by law be a bastard; and endeavours privately to conceal its death, by burying the child or the like; the mother so offending shall suffer death, as in the case of murder, unless she can prove by one witness at least that the child was actually born dead. This law, which savours pretty strongly of severity, in making the concealment of the death almost conclusive evidence of the child's being murdered by the mother, is nevertheless to be also met with in the criminal codes of many other nations of Europe; as the Danes, the Swedes, and the French: but it has of late years been usual with us, upon trials for this offence, to require some sort of presumptive evidence that the child was born alive, before the other constrained presump-

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* Chamb. Dict.

† Plot. Nat. Hist. Staf. p. 279.

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tion (that the child, whose death is concealed, was therefore killed by its parent) is admitted to convict the prisoner.

Concerning bastards in Scotland, and the laws with regard to them, see LAW.

BASTARD, in respect of artillery, is applied to those pieces which are of an unusual or illegitimate make or proportion. These are of two kinds, long and short, according as the defect is on the redundant or defective side. The long bastards again, are either common or uncommon. To the common kind belong the double culverin extraordinary, half culverin extraordinary, quarter culverin extraordinary, falcon extraordinary, &c. The ordinary bastard culverin carries a ball of eight pounds.

BASTARDS is also an appellation given to a kind of faction or troop of banditti, who rose in Guienne about the beginning of the fourteenth century, and joining with some English parties, ravaged the country, and set fire to the towns.—Mezeray supposes them to have consisted of the natural sons of the nobility of Guienne, who being excluded the right of inheriting from their fathers, put themselves at the head of robbers and plunderers to maintain themselves.

BASTARD Flower-fence. See ADENANTHERA.—The flowers of this plant bruised and steeped in milk are said to be gently anodyne; for which purpose they are often given in the West Indies to quiet very young children. The leaves are used instead of sena in Barbadoes and the Leeward islands. In Jamaica, the plant is called *sena*.

BASTARD Hemp. See DATISCA, BOTANY *Index*.

BASTARD Rocket, *Dyers-Weed*, or *Wild Woad*. See RESEDA, BOTANY *Index*.

BASTARD Star-of-Bethlehem See ALBUCA, BOTANY *Index*.

BASTARD-Scarlet is a name given to red dyed with bale madder, as coming nearest the bow-dye, or new scarlet.

BASTARDY, is a defect of birth objected to one born out of wedlock. Eustathius will have bastards among the Greeks to have been in equal favour with legitimate children, as low as the Trojan war; but the course of antiquity seems against him. Potter and others show, that there never was a time when bastardy was not in disgrace.

In the time of William the Conqueror, however, bastardy seems not to have implied any reproach, if we may judge from the circumstance of that monarch himself not scrupling to assume the appellation of bastard. His epistle to Alan count of Bretagne begins, *Ego Willielmus cognomento bastardus* *.

* *Du Cange Gloss. Lat.* tom. i. p. 502.

BASTARDY, in relation to its trial in law, is distinguished into general and special. *General* bastardy is a certificate from the bishop of the diocese, to the king's justices, after inquiry made, whether the party is a bastard or not, upon some question of inheritance. Bastardy *special* is a suit commenced in the king's courts against a person that calls another a bastard.

Arms of BASTARDY should be crossed with a bar, fillet, or traverse from the right to the left. They were not formerly allowed to carry the arms of their father, and therefore they invented arms for themselves; and this is still done by the natural sons of a king.

Right of BASTARDY, *Droit de batardise*, in the French laws, is a right, in virtue whereof the effects of bastards dying intestate devolve to the king or the lord.

BASTARNÆ, or BASTERNÆ, a people of German original, manners, and language; who extended themselves a great way to the east of the Vistula, the east boundary of Germany, among the Sarmatæ, as far as the mouth of the Ister and the Euxine; and were divided into several nations.

BASTARNICÆ ALPES, in *Ancient Geography*, mountains extending between Poland, Hungary, and Transylvania, called also the *Carpates*, and now the *Carpathian* mountains.

BASTI, in *Ancient Geography*, a town of the province of Bætica in Spain, situated to the west of the Campus Spartarius. Now *Baza* in Granada.

BASTIA, a sea-port town of Albania in Turkey in Europe, over against the island of Corfu, at the mouth of the river Calamu. E. Long. 10. 35. N. Lat. 39. 40.

BASTIA, the capital of the island of Corsica in the Mediterranean. It has a good harbour, and is strongly fortified. It is situated on the western part of the coast, 70 miles south-south-west of Leghorn, in E. Long. 9. 42. N. Lat. 42. 35.

BASTILE, denotes a small antique castle, fortified with turrets. Such was the Bastile of Paris, which seems to have been the last castle that retained the name: it was begun to be built in 1369 by order of Charles V. and was finished in 1383 under the reign of his successor.—Its chief use was for the custody of state prisoners; or, more properly speaking, for the clandestine purpose of unfeeling despotism.

The lieutenant-general of the police of Paris was the sub-delegate of the ministry for the department of the Bastile. He had under him a titular commissary, who was called the commissary of the Bastile. He had a fixed salary for drawing up what were called instructions, but he did not do this exclusively. He had no inspection or function but in cases where he received orders: the reason of which was that all that was done in this castle was arbitrary.

Each prisoner on coming to the Bastile had an inventory made of every thing about him. His trunks, clothes, linens, and pockets were searched, to discover whether there were any papers in them relative to the matter for which he was apprehended. It was not usual to search persons of a certain rank; but they were asked for their knives, razors, scissars, watches, canes, jewels, and money. After this examination, the prisoner was conducted into an apartment, where he was locked up within three doors. They who had no servants made their own bed and fire. The hour of dining was eleven, and of supping six.

At the beginning of their confinement they had neither books, ink, or paper; they went neither to mass, nor on the walks; they were not allowed to write to any one, not even to the lieutenant of the police, on whom all depended, and of whom permission must first have been asked by means of the major, who seldom refused. At first they went to mass only every other Sunday. When a person had obtained leave to write to the lieutenant of the police, he might have asked his permission to write to his family, and to receive their answers; to have with him his servant or an attendant,

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Bastile. tendant, &c. which requests were either granted or refused according to circumstances. Nothing could be obtained but through this channel.

The officers of the staff took the charge of conveying the letters of the prisoners to the police. They were sent regularly at noon and at night: but if they desired it, their letters were sent at any hour by expresses, who were paid out of the money of those who were confined. The answers were always addressed to the major, who communicated them to the prisoner. If no notice was taken of any request contained in the letter of the prisoner, it was a refusal. The attendants whom they appointed for those who were not allowed their own servants, or who had none of their own, were commonly invalid soldiers.

Sometimes a prisoner obtained permission of having books, his watch, knife, and razors, and even paper and ink. He might have asked to see the lieutenant of the police when he came to the Bastile. This officer commonly caused prisoners to be brought down some days after their arrival. Sometimes he went to visit them in their chambers.

When the lieutenant of the police saw a prisoner, the conversation turned upon the cause of his confinement. He sometimes asked for written and signed declarations. In general, as much circumspection was necessary in these conferences as in the examination itself, since nothing that a person might have said or written was forgotten.

When a prisoner wanted to transmit any thing to the lieutenant of the police, it was always by means of the major. Notes might have been sent to this officer by the turnkeys. A person was never anticipated in any thing—he must have asked for every thing; even for permission to be shaved. This office was performed by the surgeon; who also furnished sick or indisposed prisoners with sugar, coffee, tea, chocolate, confections, and the necessary remedies.

The time of walking was an hour a-day; sometimes an hour in the morning and an hour in the evening, in the great court.

A prisoner might have been interrogated a few days after his entrance into the Bastile, but frequently this was not done till after some weeks. Sometimes he was previously informed of the day when this was to be done; often he was only acquainted with it the moment he was brought down to the council-chamber. This commission of interrogatory was executed by the lieutenant of the police, a counsellor of state, a master of requests, a counsellor or a commissioner of the Chatelet. When the lieutenant of the police did not himself interrogate, he usually came at the end of the examination.

The commissioners were purely passive beings. Frequently they attempted to frighten a prisoner; they laid snares for him, and employed the meanest artifices to get a confession from him. They pretended proofs, exhibited papers, without suffering him to read them: asserting that they were instruments of unavoidable conviction. Their interrogatories were always vague. They turned not only on the prisoner's words and actions, but on his most secret thoughts, and on the discourse and conduct of persons of his acquaintance, whom it was wished to bring into question.

The examiners told a prisoner that his life was at stake; that his fate depended on himself; that if he would make a fair declaration, they were authorized to promise him a speedy release; but if he refused to confess, he would be given up to a special commission: that they were in possession of decisive documents, of authentic proofs, more than sufficient to ruin him; that his accomplices had discovered all; that the government had unknown resources, of which he could have no suspicion. They fatigued prisoners by varied and infinitely multiplied interrogatories. According to the persons, they employed promises, caresses, and menaces. Sometimes they used insults, and treated the unhappy sufferers with an insolence that filled up the measure of that tyranny of which they were the base instruments.

If the prisoner made the required confession, the commissioners then told him, that they had no precise authority for his enlargement, but that they had every reason to expect it; that they were going to solicit it, &c. The prisoner's confessions, far from bettering his condition, gave occasion to new interrogatories, often lengthened his confinement, drew in the persons with whom he had connexions, and exposed himself to new vexations.

Although there were rules for all occasions, yet every thing was subject to exceptions arising from influence, recommendations, protection, intrigue, &c. because the first principle in this place was arbitrary will. Very frequently, persons confined on the same account were treated very differently, according as their recommendations were more or less considerable.

There was a library, founded by a foreign prisoner who died in the Bastile in the beginning of the last century. Some prisoners obtained leave to go to it; others, to have the books carried to their chambers.

The falsest things were told the prisoners with an air of sincerity and concern. "It is very unfortunate that the king has been prejudiced against you. His majesty cannot hear your name mentioned without being irritated. The affair for which you have lost your liberty is only a pretext—they had designs against you before—you have powerful enemies." These discourses were the etiquette of the place.

It would have been in vain for a prisoner to ask leave to write to the king—he could never obtain it.

The perpetual and most insupportable torment of this cruel and odious inquisition, were vague, indeterminate, false, or equivocal promises, inexhaustible and constantly deceitful hopes of a speedy release, exhortations to patience, and blind conjectures, of which the lieutenant of the police and officers were very lavish.

To cover the odium of the barbarities exercised here, and slacken the zeal of relations or patrons, the most absurd and contradictory slanders against a prisoner were frequently published. The true causes of imprisonment, and real obstacles to release, were concealed. These resources, which were infinitely varied, were inexhaustible.

When a prisoner who was known and protected had entirely lost his health, and his life was thought in danger, he was always sent out. The ministry did not choose that persons well known should die in the Bastile. If a prisoner did die there, he was interred in the parish of St Paul, under the name of a domestic;

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Bastile.

tie; and this falsity was written in the register of deaths, in order to deceive posterity. There was another register in which the true names of the deceased were entered; but it was not without great difficulty that extracts could be procured from it. The commissary of the Bastile must first have been informed of the use the family intended to make of the extract.

In 1674 the baggage of Louis chevalier de Rohan, grand huntsman of France, having been taken and rummaged in a skirmish, some letters were found which caused a suspicion that he had treated with the English for the surrender of Havre de Grace. He was arrested and put into the Bastile. The Sieur de la Tuanderie, his agent, concealed himself. The proof was not sufficient. A commission was named to proceed against the accused for treason. La Tuanderie was discovered at Rouen: an attempt was made to arrest him; but he fired on the assailants, and obliged them to kill him on the spot. Persons attached to the chevalier de Rohan went every evening round the Bastile, crying through a speaking trumpet, "La Tuanderie is dead, and has said nothing;" but the chevalier did not hear them. The commissioners, not being able to get any thing from him, told him, "that the king knew all, that they had proofs, but only wished for his own confession, and that they were authorised to promise him pardon if he would declare the truth." The chevalier, too credulous, confessed the whole. Then the perfidious commissioners changed their language, They said, "that with respect to the pardon, they could not answer for it: but that they had hopes of obtaining it, and would go and solicit it." This they troubled themselves very little about; and condemned the criminal to lose his head. He was conducted on a platform to the scaffold, by means of a gallery raised to the height of the window of the armoury in the arsenal, which looks towards the little square at the end of the *Rue des Tournelles*. He was beheaded on November 27. 1674.

The Jesuits of the college of Clermont, in the *Rue St Jacques*, Paris, having this same year (1674) invited the king (Louis XIV.) to honour with his presence a tragedy to be performed by their scholars, that prince accepted the invitation. These able courtiers took care to insert in the piece several strokes of flattery, with which the monarch, greedy of such incense, was greatly pleased. When the rector of the college was conducting the king home, a nobleman in the train applauded the success of the tragedy. Louis said, "Do you wonder at it? *this is my college*." The Jesuits did not lose a word of this. The very same night they got engraved in large golden letters on black marble, *Collegium Lodovici Magni*, instead of the former inscription which was placed beneath the name of Jesus on the principal gate of the college (*Collegium Claramontanum Societatis Jesus*); and in the morning the new inscription was put up in place of the old one. A young scholar of quality, aged 13, who was witness to the zeal of the reverend fathers, made the two following verses, which he posted up at night on the college gate:

Abstulit hinc Jesum, posuitque insignia regis
Impia gens: alium non colit illa Deum.

The Jesuits did not fail to cry out sacrilege: the young author was discovered, taken up, and put into the Bastile. The implacable society caused him, as a matter of *favour*, to be condemned to perpetual imprisonment; and he was transferred to the citadel of the isle St Marguerite. Several years after, he was brought back to the Bastile. In 1705 he had been a prisoner 31 years. Having become heir to all his family, who possessed great property, the Jesuit Riquelet, then confessor of the Bastile, remonstrated to his brethren on the necessity of restoring the prisoner to liberty. The golden shower which forced the tower of Danaë had the same effect on the castle of the Bastile. The Jesuits made a merit with the prisoner of the protection they granted him; and this man of rank, whose family would have become extinct without the aid of the society, did not fail to give them extensive proofs of his gratitude.

Nowhere else on earth, perhaps, has human misery, by human means, been rendered so lasting, so complete, or so remediless. This the following case may suffice to evince; the particulars of which are translated from that elegant and energetic writer M. Mercier. The heinous offence which merited an imprisonment surpassing torture and rendering death a blessing, though for obvious reasons not specified by our author, is known from other sources to have consisted in some unguarded expressions implying disrespect concerning the late Gallic monarch Louis XV.

Upon the accession of Louis XVI. to the throne, the ministers then in office, moved by humanity, began their administration with an act of clemency and justice; they inspected the registers of the Bastile, and set many prisoners at liberty. Among those there was an old man who had groaned in confinement for 47 years between four thick and cold stone-walls. Hardened by adversity, which strengthens both the mind and the constitution, when they are not overpowered by it, he had resisted the horrors of his long imprisonment with an invincible and manly spirit. His locks white, thin, and scattered, had almost acquired the rigidity of iron; whilst his body, environed for so long a time by a coffin of stone, had borrowed from it a firm and compact habit. The narrow door of his tomb, turning upon its grating hinges, opened not as usual by halves; and an unknown voice announced his liberty, and bade him depart. Believing this to be a dream, he hesitated; but at length rose up and walked forth with trembling steps, amazed at the space he traversed: The stairs of the prison, the halls, the court, seemed to him vast, immense, and almost without bounds. He stopped from time to time, and gazed around like a bewildered traveller: His vision was with difficulty reconciled to the clear light of day: He contemplated the heavens as a new object: His eyes remained fixed, and he could not even weep. Stupified with the newly acquired power of changing his position, his limbs, like his tongue, refused, in spite of his efforts, to perform their office; at length he got through the formidable gate.

When he felt the motion of the carriage prepared to transport him to his former habitation, he screamed out, and uttered some inarticulate sounds; and as he could not bear this new movement, he was obliged to descend. Supported by a benevolent arm, he sought out the street where he had formerly resided: he found it, but no trace of his house remained; one of the public

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Bastile. lic edifices occupied the spot where it had stood. He now saw nothing that brought to his recollection, either that particular quarter, the city itself, or the objects with which he had formerly been acquainted. The houses of his nearest neighbours, which were fresh in his memory, had assumed a new appearance. In vain were his looks directed to all the objects around him; he could discover nothing of which he had the smallest remembrance. Terrified, he stopped and fetched a deep sigh. To him, what did it import that the city was peopled with living creatures? None of them were alive to him; he was unknown to all the world, and he knew nobody: And whilst he wept, he regretted his dungeon.

At the name of the Bastile, which he often pronounced and even claimed as an asylum, and the sight of his clothes that marked a former age, the crowd gathered round him: curiosity, blended with pity, excited their attention. The most aged asked him many questions, but had no remembrance of the circumstances he recapitulated. At length accident brought in his way an ancient domestic, now a superannuated porter, who, confined to his lodge for 15 years, had barely sufficient strength to open the gate:—Even he did not know the master he had served; but informed him that grief and misfortune had brought his wife to the grave 30 years before, that his children were gone abroad to distant climes, and that of all his relations and friends none now remained. This recital was made with the indifference which people discover for events long passed, and almost forgot. The miserable man groaned, and groaned alone. The crowd around, offering only unknown features to his view, made him feel the excess of his calamities even more than he would have done in the dreadful solitude that he had left.

Overcome with sorrow, he presented himself before the minister to whose humanity he owed that liberty which was now a burden to him. Bowing down, he said, "Restore me again to that prison from which you have taken me: I cannot survive the loss of my nearest relations; of my friends; and, in one word, of a whole generation: Is it possible in the same moment to be informed of this univeral destruction, and not to wish for death? This general mortality, which to the rest of mankind comes slowly and by degrees, has to me been instantaneous, the operation of a moment. Whilst secluded from society, I lived with myself only; but here I neither can live with myself nor with this new race, to whom my anguish and despair appear only as a dream. There is nothing terrible in dying; but it is dreadful indeed to be the last." The minister was melted; he caused the old domestic to attend this unfortunate person, as only he could talk to him of his family. This discourse was the single consolation that he received: for he shunned all intercourse with a new race, born since he had been exiled from the world; and he passed his time in the midst of Paris in the same solitude as he had done whilst confined in a dungeon for almost half a century. But the chagrin and mortification of meeting no person who could say to him, We were formerly known to one another, soon put an end to his existence.

Such was the nature of this celebrated fortress. Many of our readers will probably recollect that it was attacked and taken by the Parisian mob on the 14th July 1789. At that time only seven prisoners were found in it, and it did not appear that any of them were the victims of tyranny or wanton oppression.

Bastile ‖ Baston.

BASTIMENTOS, the name of some small islands near Terra Firma in South America, at the mouth of the bay of Nombre de Dios.

BASTINADO. See BASTANADO.

BASTION, in the modern fortification, a huge mass of earth, faced usually with sods, sometimes with brick, and rarely with stone, standing out from a rampart whereof it is a principal part, and is what, in the ancient fortification, was called a *bulwark*.

Solid BASTIONS, are those that have the void space within them filled up entirely, and raised of an equal height with the rampart.

Void and Hollow BASTIONS, are those that are only surrounded with a rampart and parapet, having the space within void and empty, where the ground is so low, that, if the rampart be taken, no retrenchment can be made in the centre, but what will lie under the fire of the besieged.

Flat BASTION, is a bastion built in the middle of the curtain, when it is too long to be defended by the bastion at its extremes.

Cut BASTION, is that whose point is cut off, and instead thereof has a re-entering angle, or an angle inwards, with two points outwards; and is used either when without such a contrivance the angle would be too acute, or when water or some other impediment hinders the carrying on the bastion to its full extent.

Composed BASTION, is when two sides of the interior polygon are very unequal, which makes the gorges also unequal.

Deformed BASTION, is when the irregularity of the lines and angles makes the bastion out of shape; as when it wants one of its demigorges, one side of the interior polygon being too short.

Demi-BASTION, is composed of one face only, and but one flank, and a demigorge.

Double BASTION, is that which is raised on the plane of another bastion.

Regular BASTION, is that which has its true proportion of faces, flanks, and gorges.

BASTION *of France*, a fortress on the coast of Barbary, belonging to the French.

BASTITANI, in *Ancient Geography*, a people of the province of Bætica in Spain. See BÆTICA.

BASTOIGNE, a small town of the Netherlands, in the duchy of Luxemburgh. E. Long. 6. 0. N. Lat. 50. 10.

BASTON, in *Law*, one of the servants to the warden of the Fleet-prison, who attended the king's courts with a red staff, for taking into custody such as are committed by the court. He also attends on such prisoners as are permitted to go at large by license.

BASTON, or *Battoon*, in *Architecture*, a moulding in the base of a column, called a *tore*.

BASTON, *Baton*, or *Batune*. This word is French, and signifies a staff or cudgel: it should be spelt *Bâton*; but is, by most English writers, corruptly spelt as above. It is only borne in English coats of arms, as a badge of illegitimacy; but French heralds introduce it in arms as a difference, or mark of consanguinity.

BASTON, *Robert*, a Carmelite monk, afterwards prior

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prior of the convent of that order at Scarborough, and also poet laureat and public orator at Oxford, flourished in the fourteenth century. King Edward I. in his expedition into Scotland in 1304, took Robert Baston with him, in order to celebrate his victories over the Scots; but our poet being taken prisoner, was obliged to change his note, and sing the successes of Robert Bruce. He wrote several books in Latin, on the wars of Scotland, the Luxury of Priests, Synodical Sermons, &c.; and also a volume of tragedies and comedies, in English. He died about the year 1310.

BASTONADO, BASTONADE, the punishment of beating or drubbing a criminal with a stick. The word is formed of the French *baston*, a "stick" or "staff." The bastonade was a punishment used both among the ancient Greeks, Romans and Jews, and still obtains among the Turks. The Romans called it *fustigatio*, *fustium admonitio*, or *fustibus cædi*; which differed from the *flagellatio*, as the former was done with a stick, the latter with a rod or scourge. The fustigation was a lighter punishment, and inflicted on freemen; the flagellation a severer, and reserved for slaves. It was also called *tympanum*, because the patient here was beat with sticks, like a drum.—The punishment is much in use in the east to this day. The method there practised is thus: the criminal being laid on his belly, his feet are raised, and tied to a stake, held fast by officers for the purpose; in which posture he is beaten with a cudgel on the soles of his feet, back, chin, &c. to the number of 100 or more blows.

BASTWICK, DR JOHN, born at Writtle in Essex, in 1593; practised physic at Colchester; but being a man of warm imagination, and a good Latin scholar, applied himself to writing books against popery. About the year 1633, he printed in Holland a Latin treatise, entitled *Elenchus religionis Papisticæ*, with *Flagellum pontificis et episcoporum Latialium*, in which the English prelates thinking themselves also aimed at, he was fined 1000l. in the high commission court, excommunicated, prohibited practising physic, his books ordered to be burnt, and himself to remain in prison until he made a recantation. Instead of recanting, he wrote in prison, *Apologeticus ad præsules Anglicanos*: and another book called, *The Litany*; wherein he severely exclaimed against the proceedings of that court, and taxed the bishops with an inclination towards popery. Prynne and Burton coming under the lash of the star-chamber court at the same time, they were all censured as scandalous seditious persons, condemned to a fine of 5000l. each, to be pilloried, to lose their ears, and to perpetual imprisonment in three remote parts of the kingdom. The parliament in 1640 reversed these proceedings; and ordered Dr Bastwick a reparation of 5000l. out of the estates of the commissioners and lords who had persecuted him, which the ensuing confusions prevented his receiving: however, his wife had, in 1644, an allowance ordered for her and her husband's maintenance. What became of him afterward is not known.

BAT, in *Zoology*. See VESPERTILIO, MAMMALIA *Index*.

BAT-Fowling, a method of catching birds in the night, by lighting some straw, or torches, near the place where they are at roost; for upon beating them up, they fly to the flame, where, being amazed, they are easily caught in nets or beat down with bushes fixed to the end of poles, &c.

BAT, *Bate*, or *Batz*, a small copper coin, mixed with a little silver, current in several cities of Germany: it is worth four crutzers. It is also a coin in Switzerland, current at five livres, or 100 sols, French money.

BATABLE, or DEBATABLE GROUND, that land which lay between Scotland and England, when the kingdoms were distinct, to which both nations pretended a right.

BATACALA, a small kingdom on the coast of Malabar in the East Indies. It had a very large town of the same name; but there is nothing now left, except 11 or 12 small pagods covered with copper and stone. The country produces a good deal of pepper: the English formerly had a factory here; but were all massacred by the natives, because one of their bulldogs had killed a consecrated cow.

BATACALA, a fortified town and castle on the east coast of the island of Ceylon in the East Indies. The Dutch drove away the Portuguese, and possessed themselves of part of the adjacent country. E. Long. 81. 3. N. Lat. 7. 55.

BATANISTS, or BATENITES. See BATENITES.

BATASEK, a town of Lower Hungary, seated on the Danube, in E. Long. 19. 50. N. Lat. 46. 30.

BATAVA (*Castra* understood), a citadel of Vindelicia, so called from the Cohors Batava, in garrison under the commander in Rhætia: now *Pasau*: being first called *Batau*, from the Batavi; then *Bassau*: and *Passau*; situated in Bavaria, at the confluence of the Danube, Inn, and Ills. See PASSAU.

BATAVIA, the captial of the Dutch settlements in the East Indies; a city of the kingdom of Bantam in the island of Java. See JAVA.

BATAVORUM INSULA, the island of the Batavians, in *Ancient Geography*. Of this island Tacitus gives the following description. "The Rhine flowing in one channel, or only broken by small islands, is divided, at its entering Batavia, as it were into two rivers. One continues its course through Germany, retaining the same name, and violent current, till it falls into the ocean. The other washing the coast of Gaul, with a broader and more gentle stream, is called by the inhabitants *Vahalis*; which name it soon changes for that of *Mosa*, by the immense mouth of which river it discharges itself into the same ocean." According to Tacitus, therefore, the island of the Batavians was bounded by the ocean, the Rhine, and the Vahalis, now the *Wale*. Cæsar extends it to the Mosa, or *Meuse*; but Pliny agrees with Tacitus. However, this island was of greater extent in Tacitus's time than in Cæsar's; Drusus, the father of Germanicus, having by a new canal conveyed the waters of the Rhine into the ocean a considerable way north of the former mouth of that river. The Batavi were a branch of the Catti, who in a domestic sedition, being expelled their country, occupied the extremity of the coast of Gaul, at that time uninhabited, together with this island situated among shoals. Their name *Batavi* they carried with them from Germany; there being some towns in the territory of the Catti called *Battenberg*, and *Battenhausen*. The bravery of the Batavi, especially the horse,

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horse, procured them not only great honour from the Romans, being called their *brothers* and *friends;* but an exception from taxes, being obliged only to furnish men and arms. The modern name of this island is *Betu* or *Betaw*.

Batavorum Oppidum, in *Ancient Geography*, a town in the island of the Batavi, mentioned by Tacitus, without any particular name; which has given rise to several surmises about it, some supposing it to be *Nimeguen*, but Cluverius, *Batavadurum* or *Batemburg*, both without the island; which situation renders both these places inadmissible, since Tacitus places this nameless town within the island.

BATCHELOR. See Bachelor.

BATE, George, an eminent physician, born at Maid's Morton, near Buckingham, in the year 1608. In 1629 he obtained a license, and for some years practised in and about Oxford: his practice was chiefly amongst the Puritans, who at that time considered him as one of their party. In 1637, he took his degree of doctor in physic, and became very eminent in his profession, so that when King Charles kept his court at Oxford, he was his principal physician. When the king's affairs declined, Dr Bate removed to London, where he accommodated himself so well to the times, that he became physician to the Charter-house, fellow of the college of physicians, and afterwards principal physician to Oliver Cromwell. Upon the Restoration, he got into favour with the royal party, was made principal physician to the king, and fellow of the Royal Society; and this, we are told, was owing to a report raised on purpose by his friends, according to Mr Wood, that he gave the protector a dose which hastened his death. Dr Bate wrote in Latin an account of the late commotions in England, and some other pieces. He died at his house in Hatton-garden, and was buried at Kingston upon Thames in Surry.—There was another George Bate, who wrote a work entitled, "The Lives, Actions, and Execution, of the prime Actors and principal Contrivers of that horrid Murther of our late pious and sacred King Charles I."

BATENITES, a sect of apostates from Mahometanism, dispersed through the East, who professed the same abominable practices with the Ismaelians and Karmatians. The word properly signifies *esoteric*, or people of inward or hidden light.

BATES, William, D. D. an eminent Presbyterian divine, born in November 1625. He was admitted in Emanuel college, Cambridge, and from thence removed to King's college in 1644. He was one of the commissioners, at the conference in the Savoy, for reviewing the public liturgy, and was concerned in drawing up the exceptions against the Common Prayer: however, soon after the Restoration, he was appointed chaplain to King Charles II. and became minister of St Dunstan's in the West, but was deprived of that benefice for nonconformity. Dr Bates bore a good and amiable character; and was honoured with the friendship of the lord keeper Bridgman, the lord chancellor Finch, the earl of Nottingham, and Archbishop Tillotson. He was offered, at the Restoration, the deanery of Litchfield; which he refused. He published Select Lives of illustrious and pious persons, in Latin; and since his death, all his works, except his Select Lives, have been printed in one volume in folio. He died in July 14. 1699, in the 74th year of his age.

BATH, a city of Somersetshire in England, seated in W. Long. 2. 30. N. Lat. 51. 27. All the different names that this city has borne in different ages and languages have been taken from its medicinal waters, as the ὕδατα θερμὰ, or "hot waters," of Ptolemy; the *Aquæ Solis*, or "waters of the sun," of Antoninus; the *Caer Baden*, and *Caer Ennant*, i. e. "the city of baths," and "the city of ointment," of the Britons; and the *Ackmanchester*, i. e. "the city of valetudinarians," of the Saxons. The baths consist of the King's bath, the Queen's bath, the Cross-bath, the Hot-bath, the Leper's bath, and the duke of Kingston's bath. This place was of old a resort only for cripples and diseased persons; but now it is more frequented by the sound for pleasure than by the sick for health. The waters are very pleasant to the taste; and impregnated with a vitriolic principle, yielding, upon evaporation, a little neutral salt, and a calcareous earth and iron. They are very efficacious in strengthening the bowels and stomach, bracing the relaxed fibres, and invigorating the circulation. In bilious complaints they are counted specific; and proved serviceable in most nervous, paralytic, rheumatic, and gouty, complaints. At the King's bath is a handsome pump-room, where the gentlemen and ladies go in a morning to drink the waters; and there is a band of music that plays all the time. In the Cross-bath is a monument of marble, representing the descent of the Holy Ghost attended by angels, erected by the earl of Melfort (who was secretary of state for Scotland) when King James II. met his queen here. The King's bath is a large bason of 65 feet 10 inches by 40 feet 10 inches, containing 346 tons 2 hogsheads and 36 gallons of water when filled to its usual height. In the middle is a wooden building with niches and seats for the accommodation of the bathers. There are also iron rings all round for them to hold by; and guides, both male and female, to attend them in the bath. The person intending to bathe puts on, at his own lodgings, a bathing dress of brown canvas hired for the purpose; and is carried in a close chair, of a particular make, to one of the slips which open into the bath. There he descends by steps into the water, where he is attended by a guide. Having staid his stated time in the bath, he ascends again into the slip, where he puts off his bathing-dress, and being wrapt up in blankets, is carried home to bed, where he lies for some time to encourage perspiration. The King's bath is overlooked by the company in the pump-room; and adjoining to it are places furnished with pumps to pour the hot streams on any particular part of the body. The Queen's bath communicates with the King's, from which it is filled; therefore the water of it is not so hot, being at a greater distance from the source. As the heat is here more moderate, the bathers descend first into the Queen's bath, and advance gradually to the centre of the other. In the year 1755, the abbey-house or priory, belonging to the duke of Kingston, was taken down, in order to erect a more commodious pile of building; and in digging for the foundation, the workmen discovered, about twenty feet below the surface of the earth, the remains of Roman baths and sudatories constructed upon

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Bath. on an elegant plan, with floors suspended on pillars, and surrounded with tubulated bricks, for the conveyance of heat and vapour. These were supplied by a spring of hot water, of the same properties and temperature with those of the King's-bath; and the sewer was found still entire, that conveyed the waste water into the river. The duke, having cleared the spring and the sewer, has erected several convenient baths and sudatories on the spot, where invalids may be accommodated at all hours, by night as well as by day. The two seasons are the spring and fall; but those who take the waters purely for their health do not regard the seasons, but drink them all the year round. There are a number of genteel sedan chairs, which carry people to any distance, not exceeding half a mile, for sixpence. The company assemble in the afternoon alternately at two stately rooms, to converse together, or play at cards. At a very pretty new theatre near the parades, plays are acted every other night; and there are balls twice a-week; for which and the rooms, and books at the libraries, the gentry generally subscribe. The city is surrounded with hills on all sides, except a little opening to the east and west, through which the Avon runs. This river, which has been made navigable to Bristol by act of parliament, washes the city on the east and south sides, and there is an elegant bridge over it. This city hath formerly had a slight wall, of which some part still remains, as well as one or two of its gates; but almost all the new buildings, and much the greatest and finest part of the city, is without the walls, particularly the fine square called *Queen's-square*, in the middle of which is a small garden, with gravel walks, and an obelisk in the centre. But the greatest ornament at Bath is the circus: it is of a circular form, consisting of houses built on an uniform plan, with three openings at equal distances to the south, east, and west, leading into as many streets. The fronts of the houses, which are all three stories high, are adorned with three rows of columns in pairs, of the Doric, Ionic, and Corinthian orders, the frize embellished with sculpture. The whole has an air of magnificence, which cannot fail to strike the most indifferent spectator. In the centre of the area is a reservoir, or bason, filled by two or three springs rising in the neighbouring hills; whence the streets in this district are supplied with water. On the south side of the town are the north and south parades, two noble walks, paved with hewn stone, raised upon arches, facing each an elegant row of houses on one side, and having a stone balustrade on the other. These, with the two streets that join them, were planned and executed by one Mr Wood, an able architect, who likewise built the square and projected the circus. The two public rooms stand betwixt the north parade and Orange-grove; which last is a square planted with trees, having in the middle a stone obelisk, inscribed in Latin to the late prince of Orange, who recovered his health in consequence of drinking the Bath waters, and gave his name to this part of the town. Several new streets and rows have of late years been built on the north side of Bath, in the neighbourhood of the square, such as Gay-street, Milsom-street, Edgar-row, Harlequin-row, Bladud's-buildings, King's-mead-street, and Brock-street. Their advantages for building here are very great, having excellent freestone, limestone, and slate, in the neighbourhood. One sort of their lime is as white as snow. The guild-hall of Bath stands in the market-place, and is said to be built on a plan of Inigo Jones, which, however, exhibits nothing worthy of that great architect: besides, one end of it has been rebuilt in a different style. The hall is ornamented with some portraits of the late prince of Wales and other remarkable personages; but the greatest curiosity of the place is a Minerva's head in bronze, a real antique, dug up in Stall-street, in the year 1725. Bath boasts a noble infirmary, or general hospital, for the reception of the sick and lame from all parts of the three kingdoms. It extends 100 feet in front, and 90 in depth, being capable of receiving 150 patients. Here was anciently a monastery, of which the present cathedral was the church. It is a venerable pile: the principal front of which is adorned with angles ascending and descending. There are three other churches in Bath, and several chapels and meeting-houses. Besides the infirmary, there are several other hospitals, alms-houses, and charity schools. The corporation consists of a mayor; eight aldermen, of whom two are justices of the peace; and 24 common-council men. The city is extremely well provided with stage coaches, post coaches, chaises, machines, and waggons. Bath is the general hospital of the nation, and a great number of invalids find benefit from the waters: but as the city lies in a bottom surrounded by very high hills, the air is constantly surcharged with damps; and indeed this place is more subject to rain than most other parts in England. The markets are remarkably well supplied with provisions of all kinds at reasonable rates, particularly fish and poultry. They also afford excellent mutton fed upon Lansdown, one of the highest hills that overlook the city. This down, remarkable for its pure air, extends about three miles; and at the extremity of it there is a stone monument, with an inscription, erected to the memory of Sir Beville Granville, who was here killed in a battle which he fought with the parliament's army in the reign of Charles I. Bath sends two members to parliament. The earldom of Bath was bestowed on William Pultney in the end of Sir Robert Walpole's administration, but is now extinct. The population varies of course considerably, but is estimated on a mean at 38,000.

Bath is joined with Wells to form a bishopric, called the diocese of Bath and Wells. The bishop's seat is at Wells, whose cathedral church was built by Ina, king of the West Saxons in 704, and by him dedicated to St Andrew. Several other of the West Saxon kings endowed it, and it was erected into a bishopric in 905, during the reign of King Edward the Elder. The present church was begun by Robert the 18th bishop of this see, and completed by his immediate successor. John de Villula, the 16th bishop, having purchased the city of Bath for 500 merks of King Henry I. transferred his seat to that city in 1088. From this, disputes arose between the monks of Bath and the canons of Wells, about the election of a bishop; but they were at last compromised by Robert the 18th bishop, who decreed, that from henceforward the bishop should be styled from both places, and that the precedency should be given to Bath; that in the vacancy of the see, the bishop should be elected by a certain number of delegates from both churches; and that he should be in-

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stalled in them both; both of them to constitute the bishop's chapter; and all his grants and patents to be confirmed in both. So it stood till the Reformation. But in the 35th of King Henry VIII. an act of parliament passed for the dean and chapter of Wells to make one sole chapter for the bishop. This diocese hath yielded to the church of Rome one cardinal, and to the civil state of England six lord chancellors, five lord treasurers, one lord privy seal, one lord president of Wales, and principal secretary of state. The diocese contains the whole county of Somerset, except a few churches in the city of Bristol; the number of parishes amounting to 388, and the churches and chapels to 503. Of the parishes 160 are impropriate. It is valued in the king's books at 535l. 1s. 3d. and computed to be worth annually 2200l. The clergy's tenth is 353l. 18s. 0½d. To the cathedral belong a bishop, a dean, three archdeacons, a chancellor, a treasurer, a sub-dean, fifty-nine prebendaries, four priest-vicars, eight lay vicars, an organist, six choristers, and other officers.

Knights of the Bath, a military order in England, concerning the origin of which antiquaries differ in their accounts. The most probable deduction seems to be the following.

The knighthood of the Bath is supposed to have been practised by the ancient Franks, the inhabitants of Lower Germany, with whom it is highly probable the Saxons, who invaded England, had the same common descent, and, with other customs, upon their setling here, introduced the same method of knighthood. These ancient Franks, when they conferred knighthood, observed, amongst other solemn rites, bathing before they performed their vigils; which custom continues to be practised in England: they were from thence denominated *Knights of the Bath*.

In the reign of Henry IV. there was a degree of knighthood specified under the express appellation of *the Bath*. That king, on the day of his coronation in the tower of London, conferred the same upon 46 esquires, who had watched all the night before, and had bathed themselves. From that time it was customary with our kings to confer this dignity preceding their coronations, the coronations of their queens, the birth and marriage of the royal issue, and their first advancement to honours, upon their designed expeditions against their foreign enemies, upon installations of knights of the Garter, and when some grand anniversary festivals were celebrated. The last knights of the Bath so made were at the coronation of King Charles II. in 1661; after which the order was neglected until the year 1725, when George I. was pleased to revive it, and to order a book of statutes for the government of the order. By this the number of knights is fixed to 38, viz. the sovereign, and 37 knights-companions.

The apparel of a knight of the Bath is a red surcoat, lined and edged with white, girded about with a white girdle, without any ornament thereon; the mantle is of the same colour and lining, made fast about the neck with a lace of white silk, having a pair of white gloves tied therein, with tassels of silk and gold at the end; which mantles are adorned upon the left shoulders with the ensign of the order, being three imperial crowns *or*, surrounded with the ancient motto of this knighthood, *Tria juncta in uno*, wrought upon a circle *gules*, with a glory or rays issuing from the centre, and under it the lace of white silk heretofore worn by the knights of the Bath. They have red breeches and stockings, and have white hats, with a plume of white feathers thereon. The king allowed the chapel of King Henry VII. to be the chapel of the order, and ordered that each knight's banner, with plates of his arms and style, should be placed over their several stalls, in like manner as the knights of the Garter in St George's chapel in the castle of Windsor; and he allowed them supporters to their arms. His Royal Highness Prince William, second son to the prince of Wales, on this occasion, was made the first knight-companion, and his grace the duke of Montague grand master of the order, the dean of Westminster (for the time being) dean of the order; the other officers of which are, Bath king of arms, a genealogist, register and secretary, gentleman usher, and messenger.

Bath, *Balneum*, a convenient receptacle of water for persons to wash or plunge in, either for health or pleasure.—Baths are distinguished into *hot* and *cold*; and these again are either natural or artificial. The natural hot baths are formed of the water of hot springs, of which there are many in different parts of the world; especially in those countries where there are or have evidently been volcanoes. The artificial hot baths consist either of water or of some other fluid made hot by art. The cold bath consists of water, either fresh or salt, in its natural degree of heat; or it may be made colder by art, as by a mixture of nitre, sal-ammoniac, &c. The chief hot baths in our country are those of Bath and Bristol, in Somersetshire; and those others of Buxton and Matlock, in Derbyshire; which latter, however, are rather warm or tepid than hot. The use of these baths is found beneficial in diseases of the head, as palsies, &c. in cuticular diseases, as leprosies, &c. obstructions and constipations of the bowels, the scurvy and stone, and in most diseases of women and children. The baths have performed many cures, and are commonly used as a last remedy in obstinate chronic diseases; where they succeed well, if they agree with the constitution of the patient: but whether they will agree or not, cannot be known without trial.

As to the origin of those hot waters, of which the natural hot baths are formed, we are very much in the dark. All that can be affirmed with certainty is, that where there are volcanoes, there also there are hot springs in great abundance; but how the heat of the volcano should be constantly communicated to the waters of a spring for many ages, during a great part of which the volcano itself has lain in a dormant state, seems almost beyond the reach of investigation. Another thing that creates a great difficulty is, that the fire of a volcano must certainly lie very deep in the earth, and most probably shifts from place to place; but the waters of a spring must always issue from a place situated lower than the origin of the spring itself. Besides, though we should suppose the water to come from the top of a volcano itself, and consequently boiling hot, it could not be supposed to percolate far through cold earth, without losing all the heat it acquired from the volcano. From some observations, however,

however, it certainly does appear, that there are some spots on the earth which have a power of producing heat within themselves, independent of any thing foreign; and that water is so far from being able to destroy this power, that it seems rather to promote and continue it. We know that water hath this effect upon a mixture of iron filings and sulphur; but whatever quantities of similar substances we may suppose to be contained in the earth, we must also suppose to be destroyed by one great confiagration soon after they have begun to act upon each other, so that by their means no lasting heat in waters could be produced. Dr Stukely indeed would solve this, and several other phenomena, by making the fire and smoke of volcanoes the effects of electricity: but here sufficient proof is wanting; for electricity, even in its most powerful state, is not very apt to set bodies on fire. The thought, however, deserves attention; for if electricity is capable of setting a volcano on fire, it is undoubtedly capable of producing solfaterras where it meets with proper materials, and from them springs of any degree of heat.

The cold bath is found one of the most universal and innocent remedies yet discovered, though still its use is not to be adopted without precautions.

Baths in vapour, the fume or steam of some decoction is received upon the body to promote a perspiration.—These are also by some called *Balnea Laconica.*

Vapour baths are, when the patient is not plunged into what is prepared for the bath, but only receives its steam upon those parts of his body which require it: as in some distempers of the fundament and womb, where the patient sits and receives the fumes of some proper fomentation, &c. To these may be added the bagnio; where people are made to sweat by the heat of a room, and pouring on of hot water; after which they generally go into a hot bath or bagnio.

A peculiar sort of vapour-bath was much used by the ancient Mexicans, and is still in use among the present Indians their descendants. According to the abbé Clavigero, these baths are built of raw bricks, and their form is similar to that of ovens for baking bread: but with this difference, that the pavement of the bath is a little convex, and lower than the surface of the earth; whereas that of most ovens is plain, and a little elevated for the accommodation of the baker. The greatest diameter of a bath is about eight feet, and its greatest height six. The entrance, like the mouth of an oven, is wide enough to allow a man to creep easily in. In the place opposite to the entrance there is a furnace of stone or raw bricks, with its mouth outwards to receive the fire, and a hole above it to carry off the smoke. The part which unites the furnace to the bath, and which is about two feet and a half square, is shut with a certain dry stone of a porous texture. In the upper part of the vault there is an air-hole, like that to the furnace. This is the usual structure of the temazcalli; but there are others that are without vault or furnace, mere little square chambers, yet well covered and defended from the air.—When any person goes to bathe, he first lays a mat within the temazcalli, a pitcher of water, and a bunch of herbs or leaves of maize. He then causes a fire to be made in the furnace, which is kept burning until the stones which join the bath and furnace are quite hot. The person who is to use the bath enters commonly naked, and generally accompanied for the sake of convenience, or on account of infirmity, by one of his domestics. As soon as he enters, he shuts the entrance close, but leaves the air-hole at top for a little time open, to let out any smoke which may have been introduced through the chinks of the stone; when it is all out he likewise stops up the air-hole. He then throws water upon the hot stones, from which immediately arises a thick steam to the top of the temazcalli. While the sick person lies upon the mat, the domestic drives the vapour downwards, and gently beats the sick person, particularly on the ailing part, with the bunch of herbs which are dipped for a little while in the water of the pitcher, which has then become a little warm. The sick person falls immediately into a soft and copious sweat, which is increased or diminished at pleasure, according as the case requires. When the evacuation desired is obtained, the vapour is let off, the entrance is cleared, and the sick person clothes himself, or is transported on the mat to his chamber; as the entrance to the bath is usually within some chamber of his habitation.—This sort of bath, called *temazcalli* by the natives, has been regularly used in several disorders, particularly in fevers occasioned by costiveness. The Indian women use it commonly after childbirth, and also those persons who have been stung or wounded by any poisonous animal. It is undoubtedly a powerful remedy for all those who have occasion to carry off gross humours; and certainly it would be most useful in Italy, where the rheumatism is so frequent and afflicting. When a very copious sweat is desired, the sick person is raised up and held in the vapour; as he sweats the more nearer he is to it. The temazcalli is so common, that in every place inhabited by the Indians there are many of them.

Baths, Dry, are those made of ashes, salt, sand, shreds of leather, and the like.—The ancients had divers ways of sweating by a dry heat; as by the means of a hot sand, stove-rooms, or artificial bagnios, and certain natural hot steams of the earth, received under a proper arch, or hot-house, as we learn from Celsus. They had also another kind of bath by insolation, where the body was exposed to the sun for some time, in order to draw forth the superfluous moisture from the inward parts; and to this day it is a practice in some nations to bury the body over with horse-dung, especially in chronical diseases, to digest and breathe out the humour that causes the distemper. In New England they make a kind of stoves of turf, wherein the sick are shut up to bathe or sweat.

The same name is sometimes also given to another kind of bath, made of kindled coals, or burning spirit of wine; the patient being placed in a convenient close chair for the reception of the fume, which rises and provokes sweat in a plentiful manner: care is here taken to keep the head out, and to secure respiration. This bath has been found very effectual in removing old obstinate pains in the limbs; and venereal complaints; and will often complete a cure left unperformed by salivation.

Some authors speak of bloody baths, *balnea sanguinolenta*,

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nolenta, prepared especially of the blood of infants, anciently supposed to be a kind of specific for the leprosy.

Baths, Metalline, those made of water impregnated with the *scoriæ* of metals. The most common and useful of this kind are those prepared with the *scoriæ* of iron, which abound with the earthy, saline, and sulphureous substance of the metal; and these are of excellent service for strengthening and bracing up the part to which they are applied, and recovering weak and decayed limbs; stopping various kinds of bleeding; and restoring the menstrual and hemorrhoidal flux where obstructed; insomuch that they may well be substituted for the natural iron baths.

Adjacent to the smelting huts where metals are run from their ore, are to be found large quantities of the slag of copper, antimony, and cobalt, which abounding with sulphur, vitriolic salt, and an earthy principle, make serviceable baths for strengthening the lost tone of the fibres, and relaxing them when they are too stiff. These baths have likewise a detersive and cleansing virtue; so that with prudence, and due regard to circumstances, they may be used on many occasions. The way of making these artificial baths is, either to take the slags as they come hot from the furnace, or else to heat them afresh, and throw them into hot water; which is afterwards to be used either in the way of bath, or fomentation, occasionally. There are other artificial baths, prepared of alum and quicklime, by boiling them together in fine rain-water. Such baths are highly serviceable in paralytic disorders and weakness of the limbs.

The pepper bath, or peffer wasser, on the Alps, is one of the most celebrated in Europe, and has been the subject of particular treatises, besides what has been said of it occasionally by Scheuchzer and others. It was first discovered in the year 1240, and is of the periodical kind. The water breaks forth in a dreadful place, scarce accessible to the sunbeams, or indeed to men, unless of the greatest boldness, and such as are not in the least subject to dizziness. These baths have this singularity above all others, that they commonly break forth in May, and that with a sort of impetuosity, bringing with them beech leaves, crabs or other wood-fruit; and that their course desists in September or October. Scheuchzer professes himself of opinion, that these waters are not impregnated with any minerals, or, if they do contain any, that their virtues in curing distempers and preserving health do not proceed from them. They are exceedingly clear, destitute of colour, taste, or smell.

Baths, *Balnea*, in *Architecture*, denote large pompous buildings among the ancients, erected for the sake of bathing. Baths made a part of the ancient *gymnasia*, though they were frequented more for the sake of pleasure than health.

The most magnificent baths were those of Titus, Paulus Æmilius, and Dioclesian, of which there are some ruins still remaining. It is said that at Rome there were 856 public baths. Fabricius adds, that the excessive luxury of the Romans appeared in nothing more visible than in their baths. Seneca complains, that the baths of plebeians were filled from silver pumps; and that the freedmen trod on gems. Macrobius tells us of one Sergius Oratus, a voluptuary, who had pendant baths hanging in the air.

According to Dion, Mæcenas was the first who made a bath at Rome; yet there are instances of public baths prior to this; but they were of cold water, small, and poorly decorated. Agrippa, in his ædilate, built 160 places for bathing, where the citizens might be accommodated, either with hot or cold *gratis*. After this example, Nero, Vespasian, Titus, Domitian, Severus, Gordian, Aurelian, Maximian, Dioclesian, and most of the emperors who studied to gain the affections of the people, erected baths laid with the richest marble, and wrought according to the rules of the most delicate architecture. The rich had baths at home, and frequently very magnificent ones, especially after the time that the practice of pillaging the provinces had begun; but they only used them on extraordinary occasions. The great men, and even emperors themselves, sometimes bathed in public with the rest of the people. Alexander Severus was the first who allowed the public baths to be opened in the night-time during the heats of summer.

The Greek baths were usually annexed to *palestræ* or *gymnasia*, of which they were considered as a part. These baths consisted of seven different apartments, usually separated from each other, and intermixed with other buildings belonging to the other sorts of exercises. These were, 1st, The cold bath, *frigida lavatio*; 2dly, The *elæothesium*, or room where they were anointed with oil; 3dly, The *frigidarium*, or cooling room; 4thly, The *propnigeum*, or entrance of the *hypocaustum* or stove; 5thly, The vaulted room for sweating in, or vapour-bath, called *concamerata sudatio*, or *tepidarium*; 6thly, The *laconicum*, or dry stove; 7thly, The hot bath, called *callida lavatio*.

As for the baths separate from the *palestræ*, they appear to have been usually double, one for men, the other for women; but so near, that the same furnace heated both. The middle part was possessed by a large bason that received water by several pipes, and was surrounded by a balustrade, behind which there was an area for the reception of those who waited to use the bath. They were vaulted over, and only received light from the top.

In the Roman baths, the first part that appeared was a large bason, called κολυμβηθρα in Greek, and *natatio* or *piscina* in Latin. In the middle was the *hypocaustum*, which had a row of four apartments on each side, called *balnearia*: these were the stove, the bath, cold bath, and *tepidarium*. The two stoves, called *laconicum* and *tepidarium*, were circular and joined together. Their floor was hollow and suspended, in order to receive the heat of a large furnace, which was communicated to the stoves through the vacuities of their floor. This furnace also heated another room called *vasarium*, in which were three large brazen vessels called *milliaria*, respectively containing hot, warm, and cold water; which were so disposed, that the water might be made to pass by syphons and pipes out of one or other of them into the bath, in order to adjust its temperature. The description is given by Vitruvius. At three in the afternoon, which is what Pliny calls *hora octava et nona*, the Romans all repaired to the baths, either the public or the private ones: this

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was called the *bath hour*, *hora balnei*, which in winter was at nine, in summer at eight. The public baths were all opened at the sound of a bell, and always at the same hour. Those who came too late, stood a chance for bathing in cold water.

They began with hot water; after which, as the pores were now opened, and might give room for too plentiful a perspiration, they thought it necessary for their health to close them again, either with the cold bath, or at least with a sprinkling of cold water. During the bath, the body was scraped with a kind of knives, or small strigils, such as are still found in the cabinets of the curious. After bathing succeeded unction and perfuming, from which they went fresh to supper.

The Romans, when they found their stomachs overcharged with meat, went to the bath, as we learn from Juvenal, who inveighs against those who, having gorged themselves with eating, were forced to go into the baths to give themselves relief. They found also that a bath was good to refresh themselves after some considerable fatigue or travel, as Celsus tells us; which makes Plautus say, that all the baths in this world were not sufficient to remove the weariness he felt. After Pompey's time, the humour of bathing was carried to great excess, by which many were ruined, several having brought themselves to such a pitch, that they could not bear food without bathing first. The emperor Titus is said to have lost his life thereby. Hence Pliny inveighs severely against those physicians who held, that hot baths digested the food. The emperor Hadrian first laid a restraint on the immoderate humour of bathing, by a public edict, prohibiting all persons to bathe before the eighth hour.

Baths of Agrippa, (*thermæ Agrippinæ*,) were built of brick, but painted in enamel: those of Nero, *thermæ Neronianæ*, were not only furnished with fresh water, but even had the sea brought into them: those of Caracalla were adorned with 200 marble columns, and furnished with 1600 seats of the same matter. Lipsius assures us they were so large, that 1800 persons might conveniently bathe in them at the same time. But the baths of Dioclesian, *thermæ Dioclesianæ*, surpassed all the rest in magnificence. One hundred and forty thousand men were employed many years in building them. Great part of these, as well as those of Caracalla, are still standing; and with the vast high arches, the beautiful and stately pillars, the extraordinary plenty of foreign marble, the curious vaulting of the roofs, the prodigious number of spacious apartments, and a thousand other ornaments, make one of the greatest curiosities of modern Rome.

Bath, in *Chemistry*. Several kinds of apparatus employed to transmit heat are called baths; but the substances most frequently used by chemists for this purpose are water and sand. When water is employed, it is called *Balneum Mariæ*, or *water bath;* which is very much used, very convenient for many operations, and may be employed successfully for all degrees of heat inferior to that of boiling water. As water, when exposed to fire in any vessel from which it can evaporate; does only receive a determinate degree of heat, which always remains the same when once it has arrived at the boiling heat, it follows, that by the water bath, a degree of heat always equal may be transmitted with certainty. Farther, this degree of heat being incapable of burning, or of communicating an empyreumatic quality to matters susceptible of it, the water bath has also the advantage of not exposing substances to this inconvenience. When vessels in which distillations and digestions are made, are placed in sand, then a sand bath is formed. This intermediate substance of sand is very convenient, to moderate the too great activity of the naked fire, and to transmit any degree of heat, from the weakest to a red heat. As this bath is attended with less trouble, and requires less apparatus than the water bath, it is much used in laboratories. Nothing is requisite for the sand bath, but an earthen or iron vessel full of fine sand, which is fitted into a furnace, and capable of containing the cucurbits, retorts, matrasses, or other vessels containing the matter to be operated upon.

Bath, in *Metallurgy*, is used to signify the fusion of metallic matter in certain operations. In refining or cupelling, for example, the metals are said to be in bath when they are melted. When gold is purified by antimony, this semi-metal, melted, is called by some the *bath of gold;* alchemists, who consider gold as the king of metals, call antimony the *bath of the king only;* because in fact gold only can resist the action of antimony.

Bath, in Hebrew antiquity, a measure of capacity, containing the tenth part of an omar, or seven gallons and four pints, as a measure for things liquid; or three pecks and three pints, as a measure for things dry.

Bath-Kol, the daughter of a voice. So the Jews call one of their oracles, which is frequently mentioned in their books, especially the Talmud; being a fantastical way of divination invented by the Jews themselves, though called by them a revelation from God's will, which he made to his chosen people, after all verbal prophecies had ceased in Israel. It was in fact a method of divination similar to the *sortes Virgilianæ* of the Heathens. For as, with them, the first words they happened to dip into, in the works of that poet, were a kind of oracle whereby they predicted future events; so with the Jews, when they appealed to Bath-kol, the first words they heard from any man's mouth were looked upon as a voice from heaven, directing them in the matter they inquired about. The Christians were not quite free from this superstition, making the same use of the book of the Scriptures as the Pagans did of the works of Virgil. It was practised by Heraclius, emperor of the east, in the beginning of the seventh century: for, being at war with Chosroes king of Persia, and in doubt, after a successful campaign, where to take up his winter quarters, he consulted the book of the scriptures in this way of divination, and was determined thereby. In France, it was the practice for several ages to use this kind of divination at the consecration of a bishop, in order to discover his life, manners, and future behaviour. This usage came into England with the Norman conquest; for we are told, that at the consecration of William, the second Norman bishop of the diocese of Norwich, the words which first occurred on dipping into the Bible were, *Not this man, but Barrabas:* soon after which, William died, and Herbert de Lozinga, chief simony broker to King William Rufus, succeeded him; at whose consecration the words at which the Bible opened were the same which

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which Jesus spoke to Judas the traitor; *Friend, wherefore art thou come?* This circumstance so affected Herbert, that it brought him to a thorough repentance of his crime; in expiation of which he built the cathedral church of Norwich, the first stone of which he laid in the year 1096.

BATHA, BATH, or *Bachia*, a town of Hungary, and capital of a county of the same name, seated on the Danube. E. Long. 20. 40. N. Lat. 46. 40.

BATHING, the act of using or applying a bath; that is, of immerging the body, or part of it, in water or other fluid.

Bathing is a practice of great antiquity. The Greeks, as early as the heroic age, are said to have bathed themselves in the sea, in rivers, &c. We even find mention in Homer of hot baths in the Trojan times; but these seem to have been very rare, and only used on extraordinary occasions. Athenæus speaks of hot baths as unusual even in his age. In reality, public baths appear to have been discouraged, and even prohibited, by the ancient Greeks, who were contented to wash themselves at home in a sort of bathing tubs. The method of bathing among the ancient Greeks was, by heating water in a large vessel with three feet, and thence pouring it on the head and shoulders of the person seated in a tub for that purpose, who at coming out was anointed with oil.

The Romans were also long before they came into the use of baths; the very name of which, *thermæ*, shows they borrowed it from the Greeks. As the ancient Romans were chiefly employed in agriculture, their custom was, every evening after work, to wash their arms and legs, that they might sit down to supper with more decency: for it is to be observed, the use of linen was then unknown: and the people of that age went with their arms and legs bare, and consequently exposed to dust and filth. But this was not all; for every ninth day, when they repaired to the city, either to the nundinæ or to attend at the assemblies of the people, they bathed all over in the Tiber, or some other river which happened to be nearest them. This seems to have been all the bathing known till the time of Pompey, when the custom began of bathing every day. See BATH.

The Celtic nations were not without the use of bathing: the ancient Germans bathed every day, in warm water in winter, and in summer in cold. In England, the famous bath in Somersetshire is said by some to have been in use 800 years before Christ. Of this, however, it must be owned, we have but very slender evidence; but Dr Musgrave makes it probable that it was a place of considerable resort in Geta's time; there being still the remains of a statue erected to that general, in gratitude for some benefactions he had conferred upon it.

Although bathing, among the ancients, made, as it were, a part of diet, and was used as familiarly as eating or sleep; yet it was in high esteem among their physicians for the cure of diseases, as appears from Strabo, Pliny, Hippocrates, and Oribasius; whence frequent exhortations to washing in the sea, and plunging into cold water. The first instance of cold bathing, as a medicine, is Melampus's bathing the daughters of the king of Argos; and the first instance of warm bathing is Medea's use of it, who was said to boil people alive, because Pelias king of Thessaly died in a warm bath under her hands. The cold bath was used with success by Antonius Musa, physician to the emperor Augustus, for the recovery of that prince; but fell into neglect after the death of Marcellus, who was thought to have been destroyed by the improper use of it. It was again brought into request towards the close of the reign of Nero, by means of a physician of Marseilles named *Charmis;* but during the ignorance of the succeeding ages, the practice was again banished for a long time.—Both hot and cold bathing are now prescribed in many cases by the physicians, though they are not agreed as to the manner in which they operate on the human body. See MEDICINE *Index*.

Bathing among the Turks, as among the ancients, makes a part of diet and luxury; and in every town, and even village, there is a public bath. Indeed, the necessity of cleanliness, in a climate where one perspires so copiously, has rendered bathing indispensable; the comfort it produces preserves the use of it; and Mahomet, who knew its utility, has reduced it to a precept. Of these baths, and the manner of bathing, particularly at Cairo, the following account is given by M. Savary in his Letters on Egypt.

"The first apartment one finds in going to the bath, is a large hall, which rises in the form of a rotunda. It is open at the top, to give a free circulation to the air. A spacious estrade, or raised floor, covered with a carpet, and divided into compartments, goes round it, on which one lays one's clothes. In the middle of the building, a jet-d'eau spouts up from a bason, and agreeably entertains the eye. When you are undressed, you tie a napkin round your loins, take a pair of sandals, and enter into a narrow passage, where you begin to be sensible of the heat. The door shuts to; and at 20 paces off, you open a second, and go along a passage, which forms a right angle with the former. Here the heat increases. They who are afraid of suddenly exposing themselves to a stronger degree of it, stop in a marble hall, in the way to the bath properly so called. The bath is a spacious and vaulted apartment, paved and lined with marble, around which there are four closets. The vapour incessantly arising from a fountain and cistern of hot water, mixes itself with the burning perfumes. These, however, are never burnt except the persons who are in the bath desire it. They are mixed with the steam of the water, and produce a most agreeable effect.

"The bathers are not imprisoned here, as in Europe, in a sort of tub, where one is never at one's ease. Extended on a cloth spread out, the head supported by a small cushion, they stretch themselves freely in every posture, whilst they are wrapped up in a cloud of odoriferous vapours, which penetrate into all their pores. After reposing there some time, until there is a gentle moisture over the whole body, a servant comes, presses you gently, turns you over, and when the limbs are become supple and flexible he makes all the joints crack without any difficulty. He masses * and seems to knead the flesh without making you feel the smallest pain. This operation finished, he puts on a stuff glove, and rubs you a long time. During this operation, he detaches from the body of the patient, which is running with sweat, a sort of small scales, and removes even

* "Masser" comes from the Arabic verb *mass*, which signifies touching a delicate the masser.

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the imperceptible dirt that stops the pores. The skin becomes soft and smooth like satin. He then conducts you into a closet, pours the lather of perfumed soap upon your head, and withdraws. The ancients did more honour to their guests, and treated them in a more voluptuous manner. Whilst Telemachus was at the court of Nestor, 'the beautiful Polycasta, the handsomest of the daughters of the king of Pylos, led the son of Ulysses to the bath; washed him with her own hands; and, after anointing his body with precious oils, covered him with rich habits and a splendid cloak.' Pisistratus and Telemachus were not worse treated in the palace of Menelaus. "When they had admired its beauties, they were conducted to basons of marble, where a bath was prepared: Beautiful female slaves washed them; and, after anointing them with oil, covered them with rich tunics and superb pellices.

"The closet to which one is conducted is furnished with a cistern and two cocks; one for cold and the other for hot water. There you wash yourself. Soon after the servant returns with a depilatory pomatum, which in an instant makes the hair fall off the places it is applied to. Both men and women make general use of it in Egypt. It is composed of a mineral called *rusma;* which is of a deep brown. The Egyptians burn it lightly, knead it with water, mixing it with half the quantity of slaked lime. This grayish paste applied to the hair, makes it fall off in two or three minutes, without giving the slightest pain.

"After being well washed and purified, you are wrapped up in hot linen, and follow the guide through the windings that lead to the outer apartment. This insensible transition from heat to cold prevents one from suffering any inconvenience from it. On arriving at the estrade, you find a bed prepared for you; and scarcely are you laid down before a child comes to press every part of your body with his delicate fingers, in order to dry you thoroughly. You change linen a second time, and the child gently grates the callosity of your feet with pumice stone. He then brings you a pipe and Moka coffee.

"Coming out of a stove where one was surrounded by a hot and moist fog, where the sweat gushed from every limb, and transported into a spacious apartment open to the external air, the breast dilates, and one breathes with voluptuousness. Perfectly massed, and as it were regenerated, one experiences an universal comfort. The blood circulates with freedom; and one feels as if disengaged from an enormous weight, together with a suppleness and lightness to which one has been hitherto a stranger. A lively sensation of existence diffuses itself to the very extremities of the body. Whilst it is lost in delicate sensations, the soul, sympathizing with the delight, enjoys the most agreeable ideas. The imagination, wandering over the universe, which it embellishes, sees on every side the most enchanting pictures, everywhere the image of happiness. If life be nothing but the succession of our ideas, the rapidity with which they then recur to the memory, the vigour with which the mind runs over the extended chain of them, would induce a belief that in the two hours of that delicious calm that succeeds the bath, one has lived a number of years."

Such are the baths, the use of which were so strongly recommended by the ancients, and which are still the delight of the Egyptians. It is by means of them that they prevent or dispel rheumatisms, catarrhs, and such cutaneous disorders as are produced by want of perspiration. Hence likewise they find a radical cure for that fatal evil which attacks the sources of generation, the remedy for which is so dangerous in Europe. By the same resource they get rid of that uncomfortable feeling so common to all nations who do not pay so much attention to the cleanliness of their bodies.—M. Tournefort, indeed, who had used steam baths at Constantinople, where there is less refinement in them than at Cairo, is of opinion that they injure the breast. But, according to M. Savary, this is an error which further experience would have corrected. There are no people who make more frequent use of them than the Egyptians, and there is no country where there are fewer asthmatic people. The asthma is scarcely known there.

The women are passionately fond of these baths. They frequent them at least once a-week, and take with them slaves properly qualified for the purpose. More luxurious than the men, they use rose-water. It is there that female head-dressers form their long black hair into tresses, which they mix with precious essences instead of powder and pomatum. It is there that they blacken the edge of their eye-lids, and lengthen their eye-brows with cohel, a preparation of tin burnt with gall-nuts; it is there they stain the finger and toe nails with the leaves of hennè, a shrub common in Egypt, and which gives them a golden colour. The linen and clothing they make use of are passed through the sweet steam of the wood of aloes; and when the work of the toilet is at an end, they remain in the outer apartment, and pass the day in entertainments. Females entertain them with voluptuous songs and dances, or tell them tales of love.

The medical effects of bathing are considered under the article BATHING, in the SUPPLEMENT.

BATHURST, RALPH, M. D. an eminent physician, poet, and divine, born in the year 1620. He studied divinity in Trinity college, Oxford; but the times of confusion coming on, he changed the course of his studies, and applied himself to physic. He took a doctor's degree in that faculty; in which he rose to such eminence, that he was in the time of the usurpation, appointed physician to the state. Upon the Restoration, he quitted his profession of physic; was elected a fellow of the Royal Society, and president of his college; and having entered into holy orders, he was made chaplain to the king, and afterwards dean of Wells. Soon after, he served the office of vice-chancellor of Oxford, and was nominated by King William and Queen Mary to the see of Bristol; which he refused to accept. His learning and talents were various. He was an orator, a philosopher, and a poet: he possessed an inexhaustible fund of wit, and was a facetious companion at 80 years of age. Ridicule was the weapon with which he used to correct the delinquents of his college; and he was so absolute a master of it, that he had it always at hand. His poetical pieces in the *Musæ Anglicanæ* are excellent in their kind. He wrote several poems, both in English and Latin; and died June 14. 1704, in the 84th year of his age.

BATHURST, *Allen*, earl of Bathurst, one of the last worthies

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Bathurst. worthies of Queen Anne's reign, that shining period of triumphs, taste, genius, and elegance, was born in the year 1684. His studies and his education were equally conducive to the brilliant figure he was destined to make in social life and in the senate, as a polite scholar, a patriot, and a statesman. These talents he had an opportunity to display as early as the year 1705; when, at the request of his father Sir Benjamin Bathurst, and the solicitation of the constituents of Cirencester, he served in parliament for that borough, his native soil, with reputation and integrity. He distinguished himself particularly in the struggles and debates relative to the union between the two kingdoms, firmly supporting this measure, calculated to strengthen the vigour of government by its uniting force. Though he was contented to act a subordinate character in the great opposition planned by Mr Harley and Mr St John, his intimate friends, to sap the credit of the duke of Marlborough and his adherents, he was of infinite service to his party in arraigning, with spirit and eloquence, the conduct of the general and the earl of Godolphin, who had long governed the queen, and lavished the treasures of the nation on conquests more splendid than serviceable. The loss of the battle of Almanza seconded his efforts to dispel the intoxication of former successes. His personal regard for Lord Somers, president of the council, was never altered, though they were of different opinions in politics; and when he was divested of his office, Mr Bathurst acted with such tenderness and delicacy, as to preserve the esteem of Lord Somers in a private station. In consideration of his zeal and services, the queen advanced him, in 1711, to the dignity of a peer, by the title of Baron Bathurst, of Battlesden, in Bedfordshire.

His lordship continued to speak his sentiments with an undaunted freedom in the upper house; and stept forth as a formidable opponent to the court measures in the reign of George I. and during Sir Robert Walpole's administration. The acrimony of the prosecution carried on against the earl of Oxford, Lord Bolingbroke, and the duke of Ormond, stimulated his indignation and his eloquence against such vindictive proceedings; and he observed, "that the king of a faction was but the sovereign of half his subjects."

The South-sea scheme having infected the whole nation with a spirit of avaricious enterprise, the people awaked from their delirium, and an infinite number of families were involved in ruin. Lord Bathurst publicly impeached the directors, whose arts had enabled them by these vain expectations to amass surprising fortunes: he represented that the national honour was concerned in stripping them of their ill acquired wealth; and moved for having all the directors of the South-sea company punished by a forfeiture of their estates, for such a notorious act of sordid knavery.

When the bill was brought into the house of lords against Dr Atterbury bishop of Rochester, that learned prelate, who joined to the graces of style and elocution all the elegance of a just delivery; among the many friends, the bishop's eloquence, politeness, and ingenuity had procured him, was Lord Bathurt. He spoke against the bill with great vehemence and propriety; observing, "that if such extraordinary proceedings were countenanced, he saw nothing remaining for him and others to do, but to retire to their country-houses, and there, if possible, quietly enjoy their estates within their own families, since the least correspondence, or intercepted letter, might be made criminal." Then turning to the bishops, he said, he "could hardly account for the inveterate hatred and malice some persons bore the ingenious bishop of Rochester, unless it was that they were infatuated like the wild Americans, who fondly believe they inherit not only the spoils, but even the abilities, of the man they destroy." He was one of the lords who entered his protest against the bill.

His lordship was entirely averse to continental connections; and animadverted severely upon the monarch whose thoughts were turned to foreign concerns and alliances which could never be useful; complaining of the immense sums lavished in subsidies to needy and rapacious princes.

The directors of the charitable corporation having embezzled 500,000l. of the proprietors capital, Lord Bathurst declared in the house of lords, his abhorrence of this most iniquitous scene of fraud; asserting that not one shilling of the money was ever applied to the proper service, but became the reward of avarice and venality.

His lordship concurred, with all his power, in the opposition to Sir Robert Walpole, who now tottered on the brink of ruin. This minister, after obstinate struggles, having been forced to resign all his employments, Lord Bathurst was sworn of the privy council, and made captain of the gentlemen pensioners, which post he resigned in 1744. He was appointed treasurer to the present king, then prince of Wales, in 1757, and continued in the list of privy-counsellors at his accession to the throne; but, on account of his great age, he chose to enjoy *otium cum dignitate*.

Lord Bathurst's integrity gained him the esteem even of his opponents; and his humanity and benevolence, the affection of all that knew him more intimately. He added to his public virtues all the good breeding, politeness, and elegance, of social intercourse. Dr Freind, Congreve, Vanbrugh, Swift, Prior, Rowe, Addison, Pope, Arbuthnot, Gay, and most men of genius in his own time, cultivated his friendship, and were proud of his correspondence.

Pope, in his Epistle to him on the Use of Riches, thus addresses him:

> The sense to value riches, with the art
> T'enjoy them, and the virtue to impart;
> To balance fortune by a just expence,
> Join with economy magnificence;
> With splendor, charity; with plenty, health:
> O teach us, Bathurst, yet unspoil'd by wealth!
> That secret rare, between th' extremes to move,
> Of mad good nature, and of mean self-love.

And Sterne, in his letters to Eliza, thus speaks of him: "This nobleman is an old friend of mine: he was always the protector of men of wit and genius; and has had those of the last century always at his table. The manner in which his notice began of me, was as singular as it was polite.—He came up to me one day as I was at the princess of Wales's court. 'I want to know you, Mr Sterne; but it is fit you should know also who it is that wishes this pleasure: you have heard (continued he) of an old Lord Bathurst, of whom

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whom your Popes and Swifts have sung and spoken so much: I have lived my life with geniuses of that cast, but have survived them; and despairing ever to find their equals, it is some years since I have closed my accounts, and shut up my books, with thoughts of never opening them again: but you have kindled a desire in me of opening them once more before I die, which I now do: so go home, and dine with me.' This nobleman, I say, is a prodigy: for at 85 he has all the wit and promptness of a man of 30; a disposition to be pleased, and a power to please others beyond whatever I knew! added to which, a man of learning, courtesy, and feeling."

His lordship, in the latter part of his life, preserved his natural cheerfulness and vivacity, always accessible, hospitable, and beneficent. Lately he delighted in rural amusements; and enjoyed, with a philosophical satisfaction, the shade of the lofty trees he had planted himself. Till within a month of his death he constantly rode out on horseback two hours before dinner, and constantly drank his bottle of claret or Madeira after dinner. He used to declare, in a jocose manner, he never could think of adopting Dr Cadogan's method, as Dr Cheyne had assured him, 50 years ago, he would never live seven years longer unless he abridged himself of his wine. Pursuant to this maxim, his lordship having, some years ago, invited several of his friends to spend a few cheerful days with him at his seat at Cirencester, and being one evening very loth to part with them; on his son the late chancellor's objecting to their sitting up any longer, and adding that health and long life were best secured by regularity, he suffered him to retire: but, as soon as he was gone, the cheerful father said, "Come, my good friends, since the old gentleman is gone to bed, I think we may venture to crack another bottle."

His lordship was advanced to the dignity of earl in 1772; and lived to see the above nobleman, his eldest son, several years lord high chancellor of Great Britain, and promoted to the peerage in 1771 by the title of Baron Apsley. Lord Bathurst married Catharine daughter of Sir Peter Apsley, by whom he had two other sons and five daughters. His death happened, after a few days illness, at his seat near Cirencester, in the 91st year of his age, and on the 16th of September 1775.

BATHYLLUS *and* PYLADES, inventors of pantomime entertainments on the stage. Bathyllus succeeded in representing comedy; Pylades in tragedy. The art consisted in expressing the passions by gestures, attitudes, and dumb show; not, as in modern times, in machinery, and the fooleries of Harlequin. They flourished at Rome, under Augustus, about A. D. 10. Each of them kept scholars, who perpetuated their master's name: for the followers of Bathyllus, who excelled in the comic part, called themselves *Bathylli;* and those of Pylades, who excelled in the tragic, called themselves *Pyladæ.*

BATILLUS, a musical instrument made of metal, in the form of a staff, furnished with metalline rings, which being struck, yielded a kind of harmonical sounds; used by the Armenians in their church-service.

BATIS. See BOTANY *Index.*

BATISTE, in commerce, a fine white kind of linen cloth, manufactured in Flanders and Picardy.

There are three kinds of batiste; the first very thin; the second less thin; and the third much thicker, called *Holland Batiste,* as coming very near the goodness of Hollands. They are used for neck-cloths, &c.

BATMAN, in commerce, a kind of weight used at Smyrna, containing six okes of 400 drams each, which amount to 16 pounds 6 ounces and 15 drams of English weight.

BATMANSON, JOHN, prior of the Carthusian monastery, or Charter-house, in the suburbs of London. He was some time a student at Oxford, but it does not appear that he took any degree in that university. He was intimately acquainted with Edward Lee archbishop of York, at whose request he wrote against Erasmus and Luther. He died in the year 1531, and was buried in the chapel belonging to the Charter-house. According to Bale, he was a proud forward person; and he says that Erasmus, in one of his letters to the bishop of Winchester, calls him an ignorant fellow. Pits, on the contrary, gives him the character of a man of singular genius, zeal, piety, and learning. He wrote, 1. *Animadversiones in annotationes Erasmi in Nov. Testamentum.* 2. A treatise against some of Luther's works. These two he afterwards retracted. 3. *Commentaria in proverbia Solomonis.* 4. *In cantica canticorum.* 5. *De unica Magdalena.* 6. *Institutiones noviciorum.* 7. *De contemptu mundi.* 8. *De Christo duodenni.* 9. On the words, *Missus est,* &c.

BATNEARS, or BATTIES, a people of the north of Hindostan. See SUPPLEMENT.

BATON, or BASTON. See BASTON.

BATRACHOMYOMACHIA, the battle of the frogs and the mice, the title of a fine burlesque poem generally ascribed to Homer.—The subject of the work is the death of Psycharpax, a mouse, son to Toxartes, who being mounted on the back of Physignathus, a frog, on a voyage to her palace, to which she had invited him, was seized with fear when he saw himself in the middle of the pond, so that he tumbled off and was drowned. Physignathus being suspected to have shaken him off with design, the mice demanded satisfaction, and unanimously declared war against the frogs.

BATTÆ, in *Ancient Geography,* a people of Germany, formerly inhabitants of what is now called *Hesse.* Being dissatisfied with their situation there, they settled on the island formed by the Vahalis and Rhine, which from them took the name of *Batavia,* or *Batavorum Insula.* Their government was a mixture of monarchy, aristocracy, and democracy. Their chief was, properly speaking, nothing more than a principal citizen, whose business was rather to advise than to command. The principal men who exercised jurisdiction, and commanded the troops, in their respective districts, were chosen, as well as the kings, in an assembly of the people. A hundred persons selected from among the people, presided over every county, and acted as chiefs in the different hamlets. The whole nation was, in some measure, an army always in readiness. Each family composed a body of militia, which served under a captain of their own choosing. See BATAVORUM *Insula.*

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BATTALIA, an army ranged in order of battle, or ready for engagement. The word seems formed from the Latin *batualia*, sometimes also written *batalia*, denoting a sort of military or gladiatorial exercise, as fighting with foils, or tilting at a post. In this sense, we meet with the depth of a battalia; to march in battalia, with the baggage in the middle; to break the battalia, &c. In the Roman battalia, the *hastati* made the front.

BATTALION, a small body of infantry, ranged in form of battle, and ready to engage.

A battalion usually contains from 500 to 800 men; but the number it consists of is not determined. They are armed with firelocks, swords, and bayonets; and divided into 13 companies, one of which is grenadiers. They are usually drawn up three men deep. Some regiments consist of but one battalion, others are divided into four or five.

BATTATAS, the Indian name of the potato. See CONVOLVULUS.

BATTEL, a town of Sussex, five miles north-west of Hastings, situated in E. Long. 0. 35. N. Lat. 50. 55. It was formerly called *Epiton;* and is the place where William the Conqueror vanquished Harold king of England on October 14. 1066. William, in memory of this victory, erected an abbey, which he called *Battel Abbey;* and if a criminal could but reach this abbey, he was dismissed from thence, and was afterwards in no danger for his past faults. The abbey was a large and noble structure, as may be judged by the gateway which is still entire, as well as from the other remains. This place is noted for making gunpowder equal to that of Dantzick; and the best goes by the name of *Battel gunpowder*. Population in 1811, 2531.

BATTEL, in *Law*, or *Trial by wager of battle*, a species of trial of great antiquity, but now much disused. It seems to have owed its original to the military spirit of our ancestors, joined to a superstitious frame of mind; it being in the nature of an appeal to Providence, under an apprehension and hope (however presumptuous and unwarrantable), that Heaven would give the victory to him who had the right. The decision of suits, by this appeal to the God of battles, is by some said to have been invented by the Burgundi, one of the northern or German clans that planted themselves in Gaul. And it is true, that the first written injunction of judiciary combats that we meet with, is in the laws of Gundebal, A. D. 501, which are preserved in the Burgundian code. Yet it does not seem to have been merely a local custom of this or that particular tribe, but to have been the common usage of all those warlike people from the earliest times. And it may also seem, from a passage in Velleius Paterculus, that the Germans, when first they became known to the Romans, were wont to decide all contests of right by the sword: for when Quintilius Varus endeavoured to introduce among them the Roman laws and method of trial, it was looked upon (says the historian) as a *novitas incognitæ disciplinæ, ut solita armis decerni jure terminarentur*. And among the ancient Goths in Sweden we find the practice of judiciary duels established upon much the same footing as they formerly were in our own country.

This trial was introduced in England among other Norman customs by William the Conqueror; but was only used in three cases, one military, one criminal, and the third civil. The first in the court martial, or court of chivalry and honour; the second in appeals of felony; and the third upon issue joined in a writ of right, the last and most solemn decision of real property. For in writs of right the *jus proprietatis*, which is frequently a matter of difficulty, is in question; but other real actions being merely questions of the *jus possessionis*, which are usually more plain and obvious, our ancestors did not in them appeal to the decision of Providence. Another pretext for allowing it, upon these final writs of right, was also for the sake of such claimants as might have the true right, but yet by the death of witnesses or other defect of evidence be unable to prove it to a jury. But the most curious reason of all is given in the Mirror, that it is allowable upon warrant of the combat between David for the people of Israel of the one party, and Goliath for the Philistines of the other party: a reason which Pope Nicholas I. very seriously decides to be inconclusive. Of battel therefore on a writ of right we shall first speak: and although the writ of right itself, and of course this trial thereof, be at present disused; yet, as it is law at this day, it may be matter of curiosity, at least, to inquire into the forms of this proceeding, as we may gather them from ancient authors.

1. The last trial of battel that was waged in the court of common pleas at Westminster (though there was afterwards one in the court of chivalry in 1631, and another in the county palatine of Durham in 1638) was in the 13th year of Queen Elizabeth, A. D. 1571, as reported by Sir James Dyer; and was held in Tothill-fields, Westminster, "*non sine magna juris consultorum perturbatione*," saith Sir Henry Spelman, who was himself a witness of the ceremony. The form, as appears from the authors before cited, is as follows.

When the tenant in a writ of right pleads the general issue, viz. that he hath more right to hold than the demandant hath to recover; and offers to prove it by the body of his champion, which tender is accepted by the demandant; the tenant in the first place must produce his champion, who, by throwing down his glove as a gage or pledge, thus wages or stipulates battel with the champion of the demandant; who, by taking up the gage or glove, stipulates on his part to accept the challenge. The reason why it is waged by champions, and not by the parties themselves, in civil actions, is because, if any party to the suit dies, the suit must abate and be at an end for the present; and therefore no judgment could be given for the lands in question, if either of the parties were slain in battel: and also that no person might claim an exemption from this trial, as was allowed in criminal cases where the battel was waged in person.

A piece of ground is then in due time set out, of 60 feet square, enclosed with lists, and on one side a court erected for the judges of the court of common pleas, who attend there in their scarlet robes; and also a bar is prepared for the learned serjeants at law. When the court sits, which ought to be by sunrising, proclamation is made for the parties and their champions; who are introduced by two knights, and are dressed in a coat of armour, with red sandals, barelegged from the knee downwards, bareheaded, and with bare arms to the elbows. The weapons allowed them are only batons, or

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Battel or staves, of an ell long, and a four-cornered leather target; so that death very seldom ensued this civil combat. In the court military, indeed, they fought with sword and lance, according to Spelman and Rushworth; and likewise in France: only villains fought with buckler and baton, gentlemen armed at all points. And upon this, and other circumstances, the president Montesquieu had with great ingenuity not only deduced the impious custom of private duels upon imaginary points of honour, but hath also traced the heroic madness of knight-errantry from the same original of judicial combats. But to proceed:

When the champions, thus armed with batons, arrive within the lists or place of combat, the champion of the tenant then takes his adversary by the hand, and makes oath that the tenements in dispute are not the right of the demandant; and the champion of the demandant, then taking the other by the hand, swears in the same manner that they are; so that each champion is, or ought to be, thoroughly persuaded of the truth of the cause he fights for. Next an oath against sorcery and enchantment is to be taken by both the champions, in this or a similar form: "Hear this, ye justices, that I have this day neither ate, drank, nor have upon me either bone, stone, nor grass; nor any enchantment, sorcery, or witchcraft, whereby the law of God may be abased, or the law of the devil exalted. So help me God and his saints."

The battel is thus begun, and the combatants are bound to fight till the stars appear in the evening: and, if the champion of the tenant can defend himself till the stars appear, the tenant shall prevail in his cause; for it is sufficient for him to maintain his ground, and make it a drawn battel, he being already in possession; but, if victory declares itself for either party, for him is judgment finally given. This victory may arise from the death of either of the champions: which indeed hath rarely happened; the whole ceremony, to say the truth, bearing a near resemblance to certain rural athletic diversions, which are probably derived from this original. Or victory is obtained if either champion proves *recreant*, that is, yields, and pronounces the horrible word of *craven*: a word of disgrace and obloquy, rather than of any determinate meaning. But a horrible word it indeed is to the vanquished champion; since, as a punishment to him for forfeiting the land of his principal by pronouncing that shameful word, he is condemned as a recreant, *amittere liberam legem*, that is, to become infamous, and not to be accounted *liber et legalis homo*; being supposed by the event to be proved forsworn, and therefore never to be put upon a jury, or admitted as a witness in any cause.

This is the form of a trial by battel; a trial which the tenant, or defendant in a writ of right, has it in his election at this day to demand; and which was the only decision of such writ of right after the Conquest, till Henry II. by consent of parliament, introduced the *grand assise*, a peculiar species of trial by jury, in concurrence therewith; giving the tenant his choice of either the one or the other. Which example, of discountenancing these judicial combats, was imitated about a century afterwards in France, by an edict of Louis the Pious, A. D. 1260, and soon after by the rest of Europe. The establishment of this alternative, Glanvil, chief justice to Henry II. and probably his adviser herein, considers as a most noble improvement, as in fact it was, of the law.

2. In appeal * of felony, the trial by battel may be demanded, at the election of the appellee, in either an appeal or an improvement; and it is carried on with equal solemnity as that on a writ of right; but with this difference, that there each party hires a champion, but here they must fight in their proper persons. And, therefore, if the appellant or approver be a woman, a priest, an infant, or of the age of 60, or lame, or blind, he or she may counterplead and refuse the wager of battel; and compel the appellee to put himself upon the country. Also peers of the realm, bringing an appeal, shall not be challenged to wage battel, on account of the dignity of their persons; nor the citizens of London, by special charter, because fighting seems foreign to their education and employment. So likewise, if the crime be notorious; as if the thief be taken with the *mainour*, or the murderer in the room with a bloody knife, the appellant may refuse the tender of battel from the appellee; and it is unreasonable an innocent man should stake his life against one who is already half-convicted.

* See *Appeal*.

The form and manner of waging battel upon appeals are much the same as upon a writ of right; only the oaths of the two combatants are vastly more striking and solemn. The appellee, when appealed of felony, pleads *not guilty*; and throws down his glove, and declares he will defend the same by his body: the appellant takes up the glove; and replies that he is ready to make good the appeal, body for body. And thereupon, the appellee taking the book in his right hand, and in his left the right hand of his antagonist, swears to this effect: *Hoc audi, homo, quem per manum teneo*, &c. "Hear this, O man, whom I hold by the hand, who callest thyself *John* by the name of baptism, that I, who call myself *Thomas* by the name of baptism, did not feloniously murder thy father, *William* by name, nor am any way guilty of the said felony. So help me God, and the saints; and this I will defend against thee by my body, as this court shall award." To which the appellant replies, holding the Bible and his antagonist's hand in the same manner as the other: "Hear this, O man, whom I hold by the hand, who callest thyself *Thomas*, by the name of baptism, that thou art perjured; and therefore perjured, because that thou feloniously didst murder my father, *William* by name. So help me God, and the saints; and this I will prove against thee by my body, as this court shall award." The battel is then to be fought, with the same weapons, viz. batons, the same solemnity, and the same oath against amulets and sorcery, that are used in the civil combat: and if the appellee be so far vanquished that he cannot or will not fight any longer, he shall be adjudged to be hanged immediately; and then, as well as if he be killed in battel, Providence is deemed to have determined in favour of the truth, and his blood shall be attainted. But if he kills the appellant, or can maintain the fight from sunrising till the stars appear in the evening, he shall be acquitted. So also, if the appellant becomes recreant, and pronounces the horrible word *craven*, he shall lose his *liberam legem*, and become infamous; and the appellee shall recover his damages, and also be for ever quit, not only

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only of the appeal, but of all indictments likewise for the same offence.

BATTEN, a name that workmen give to a scantling of wooden stuff, from two to four inches broad, and about one inch thick; the length is pretty considerable, but undetermined.—This term is chiefly used in speaking of doors and windows of shops, &c. which are not framed of whole deal, &c. with stiles, rails, and pannels like wainscot; but are made to appear as if they were by means of these battens braded on the plain board round the edges, and sometimes cross them, and up and down.

BATTENBURG, a town of Dutch Guelderland, seated on the north bank of the Meuse, almost opposite to Ravenstein. E. Long. 5. 35. N. Lat. 50. 55.

BATTERING, the attacking a place, work, or the like, with heavy artillery.

To batter in breach, is to play furiously on a work, as the angle of a half-moon, in order to demolish and make a gape therein. In this they observe never to fire a piece at the top, but all at the bottom, from three to six feet from the ground.

The battery of a camp is usually surrounded with a trench, and pallisadoes at the bottom, with two redoubts on the wings, or certain places of arms, capable of covering the troops which are appointed for their defence. See BATTERY.

BATTERING-Ram, in antiquity, a military engine used to batter and beat down the walls of places besieged. It is said to have been invented by Artemanes of Clazomene, a Greek architect who flourished 441 B. C.—The machine is thus described by Josephus: It is a vast beam, like the mast of a ship, strengthened at the one end with a head of iron, something resembling that of a ram, whence it took its name. This was hung by the middle with ropes to another beam, which lay across two posts; and hanging thus equally balanced, it was by a great number of men drawn backwards and pushed forwards, striking the wall with its iron head. But this engine did most execution when it was mounted on wheels, which is said to have been first done at the siege of Byzantium under Philip of Macedon.

Plutarch informs us, that Mark Antony, in the Parthian war, made use of a ram fourscore feet long: and Vitruvius tells us, that they were sometimes 106, and sometimes 120, feet in length; and to this perhaps the force and strength of the engine was in a great measure owing. The ram was managed at one time by a whole century of soldiers; and they being spent, were seconded by another century, so that it played continually without any intermission.

Plate LXXXVIII. fig. 1. represents the battering-ram suspended. 2. The ram. 3. The form of its head, fastened to the enormous beam by three or four bands of iron, four feet in breadth. At the extremity of each of these bands (4) was a chain (5) of the same metal, one end of which was fastened to a hook (6), and at the other extremity of each of these chains was a cable firmly bound to the last link. These cables ran the whole length of the beam to the end of the ram (7), where they were all bound together as fast as possible with small ropes. To the end of these cables another was fixed, composed of several strong cords plaited together to a certain length, and then running single (8). At each of these several men were placed, to balance and work the machine. 10. The chain or cable by which it hung to the cross beam (11), fixed on the top of the frame. 12. The base of the machine.—The unsuspended ram differed from this only in the manner of working it: for instead of being slung by a chain or cable, it moved on small wheels on another large beam.

BATTERING-Rams, in *Heraldry*, a bearing or coat of arms resembling the military engine of the same name.

BATTERY, in the military art, a parapet thrown up to cover the gunners and men employed about the guns from the enemy's shot. This parapet is cut into embrasures, for the cannon to fire through. The height of the embrasures on the inside is about three feet; but they go sloping lower to the outside. Their wideness is two or three feet, but open to six or seven on the outside. The mass of earth that is betwixt two embrasures, is called the *merlon*. The platform of a battery is a floor of planks and sleepers, to keep the wheels of the guns from sinking into the earth; and is always made sloping towards the embrasures, both to hinder the reverse, and to facilitate the bringing back of the gun.

BATTERY of Mortars differs from a battery of guns; for it is sunk into the ground, and has no embrasures.

Cross-BATTERIES, are two batteries which play athwart one another upon the same object, forming there an angle, and beating with more violence and destruction; because what one bullet shakes, the other beats down.

BATTERY, Sunk or *Buried*, is when its platform is sunk or let down into the ground, so that there must be trenches cut in the earth, against the muzzles of the guns, for them to fire out at, and to serve for embrasures.

BATTERY d'Enfilade, is one that sweeps or scours the whole length of a straight line.

BATTERY en Echarpe is that which plays obliquely.

BATTERY de Reverse, that which plays upon the enemy's back.

Camerade BATTERY, is when several guns play at the same time upon one place.

BATTERY, in *Law*, is the unlawful beating of another. The least touching of another's person wilfully, or in anger, is a battery, for the law cannot draw the line between different degrees of violence, and therefore totally prohibits the first and lowest stage of it; every man's person being sacred, and no other having a right to meddle with it, in any the slightest manner. And therefore, upon a similar principle, the Cornelian law *de injuriis* prohibited *pulsation* as well as *verberation*; distinguishing verberation, which was accompanied with pain, from pulsation which was attended with none. But battery is in some cases justifiable or lawful; as where one who hath authority, a parent or master, gives moderate correction to his child, his scholar, or his apprentice. So also on the principle of self-defence: for if one strikes me first, or even only assaults me, I may strike in my own defence; and if sued for it, may plead *son assault demesne*, or that it was the plaintiff's own original assault that occasioned it. So likewise in defence of my goods or possession, if

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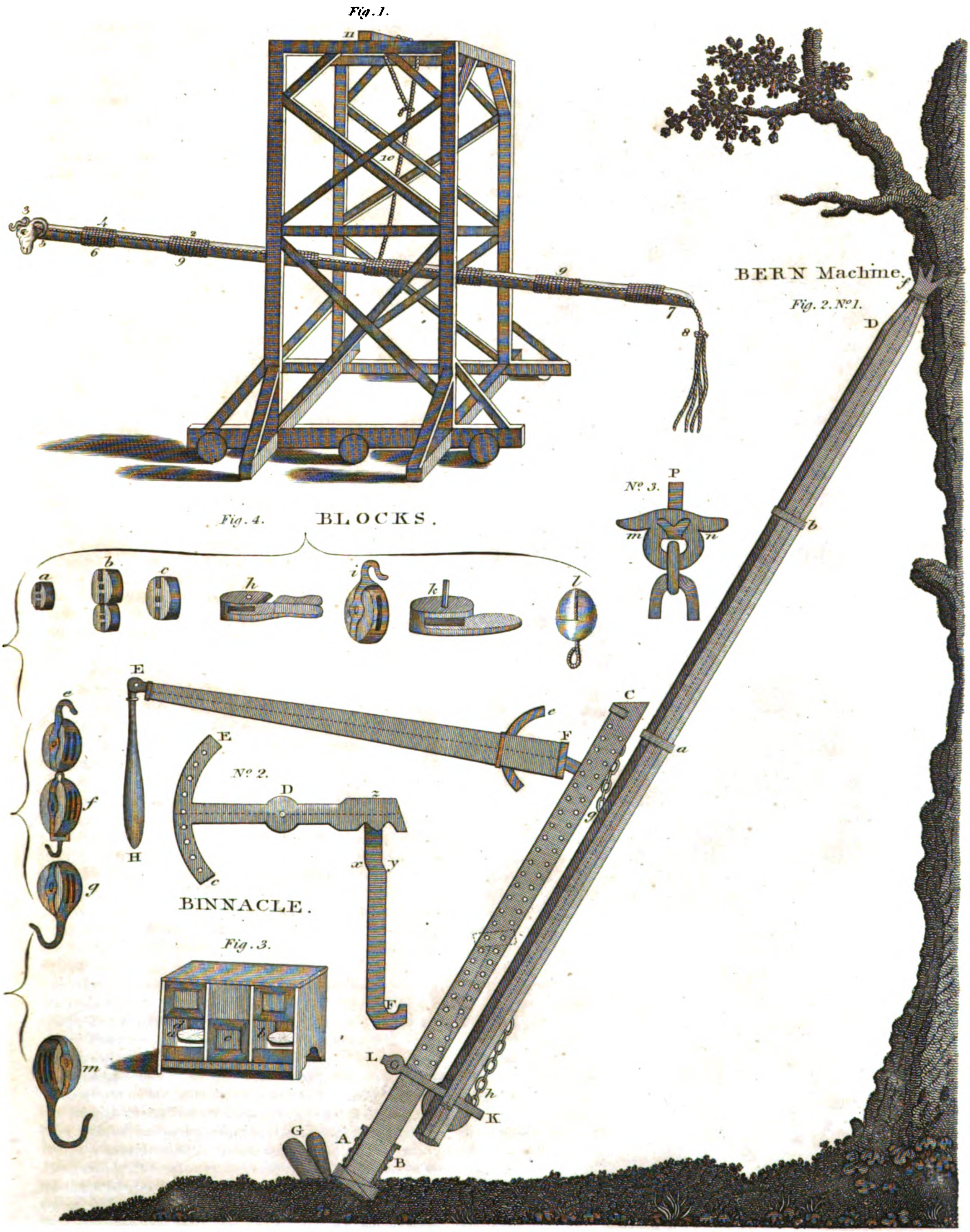

W. Tran Sculp.

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if a man endeavours to deprive me of them, I may justify laying hands upon him to prevent him; and in case he persists with violence, I may proceed to beat him away. Thus too in the exercise of an office, as that of church warden or beadle, a man may lay hands upon another to turn him out of church, and prevent his disturbing the congregation. And if sued for this or the like battery, he may set forth the whole case, and plead that he laid hands upon him gently, *molliter manus imposuit*, for this purpose. On account of these causes of justification, battery is defined to be the unlawful beating of another; for which the remedy is, as for assault, by action of *trespass vi et armis*: wherein the jury will give adequate damages.

BATTISTA, Franco, a celebrated painter, born at Venice, was one of the disciples of Michael Angelo, whose manner he followed so closely, that, in the correctness of his outlines, he surpassed most of the masters of his time. His paintings are pretty numerous, and dispersed all over Italy and other parts of Europe; but his colouring being very dry, they are not much more esteemed than the prints etched by his hand. He died in 1561.

BATTLE, a general engagement between two armies in a country sufficiently open for them to encounter in front and at the same time (see War). The word is also written *battel*, *battell*, and *battail*. It is formed from the French *battaille*, of the Latin verb *batuere*, to *fence* or *exercise with arms*: whence *batualia* and *batalia*, which properly denoted the action or exercise of those who learned to fence, and who were hence also denominated *batuatores*.

The ancients never joined battle without much ceremony and preparation; as taking auguries, offering sacrifice, haranguing the soldiers, giving the word or a *tessera*, &c. The signals of battle were, sounding the *classicum* or general charge, and displaying a peculiar flag, called by Plutarch a *purple robe*. To which may be added, singing pæans, raising military shouts, and the like. A Roman legion, ranged in order of battle, consisted of *hastati*, placed in the front; of *principes*, who were all old experienced soldiers, placed behind the former; and of *triarii*, heavy armed with large bucklers, behind the *principes*. The *hastati* were ranked close; the ranks of the *principes* were much opener, so that they could receive the *hastati;* and those of the *triarii* opener still, insomuch that they could receive both the *principes* and the *hastati* within them, without any disorder, and still facing the enemy. When therefore the *hastati* found themselves unable to stand the enemy's charge, they retired gently within the *principes*, where joining with them they renewed the combat. If these found themselves too weak to sustain the enemy, both retired among the *triarii*, where rallying, they formed a new corps, and charged with more vigour than ever. If these failed, the battle was lost: the Romans had no farther resource. The moderns are unacquainted with this method of inserting or embattling one company into another; without which the former cannot be well succoured or defended, and their places taken by others; which was a thing the Romans practised with great exactness. For the *velites*, and in latter times the archers and slingers, were not drawn up in this regular manner, but either disposed of before the front of the *hastati*, or scattered up and down among the void spaces of the *hastati*, or sometimes placed in two bodies in the wings. These always began the combat, skirmishing in flying parties with the foremost troops of the enemy. If they were repulsed, which was usually the case, they fell back to the flanks of the army, or retired again in the rear. When they retired, the *hastati* advanced to the charge. As to the cavalry, it was posted at the two corners of the army, like the wings on a body; and fought sometimes on foot, sometimes on horseback. The auxiliary forces composed the two points of the battle, and covered the whole body of the Romans.—Other less usual forms of battle among the Romans were the *cuneus*, or wedge; *globus*, or round form; *forfex*, or pair of sheers; *turris*, or an oblong square figure; *serra*, or saw. The Greeks were inferior to the Romans in marshalling their armies for battle, as they drew up their whole army in a front, and trusted the success of the day to a single force. They had three forms of battle for the horse, viz. the square, the wedge, and the rhombus or diamond form. The first held best for the defensive; the latter for the offensive; the wedge being preferred as bringing most hands to fight.

The Greeks notified the places of their battles and victories by adding the word Νικη; whence Nicomedia Nicopolis, Thessalonica, &c. The ancient Britons did the like, by adding the word *mais;* whence Maisseveth, Malmaisbury, &c. The English by the word *field*.—The Romans had their particular days, called *præliares dies*, in which alone it was lawful to join battle, and others wherein it was unlawful, called *dies atri*. The Athenians, by the ancient laws of their country, were not to draw out their forces for battle till after the seventh day of the month: And Lucian relates of the Lacedæmonians, that by the laws of Lycurgus, they were not to fight before full moon. Among the Germans, it was reputed an impiety to fight in the wane of the moon; and Cæsar tells us, that Ariovistus was beaten by him, because, contrary to the laws of his country, he had fought when the moon was in her wane. The German soldiers were intimidated with the apprehension, and afforded Cæsar an easy victory; *acie commissa, impeditos religione hostes vicit*. It is well known that Jerusalem was taken by Pompey in an attack on the Sabbath-day, when by the Jewish superstitious notions, they were not allowed to fight, or even to defend themselves. The Romans did not carry their superstition so far: their *atri dies* were only observed in respect of attacking; no day was too holy for them to defend themselves in. Among the ancients, we find frequent instances of battles in the night; it was by the moonlight that Pompey beat Mithridates, and Scipio Asdrubal and Syphax.

The first pitched battle, of which we have any distinct account is, that between Crœsus and Cyrus, described by Xenophon, concerning which we have a dissertation expressly by M. Freret, wherein several points of the ancient tactics are well explained. In the modern war, we find few pitched or set battles; the chief view of the great commanders of late days is rather to harass or starve the enemy by frequent alarms, cutting off his provisions, carrying off his baggage, seizing his posts, &c. than to join issue with him, and put the whole on the event of one day; a battle generally deciding the fate of a campaign, sometimes of a whole war. Hence it is a rule never to venture a general

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neral battle, unless either you fight to advantage, or be forced to it. Joining or giving battle should always be by design: a general should never suffer himself to be forced to fight. All the measures, movements, encampments, he makes, are to lead to the execution of his great design, which is to fight to advantage, till by some mistake of the enemy, he at length find the favourable opportunity. It is in this that a superior genius will at length prevail over an inferior: in the course of a campaign, he will take a number of advantages over him, which together are equivalent to a battle, the event of which is ever doubtful.

Battle-Axe, an ancient military weapon. Axes were a principal part of the offensive armour of the Celtæ. At the siege of the Roman Capitol by the Gauls under Brennus, we find one of the most distinguished of their warriors armed with a battle-axe. And Ammianus Marcellinus, many centuries afterwards, describing a body of Gauls, furnishes them all with battle-axes and swords. Some of these weapons have been found in the sepulchres of the Britons, on the downs of Wiltshire, and in the north of Scotland. Within these four or five centuries the Irish went constantly armed with an axe. At the battle of Bannockburn, King Robert Bruce clave an English champion down to the chine, at one blow, with a battle-axe. The axe of Lochaber hath remained a formidable implement of destruction in the hands of our Highlanders, even nearly to the present period; and it is still used by the city-guard of Edinburgh in quelling mobs, &c.

BATTLEMENTS, in *Architecture*, are indentures or notches in the top of a wall or other building, in the form of embrasures, for the sake of looking through them.

BATTOLOGY, in *Grammar*, a superfluous repetition of some words or things.

BATTON, in merchandise, a name given to certain pieces of wood or deal for flooring or other purposes.

BATTORY, a name given by the Hans Towns to their magazines or factories abroad. The chief of these Battories are those at Archangel, Novogorod, Berghmen, Lisbon, Venice, and Antwerp.

BATUA, Butua, *Buthoe*, or *Buthoece*, in *Ancient Geography*, a town of Dalmatia, situated on the Adriatic; now *Budoa*; which see.

BATTUS, an order of penitents at Avignon and in Provence, whose piety carries them to exercise severe discipline upon themselves both in public and private.

BATZ, a copper coin mixed with some silver, and current at different rates, according to the alloy in Nuremberg, Basil, Fribourg, Lucerne, and other cities of Germany and Switzerland.

BAVARIA, formerly a duchy and electorate, but now a kingdom of Germany. Bavaria has experienced a great variety of changes within the last twenty years. She received a considerable accession of territory at the settling of the German indemnities in 1802, consisting of the bishoprics of Freysingen, Bamberg, Augsburg, and Kempten, ten abbeys, fifteen imperial towns, and some other small districts, which were given as an equivalent for the palatinate of the Rhine, the duchies of Juliers, and Deux Ponts, and other possessions in the Netherlands. He assumed at the same time the title of duke of Franconia. The duke having still adhered to the French, Bonaparte raised him in 1806 to the kingly dignity, and on this occasion, and afterwards at the peace in 1809, enlarged his dominions at the expence of Austria. When the fortune of the war changed in 1813, Bavaria, like others of the small powers, endeavoured to secure the advantages he had gained by entering into terms with the stronger party; and at the peace of Paris in 1814 he was allowed to keep the greater part of his new acquisitions, restoring to Austria Saltzburg and Bertholsgaden, with the parts of the Tirol and of the Hansruck formerly ceded to him. He obtained then also the greater part of what was formerly denominated the palatinate of the Rhine, with the grand duchy of Wurtsburg. The whole kingdom of Bavaria at present embraces an area of 30,000 square English miles, and had a population of 3,560,000 in 1818. The revenue of Bavaria in the same year was estimated at 1,900,000l. sterling; and the contingent of troops which it is bound to furnish to the German confederation is 35,600. About one-fourth or one-fifth of the inhabitants are Lutherans, the rest Catholics, with a small number of Calvinists and Jews. The Catholics were formerly distinguished by their bigotry and intolerance; but a great reformation has taken place in this and many other points since the present king ascended the throne. The greatest proportion of the numerous monasteries have been suppressed, and a part of the funds employed in endowing schools and academies. To crown these advantages, the king gave the nation a representative constitution in 1818; and Bavaria, which was lately the stronghold of ignorance and superstition, now bids fair to outstrip all her neighbours in the career of improvement. Munich is the capital. The country is fertile, but mountainous, and has mines of salt, coal, iron, and lead. Its vegetable productions are extremely various, and include chesnuts, Indian corn, and vines. Vast numbers of cattle are raised in the southern parts, and in the north there are considerable manufactures.

The house of Bavaria is universally allowed to be one of the most ancient in Germany. The counts of Scheyren, whose castle at present is a cloister, gave them the name. At that place are shown the tombs of more than 26 lords of Scheyren. The emperor Otho I. established as counts-palatine of Bavaria and landgraves of Scheyren, Arnolph and Herman, sons of Arnolph brother to the duke of Berchtold of Carinthia, marquis of the county upon the Ens. After the death of Berchtold, the same emperor, instead of giving Bavaria to his son, gave it to Duke Henry his brother, who had married Judith sister to Arnolph and Herman. This Duke Henry of Bavaria had by his marriage Henry Hezillon, who was succeeded by his son Henry, afterwards chosen emperor by the name of Henry II. This emperor having no children by Saint Conegond his wife, Bavaria passed again to the family of Franconia, and afterwards to that of Suabia under Henry IV. who possessed it till the year 1071, when this last emperor gave that county to Count Wolf, or Guelph, of Ravensburg in Suabia. To this Guelph, who died in the island of Cyprus, succeeded Guelph II. and to him his brother Duke Henry IX. who was succeeded by his son Henry the Proud. This last had married the only daughter of the emperor Lotharius, and after the death of his father-in-law became also duke of Saxony; but refusing to deliver up the imperial ornaments of his father-in-law to the emperor Conrad III. duke of Suabia,

bia, or to acknowledge him for emperor, he was put to the ban of the empire, and lost his states. After the death of Henry, Conrad made his brother Leopold marquis of Austria and duke of Bavaria; who, dying without issue, was succeeded by his brother Henry XI. whom the emperor Frederic I. made duke of Austria, joining together the two counties above and below the Ens, and declaring them free and independent of the government of Bavaria. The same emperor gave Bavaria thus dismembered, with Saxony, to Henry the Lion, son of Henry the Proud. But Henry the Lion afterwards losing the favour of this emperor, was put to the ban of the empire: and lost all his possessions except Brunswick and Lunenburg, which still remain to his descendants. In 1180, the duchy of Bavaria was given by the emperor to Otho the landgrave of Wittelsbach, count-palatine of the house of Bavaria. In the time of this Otho, the castle of Scheyren was changed into a monastery, in which the duke was buried. From him are descended the two great families that remain to this day in Germany; viz. the counts-palatine of the Rhine, and the electors, now kings of Bavaria. Prince Eugene Beauharnois, stepson to Bonaparte, is married to a princess of this family. See Bavaria, Supplement.

BAVAY, a small town of the late province of Hainault, now the department of the North, in France, which has been often ruined by the wars of the Low Countries. It was taken by the Austrians in 1792, but retaken the same year. E. Long. 3. 45. N. Lat. 50. 25.

BAUCIS, in fabulous history, an old woman who lived with Philemon her husband in a cottage in Phrygia. Jupiter and Mercury travelling over that country, were well received by them, after having been refused entertainment by every body else. To punish the people for their inhumanity, these gods laid the country waste with water; but took Baucis and Philemon with them to the top of a mountain, where they saw the deluge, and their own little hut above the waters turned into a temple. Having a wish granted them, they desired to officiate in this temple as priest and priestess, and also that they might die both together; which was granted them.

BAUCONICA, in *Ancient Geography*, a town of the Vangiones in Gallia Belgica; nine miles from Mogontiacum, and eleven from Borbitomagum; and therefore supposed to be *Oppenheim*, a town in the palatinate of the Rhine, and situated on that river.

BAUDELOT, Charles Cæsar, a learned advocate in the parliament of Paris, distinguished himself by his skill in ancient monuments, and was received into the Academy of Belles Lettres in 1705. He wrote a Treatise on the Advantages of Travelling; many Letters and Dissertations on Medals, &c.; and died in 1722, aged 74.

BAUDIER, Michael, a gentleman of Languedoc, lived in the reign of Louis XIII. and published several books, which procured him the character of a copious and laborious author; among which are, 1. An Inventory of the General History of the Turks. 2. The History of the Seraglio. 3. That of the Religion of the Turks. 4. That of the Court of the King of China. 5. The Life of Cardinal Ximenes, &c.

BAUDIUS, Dominic, professor of history in the university of Leyden, born at Lisle the 8th of August 1561. He began his studies at Aix-la-Chapelle, and continued them at Leyden. He removed from thence to Geneva, where he studied divinity. After residing here some time, he returned to Ghent, and from thence to Leyden, where he applied to the civil law, and was admitted doctor of law in June 1585. Soon after his admission, he accompanied the ambassadors from the States to England; and during his residence here became acquainted with several persons of distinction, particularly the famous Sir Philip Sidney. He was admitted advocate at the Hague the 5th of January 1587; but being soon tired of the bar, went to travel in France, where he remained 10 years. He was much esteemed in that kingdom, and gained many friends there. Achilles de Harlai, first president of the parliament of Paris, got him to be admitted advocate of the parliament of Paris in the year 1592. In 1602, he went to England with Christopher de Harlai, the president's son, who was sent ambassador to the court of London by Henry the Great. This same year Baudius having been named professor of eloquence at Leyden, went and settled in that university. He read lectures on history after the death of Morula, and was permitted also to do the same on the civil law. In 1611, the States conferred upon him the office of historiographer in conjunction with Meursius; and in consequence thereof he wrote The History of the Truce. Baudius is an elegant prose writer, as appears from his letters, many of which were published after his death. He was also an excellent Latin poet. The first edition of his poems was printed in the year 1587: they consist of verses of all the different measures. He published separately a book of iambics in 1591, dedicated to Cardinal Bourbon. Some of his poems he dedicated to the king of England; others to the prince of Wales, in the edition of 1607, and went over to England to present them. He died at Leyden in 1613.

BAUDOBRIGA, in *Ancient Geography*, a town of the Treviri in Germany; now *Boppart*, in the electorate of Triers. See Boppart.

BAUDRAND, Michael Anthony, a celebrated geographer, born at Paris July 18. 1633. He travelled into several countries; and then applied himself to the revisal of Ferrarius's Geographical Dictionary, which he enlarged by one half. He wrote, 1. Notes to Papirius Masso's description of the Rivers of France. 2. A Geographical and Historical Dictionary. 3. Christian Geography, or an Account of the Archbishoprics and Bishoprics of the whole world; and made several maps. He died at Paris, May 29. 1700.

BAUGE, a drugget manufactured in Burgundy, with thread spun thick and coarse wool.

Bauge, a small town of Anjou, in France, in the department of Maine and Loire, seated on the river Coesnon. E. Long. 0. 10. N. Lat. 47. 30.

BAUHIN, John, a distinguished botanist, was born at Lyons in the year 1541. He was the son of an eminent physician who quitted France, his native country, on account of religion, and settled at Basil. In early life he travelled with Gesner, the celebrated naturalist, and collected plants in the Alps, in France, and Italy, for the purpose of the great botanical work which he afterwards accomplished. He practised medicine first at Basil, where he was also elected profes-

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Bauhin.

sor of rhetoric in 1566. He resided some time at Yverdun; and was afterwards invited to be physician to the duke of Wirtemberg at Montbelliard, and in this situation he spent the remaining forty years of his life. He devoted his studies chiefly to botany, on which he bestowed great labour, comparing authors ancient and modern with each other, and with nature, and collecting information from all quarters. He likewise prosecuted other branches of natural history, and published an account of "Medicinal Waters throughout Europe," and especially in the duchy of Wirtemberg; and a particular account of the mineral spring of Boll, and the natural history of the place. His great work on plants was not completed at his death, which happened in 1613. A society at Yverdun published in 1619 the *Prodromus* of it; but it was not till 1650 and 1651 that the work itself appeared in three vols. fol. entitled *Historia Plantarum nova et absolutissima, cum auctorum consensu et dissensu circa eas.* Bauhin's son-in-law, Henry Cherler, was also a contributor to the work. This is a great performance; and, with all its defects, has been pronounced by Haller to be without an equal. The plants are numerous, generally well described and discriminated, and many new species are added. It is still considered as a standard work; and the names of John Bauhin and his brother rank high among the founders and first promoters of botanical science.

Bauhin, *Gaspard*, brother of the former, was born in 1560. He was early devoted to physic, and pursued his studies at Padua, Montpellier, and some of the celebrated schools in Germany. In his journeys he collected a number of plants which had escaped his brother's notice. Returning to Basil in 1580, he was admitted to the degree of doctor, and gave private lectures in botany and anatomy. In 1582 he was appointed to the Greek professorship in that university, and in 1588, to the anatomical and botanical chairs. He was at last made city physician, professor of the practice of medicine, rector of the university, and dean of his faculty. Thus distinguished and honoured, he acquired great reputation. He became eminent as a botanist, and was aided in his researches by the contributions of his disciples and friends in various parts of Europe. Haller gives him the character of being assiduous and laborious in collecting plants, by which he surpassed his brother in the number of them, and also in the accuracy of his figures; but he possesses less acuteness of judgment in distinguishing varieties, and detecting the same species under different names. He published several works relative to botany, of which the most valuable is his *Pinax Theatri Botanici, seu index in Theophrasti, Dioscoridis, Plinii, et botanicorum qui a seculo scripserunt opera, plantarum fere sex millium nomina, cum synonymiis et differentiis. Opus* XIV. *annorum*, 4to. The confusion that began to arise at this time from the number of botanical writers who described the same plant under different names, rendered such a task as this highly necessary; and though there are many defects in the execution, the *Pinax* of Bauhin is still a useful key to all writers before his time. Another great work which he planned was a *Theatrum Botanicum*, meant to comprise twelve parts, folio, of which he finished three, but only one was published. He also gave a very copious catalogue of the plants growing in the environs of Basil; and he edited the works of Mathiolus, with considerable additions.

Bauhin | Bausk.

Gaspard also wrote on anatomy, which he studied under Hieronymus ab Aquapendente, and pursued with vigour during his youth. The principal is *Theatrum Anatomicum infinitis locis auctum*, 4to. Frankf. 1621; which is a kind of pinax of anatomical facts and opinions. He also published a collection of anatomical plates. He died in 1613.

BAUHINIA, Mountain Ebony. See Botany *Index*.

BAVINS, in *War*, brush faggots, made with the brush at length. See Fascines; and Fire-ship, note (d).

BAUM, in *Botany*. See Melissa, Botany *Index*.

BAUME', Anthony, a French chemist. See Supplement.

Baume, *St*, a mountain of Provence in France, between Marseilles and Toulon. Here Mary Magdalen is said to have died.

Baume-les-Nomes, a town in France, in the department of Doubs, which had a rich nunnery, from whence it takes its name, seated on the river Doux, in E. Long. 6. 20. N. Lat. 47. 12. Five miles from this town is a remarkable cavern, whose entrance is 20 paces wide; and after descending 300 paces, the gate of a grotto is seen, twice as large as that of a city. The grotto is 35 paces deep, 60 wide, and is covered with a kind of vaulted roof, from which water continually drops. There is also a small brook, said to be frozen in summer, but not in winter; and at the bottom are stones that exactly resemble candied citron peel. When the peasants perceive a mist rising out of this cave, they affirm that it will certainly rain the next day.

BAUMEN, or Bauman, a cave of Lower Saxony, in Germany, about a mile from Wermigerode, and 18 from Goslar. The entrance is through a rock; and so narrow, that not above one person can pass at a time. There are several paths in it, which the peasants have turned up, in searching for the bones of animals which they sell for unicorn's horns. Some think this cave reaches as far as Goslar; but be this as it will the skeletons of men have been found in it, who are supposed to have been lost in the turnings and windings.

BAUR, William, an eminent Flemish painter, was born at Strasburg, and was the disciple of Brendel. He was some time at Rome, where his studies were wholly employed about architecture and landscapes, which prevented his studying the antique. He painted small figures in distemper on vellum. He etched with great spirit. His largest works are in the historical way. He has given us many of the sieges, and battles, which wasted Flanders in the 16th century. They may be exact, and probably they are: but they are rather plans than pictures; and have little to recommend them but historic truth, and the freedom of the execution. His best prints are some characters he has given us of different nations, in which the peculiarities of each are very well preserved. His Ovid is a poor performance. He died at Vienna in 1640.

BAUSK or Bautko, a small but important town in the duchy of Courland, on the frontiers of Poland, with a strong castle built on a rock. It was taken by the Swedes in 1625, and by the Russians in 1705, af-

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ter a bloody battle between them and the Swedes. It is situated on the river Musa, in E. Long. 24. 44. N. Lat. 56. 30.

BAUTRY, or BAWTRY, a town in the west riding of Yorkshire, on the road from London to York. It has long been noted for millstones and grindstones brought hither by the river Idle, on which it is seated. W. Long. 1. 0. N. Lat. 53. 27.

BAUTZEN, or BUDISSEN, a considerable town of Germany, and capital of Upper Lusatia, subject to the king of Saxony, with a strong citadel. Near this place a bloody battle was fought between the French and the allies in June 1813, in which the latter were defeated. E. Long. 14. 42. N. Lat. 51. 10.

BAUX, a town of Provence in France, now the department of the Mouths of the Rhone, with the title of a marquisate, seated on a rock, at the top of which is a strong castle. E. Long. 5. 0. N. Lat. 43. 42.

BAWD, a person who keeps a place of prostitution, or makes a trade of debauching women, and procuring or conducting of criminal intrigues. Some think the word is derived from the old French *Baude*, bold or impudent; though Verstegan has a conjecture which would carry it higher, viz. from *bathe* anciently written *bade*. In which sense *bawd* originally imported no more than bath-holder, as if bagnios had anciently been the chief scenes of such prostitution.

The Romans had their male as well as female bawds; the former denominated *lenones* and *proagogi*, among us *panders;* the latter, *lenæ*. Donatus, speaking of the habits of the ancient characters in comedy, says, *Leno paliis varii coloris utitur*. But the ancient *lenones*, it is to be observed, furnished boys as well as girls for venereal service. Another sort of these merchants or dealers in human flesh, were called *mangones*, by the Greeks ανδρoκαπηλοι, who sold eunuchs, slaves, &c. By a law of Constantine, bawds were to be punished by pouring melted lead down their throats. See the next article.

BAWDY-House, a house of ill fame, to which lewd persons of both sexes resort, and there have criminal conversation.

The keeping a bawdy-house is a common nuisance, not only on account that it endangers the public peace by drawing together debauched and idle persons, and promoting quarrels, but likewise for its tendency to corrupt the manners of the people. And therefore persons convicted of keeping bawdy-houses, are punishable by fine and imprisonment; also liable to stand in the pillory, and to such other punishment as the court at their discretion shall inflict. Persons resorting to a bawdy-house are likewise punishable, and they may be bound to their good behaviour.—It was always held infamous to keep a bawdy-house: yet some of our historians mention bawdy-houses publicly allowed here in former times till the reign of Henry VIII. and assign the number to be 18 thus allowed on the bank-side in Southwark. See STEWS and BROTHEL.

Bawdy-houses are licensed in Holland, and pay a considerable tax to the state.

BAWLING, among sportsmen, is spoke of the dogs, when they are too busy before they find the scent good.

BAXTER, RICHARD, an eminent divine among the Nonconformists, was born at Rowton in Shropshire, November 12. 1615; and distinguished himself by his exemplary life, his pacific and moderate principles, and his numerous writings. He was remarkable for his piety even when he was very young. Upon the opening of the long parliament, he was chosen vicar of Kidderminster. In the heat of the civil wars he withdrew from that town to Coventry, and preached to the garrison and inhabitants. When Oliver Cromwell was made protector, he would by no means comply with his measures, though he preached once before him. He came to London just before the deposing of Richard Cromwell, and preached before the parliament the day before they voted the return of King Charles II. who upon his restoration appointed him one of his chaplains in ordinary. He assisted at the conference in the Savoy, as one of the commissioners for stating the fundamentals in religion, and then drew up a reformed liturgy. He was offered the bishoprick of Hereford; which he refused; affecting no higher preferment than the liberty of continuing minister of Kidderminster; which he could not obtain, for he was not permitted to preach there above twice or thrice after the Restoration. Whereupon he returned to London, and preached occasionally about the city, till the act of uniformity took place. In 1662, Mr Baxter was married to Margaret Charleton, daughter to Francis Charleton, Esq. of the county of Salop, who was esteemed one of the best justices of the peace in that county. She was a woman of great piety, and entered thoroughly into her husband's views concerning religion. During the plague in 1665 he retired into Buckinghamshire; but afterwards returned to Acton, where he staid till the act against conventicles expired; and then his audience was so large that he wanted room. Upon this he was committed to prison; but procuring a habeas corpus, he was discharged. After the indulgence in 1672, he returned to London; and in 1682 he was seized for coming within five miles of a corporation. In 1684 he was seized again; and in the reign of King James II. was committed prisoner to the King's Bench, and tried before the lord chief justice Jefferies for his Paraphrase on the New Testament, which was called a *scandalous* and *seditious* book against the government. He continued in prison two years; from whence he was at last discharged, and had his fine remitted by the king. He died December the 8th 1691; and was buried in Christ-church.

Mr Sylvester says, that Mr Baxter's "person was tall and slender, and stooped much: his countenance composed and grave, somewhat inclining to smile. He had a piercing eye, a very articulate speech, and deportment rather plain than complimental." There is an original portrait of him at Dr Williams's library, founded for the use of Protestant Dissenting Ministers, in Red-cross street. Mr Sylvester also says, that "he had a great command over his thoughts. He had that happy faculty, so as to answer the character that was given of him by a learned man dissenting from him, after discourse with him; which was that *he could say what he would, and he could prove what he said*. He was most intent upon the necessary things. Rational learning he most valued, and was a very extraordinary master of. And as to his expressive faculty, he spake

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Baxter. properly, plainly, pertinently, and pathetically. He could speak suitably, both to men's capacities and to the things insisted on. He was a person wonderful at extemporate preaching." But his common practice appears to have been to preach with notes; though he said, "That he thought it very needful for a minister to have a body of divinity in his head." He was honoured with the friendship of some of the greatest and best men in the kingdom (as the earl of Lauderdale, the earl of Balcarras, Lord Chief Justice Hales, Dr Tillotson, &c.); and held correspondence with some of the most eminent foreign divines.—He wrote above 120 books, and had above 60 written against him. The former, however, it should seem, were greatly preferable to the latter; since Dr Barrow, an excellent judge, says, that "his practical writings were never mended, his controversial seldom confuted."

Mr Granger's character of him is too striking to be omitted. "Richard Baxter was a man famous for weakness of body and strength of mind; for having the strongest sense of religion himself, and exciting a sense of it in the thoughtless and profligate: for preaching more sermons, engaging in more controversies, and writing more books, than any other Nonconformist of his age. He spoke, disputed, and wrote with ease; and discovered the same intrepedity when he reproved Cromwell and expostulated with Charles II. as when he preached to a congregation of mechanics. His zeal for religion was extraordinary; but it seems never to have prompted him to faction, or carried him to enthusiasm. This champion of the Presbyterians was the common butt of men of every other religion, and of those who were of no religion at all. But this had very little effect upon him: his presence and his firmness of mind on no occasion forsook him. He was just the same man before he went into a prison, while he was in it, and when he came out of it; and he maintained an uniformity of character to the last gasp of his life. His enemies have placed him in hell; but every man who has not ten times the bigotry that Mr Baxter himself had, must conclude that he is in a better place. This is a very faint and imperfect sketch of Mr Baxter's character: men of his size are not to be drawn in miniature. His portrait, in full proportion, is in his *Narrative of his own Life and Times;* which though a rhapsody, composed in the manner of a diary, contains a great variety of memorable things, and is itself, as far as it goes, a History of Nonconformity."—Among his most famous works were, 1. The Saints Everlasting Rest. 2. Call to the Unconverted, of which 20,000 were sold in one year; and it was translated not only into all the European languages, but into the Indian tongue. 3. Poor Man's Family Book. 4. Dying Thoughts; and, 5. A Paraphrase on the New Testament. His practical works have been printed in four volumes folio.

Baxter, *William*, nephew and heir to the former, was an eminent schoolmaster and critic. He was born at Lanlugany in Shropshire, in the year 1650; and it is remarkable, that at the age of 18, when he first went to school, he knew not one letter nor understood one word of any language but Welsh; but he so well improved his time, that he became a person of great and extensive knowledge. His genius led him chiefly to the study of antiquities and philology, in which he composed several books. The first he published was a Grammar, in 1679, entitled *De Analogia seu Arte Latinæ Linguæ Commentariolus.* He also published a new and correct edition of Anacreon, with notes; an edition of Horace; a Dictionary of the British antiquities, in Latin: and several other books. He was a great master of the ancient British and Irish tongues, was particularly skilled in the Latin and Greek, and in the northern and eastern languages. He died May 31. 1723, after being above 20 years master of Mercer's School in London.

Baxter, *Andrew*, a very ingenious metaphysical writer, was born in 1686 or 1687, at Old Aberdeen (where his father was a merchant), and educated in King's College there. His principal employment was that of a private tutor to young gentlemen; and among others of his pupils were Lord Gray, Lord Blantyre, and Mr Hay of Drummelzier. About 1724 he married the daughter of a clergyman in the shire of Berwick. A few years after he published in 4to, "An Inquiry into the Nature of the Human Soul, wherein its immateriality is evinced from the principles of reason and philosophy;" without date. In 1741 he went abroad with Mr Hay, and resided some years at Utrecht; having there also Lord Blantyre under his care. He made excursions from thence into Flanders, France, and Germany; his wife and family residing, in the mean time, chiefly at Berwick-upon-Tweed. He returned to Scotland in 1747, and resided till his death at Whittingham, in the shire of East Lothian. He drew up, for the use of his pupils and his son, a piece entitled *Matho; sive, Cosmotheoria puerilis, Dialogus. In quo prima elementa de mundi ordine et ornatu proponuntur, &c.* This was afterwards greatly enlarged, and published in English, in two volumes 8vo. In 1750 was published, "An Appendix to his Inquiry into the Nature of the Human Soul:" wherein he endeavours to remove some difficulties which had been started against his notions of the *vis inertiæ* of matter, by Maclaurin, in his "Account of Sir Isaac Newton's Philosophical Discoveries." To this piece Mr Baxter prefixed a dedication to Mr John Wilkes, with whom he had commenced an acquaintance abroad. He died April the 23d, 1750, after suffering for some months under a complication of disorders, of which the gout was the chief. He left a wife, three daughters, and one son, Mr Alexander Baxter; from which last the authors of Biographia Britannica received, as they inform us, sundry particulars of his life.

His learning and abilities are sufficiently displayed in his writings. He was extremely studious, and sometimes sat up whole nights in reading and writing. His temper at the same time was very cheerful, and he was a friend to innocent merriment. It is said of Mr Baxter, that he entered with much good humour into the conversation and pleasures of young people, when they were of an innocent nature: and that he presided, all the time of his abode at Utrecht, at the ordinary which was frequented by all the young English gentlemen there, with much gaiety and politeness, and in such a manner as gave universal satisfaction. He also frequented the most polite assemblies in that city, and his company and conversation were particularly acceptable to the ladies. So that Mr Baxter appears to have studied the graces, though without neglecting

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neglecting more valuable acquisitions and accomplishments. He was at once the scholar and the gentleman. In conversation he was modest, and not apt to make much show of the extensive knowledge of which he was possessed. In the discharge of the several social and relative duties of life, his conduct was exemplary. He had the most reverential sentiments of the Deity, of whose presence and immediate support he had always a strong impression upon his mind; and the general tenor of his life appears to have been conformable to the rules of virtue. Mr Baxter paid a strict attention to economy, though he dressed elegantly, and was not parsimonious in his other expences. It is known also that there were several occasions on which he acted with remarkable disinterestedness; and so far was he from courting preferment, that he has repeatedly declined considerable offers of that kind which were made him, if he would have taken orders in the church of England. The French, German, and Dutch languages were spoken by him with much ease, and the Italian tolerably; and he wrote and read them all, together with the Spanish. His friends and correspondents were numerous and respectable; and among them are particularly mentioned Mr Pointz, preceptor to the late duke of Cumberland, and Dr Warburton, bishop of Gloucester. He was a man also of great benevolence and candour; which appears most strikingly from this, inasmuch as though Mr Wilkes had made himself so very obnoxious to the Scottish nation in general, yet Mr Baxter kept up with him an affectionate correspondence to the last, even after he was unable to write with his own hand. He left many manuscripts behind him; he would gladly have finished his work upon the human soul: "I own," says he, in a letter to Mr Wilkes, "if it had been the will of heaven, I would gladly have lived till I had put in order the second part of the Enquiry, showing the immortality of the human soul; but Infinite Wisdom cannot be mistaken in calling me sooner. Our blindness makes us form wishes." It was indeed, what he considered it, his capital work: a second edition of it was published in two volumes 8vo in 1737, and a third in 1745. In another letter, speaking of his endeavours to establish the particular providence of the Deity, and to show his incessant influence and action on all the parts of matter, through the wide universe, from the inactivity of this dead substance; expresses his hope, that when the present party-zeal subsides a little, men will come more easily in to own such a plain truth." "His prediction," the editors of the Biographia Britannica observe, "hath not yet been accomplished. Several eminent names seem rather disposed to increase than to lessen the powers of matter; and they have expressly maintained that the soul of man is material. However, other names equally eminent have asserted the essential distinction between the mind and the body. Perhaps, in the revolutions of opinion, the doctrine of immateriality may again obtain the general suffrage of metaphysical and philosophical inquiry."

BAY, in *Geography*, an arm of the sea shooting up into the land, and terminating in a nook. It is a kind of lesser gulf bigger than a creek, and is larger in its middle within than at its entrance. The largest and most noted bays in the world are those of Biscay, Bengal, Hudson's, Panama, &c.

BAY denotes likewise a pond-head made to keep in store of water for driving the wheels of the furnace or hammer belonging to an iron mill, by the stream that comes thence through a flood-gate called the *pen-stock*.

BAY-Colour denotes a sort of red inclining to chesnut, chiefly used in speaking of horses. In this sense, the word *bay* is formed from the Latin *baius*, or *badius*, and that from the Greek *βαϊς*, a *palm branch;* so that *badius* or *bay* properly denotes *color phœniceus*. Hence also, among the ancients, those now called *bay* horses, were denominated *equi palmati*. We have divers sorts and degrees of bays; as a light bay, a dapple bay, &c. All bay horses are said to have black manes; which distinguishes them from sorrels, which have red or white manes.

BAY, among huntsmen, is when the dogs have earthed a vermin, or brought a deer, boar, or the like, to turn head against them. In this case, not only the deer, but the dogs, are said to bay. It is dangerous going in to a hart at bay, especially at rutting-time; for then they are fiercest. There are bays at land, and others in the water.

BAY-Tree. See LAURUS, BOTANY *Index.*

BAY-Salt. See SALT.

BAYA, or BAJA, a town of Lower Hungary, in the county of Bath, situated near the Danube. E. Long. 19. 30. N. Lat. 46. 25.

BAYARD, PETER DU TERRAIL DE, esteeemed by his cotemporaries the model of soldiers and men of honour, and denominated *The knight without fear and without reproach*, was descended from an ancient and noble family in Dauphiné. He was with Charles VIII. at the conquest of the kingdom of Naples; where he gave remarkable proofs of his valour, especially at the battle of Fornoue. He was dangerously wounded at the taking of the city of Brescia: and there restored to the daughters of his host 2000 pistoles, which their mother had directed them to give him in order to prevent the house from being plundered; an action that has been celebrated by many historians. At his return to France, he was made lieutenant-general of Dauphiné. He fought by the side of Francis I. at the battle of Marignan; and that prince afterwards insisted on being knighted by his hand, after the manner of the ancient knights. The chevalier Bayard defended Meziers during six weeks, against Charles V.'s army. In 1524, at the retreat of Rebec * (the general Bonivet having been wounded and obliged to quit the field), the conduct of the rear was committed to the chevalier Bayard, who, though so much a stranger to the arts of a court that he never rose to the chief command, was always called, in times of real danger, to the posts of greatest difficulty and importance. He put himself at the head of the men at arms; and animating them by his presence and example to sustain the whole shock of the enemy's troops, he gained time for the rest of his countrymen to make good their retreat. But in this service he received a wound which he immediately perceived to be mortal; and being unable to continue any longer on horseback, he ordered one of his attendants to place him under a tree, with his face towards the enemy; then fixing his eyes on the guard of his sword, which he held up instead of a cross, he addressed his prayers to God; and in this posture, which became his character both as a soldier and as a Christian, he calmly waited

* *Hist. of Charles V.* book v.

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waited the approach of death. Bourbon, who led the foremost of the enemy's troops, found him in this situation, and expressed regret and pity at the sight. "Pity not me," cried the high-spirited chevalier, "I "die as a man of honour ought, in the discharge of "my duty: they indeed are objects of pity, who fight "against their king, their country, and their oath." The marquis de Pescara, passing soon after, manifested his admiration of Bayard's virtue, as well as his sorrow for his fate, with the generosity of a gallant enemy; and finding that he could not be removed with safety from that spot, ordered a tent to be pitched there, and appointed proper persons to attend him. He died, notwithstanding their care, as his ancestors for several generations had done, in the field of battle. Pescara ordered his body to be embalmed, and sent to his relations; and such was the respect paid to military merit in that age, that the duke of Savoy commanded it to be received with royal honours in all the cities of his dominions: in Dauphiné, Bayard's native country, the people of all ranks came out in a solemn procession to meet it.

BAYEN, Peter, an eminent French chemist. See Supplement.

BAYEUX, a considerable town of France in the department of Calvados. The cathedral church is accounted extremely fine. Population in 1815, 10,600. W. Long. 0. 33. N. Lat. 49. 16.

BAYLE, Peter, author of the Historical and Critical Dictionary, was born November 18. 1657, at Carla, a village in the county of Foix, in France, where his father John Bayle was a Protestant minister. In 1666, he went to the Protestant university at Puylaureus, where he studied with the greatest application; and in 1669, removed to the university of Toulouse, whither the Protestants at that time frequently sent their children to study under the Jesuits: but here, to the great grief of his father, he embraced the Romish religion. However, being soon sensible of his error, he left that university, and went to study at Geneva; after which he was chosen professor of philosophy at Sedan: but that Protestant university being suppressed by Louis XIV. in 1681, he was obliged to leave the city; and was soon after chosen professor of philosophy and history at Rotterdam, with a salary of about 45l. a year. The year following he published his Letter concerning Comets. And Father Maimbourg having published about this time his History of Calvinism, wherein he endeavours to draw upon the Protestants the contempt and resentment of the Catholics, Mr Bayle wrote a piece to confute his history. The reputation which he had now acquired, induced the States of Friezland, in 1684, to offer him a professorship in their university; but he wrote them a letter of thanks, and declined the offer. The same year he began to publish his *Nouvelles de la république des lettres*.

In 1686, he was drawn into a dispute in relation to the famous Christina queen of Sweden. In his Journal for April, he took notice of a printed letter supposed to have been written by her Swedish majesty to the chevalier de Terlon, wherein she condemns the persecution of the Protestants in France. He inserted the letter itself in his Journal for May; and in that of June following he says, "What we hinted at in our last month is confirmed to us from day to day, that Christina is the real author of the letter concerning the persecutions in France, which is ascribed to her: it is a remainder of Protestantism." Mr Bayle received an anonymous letter; the author of which says, that he wrote to him of his own accord, being in duty bound to it as a servant of the queen. He complains that Mr Bayle, speaking of her majesty, called her only *Christina*, without any title; he finds also great fault with his calling the letter "a remainder of Protestantism." He blames him likewise for inserting the words "I am," in the conclusion of the letter. "These words (says this anonymous writer) are not her majesty's; a queen, as she is, cannot employ these words but with regard to a very few persons, and Mr de Terlon is not of that number." Mr Bayle wrote a vindication of himself as to these particulars, with which the author of the anonymous letter declared himself satisfied, excepting what related to "the remainder of Protestantism." He would not admit of the defence with regard to that expression; and in another letter, advised him to retract that expression. He adds in a postscript, "You mention, in your Journal of August, a second letter of the queen, which you scruple to publish. Her majesty would be glad to see that letter; and you will do a thing agreeable to her if you would send it to her. You might take this opportunity of writing to her majesty. This counsel may be of some use to you; do not neglect it." Mr Bayle took the hint, and wrote a letter to her majesty, dated the 14th of November 1686; to which the queen, on the 14th of December, wrote the following answer:—"Mr Bayle, I have received your excuses; and am willing you should know by this letter, that I am satisfied with them. I am obliged to the zeal of the person who gave you occasion of writing to me: for I am very glad to know you. You express so much respect and affection for me, that I pardon you sincerely; and I would have you know, that nothing gave me offence but that *remainder of Protestantism*, of which you accused me. I am very delicate on that head, because nobody can suspect me of it, without lessening my glory, and injuring me in the most sensible manner. You would do well if you should even acquaint the public with the mistake you have made, and with your regret for it. This is all that remains to be done by you, in order to deserve my being entirely satisfied with you. As to the letter which you have sent me, it is mine without doubt; and since you tell me that it is printed, you will do me a pleasure if you send me some copies of it. As I fear nothing in France, so neither do I fear any thing at Rome. My fortune, my blood, and even my life, are entirely devoted to the service of the church; but I flatter nobody, and will never speak any thing but the truth. I am obliged to those who have been pleased to publish my letter, for I do not at all disguise my sentiments. I thank God, they are too noble and too honourable to be disowned. However, it is not true that this letter was written to one of my ministers. As I have everywhere enemies and persons who envy me, so in all places I have friends and servants: and I have possibly as many in France, notwithstanding of the court, as anywhere in the world. This is purely the truth, and you may regulate yourself accordingly. But you shall not get

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get off so cheap as you imagine. I will enjoin you a penance; which is, that you will henceforth take the trouble of sending me all curious books that shall be published in Latin, French, Spanish, or Italian, on whatever subject or science, provided they are worthy of being looked into; I do not even except romances or satires; and above all, if there are any books of chemistry, I desire you may send them to me as soon as possible. Do not forget likewise to send me your Journal. I shall order that you be paid for whatever you lay out, do but send me an account of it. This will be the most agreeable and most important service that can be done me. May God prosper you.

CHRISTINA ALEXANDRA."

It now only remained that Mr Bayle should acquaint the public with the mistake he had made, in order to merit that princess's entire satisfaction; and this he did in the beginning of his Journal of the month of January, 1687.

The persecution which the Protestants at this time suffered in France affected Mr Bayle extremely. He made occasionally some reflections on their sufferings in his Journal; and he wrote a pamphlet also on the subject. Some time afterwards he published his *Commentaire Philosophique* upon these words, "Compel them to come in;" but the great application he gave to this and his other works, threw him into a fit of sickness, which obliged him to discontinue his Literary Journal. Being advised to try a change of air, he left Rotterdam on the 8th of August, and went to Cleves; whence, after having continued some time, he removed to Aix-la-Chapelle, and from thence returned to Rotterdam on the 18th of October. In the year 1690, the famous book, entitled, *Avis aux Refugiez*, &c. made its appearance. Mr Jurieu, who took Mr Bayle for the author thereof, wrote a piece against it; and he prefixed an advice to the public, wherein he calls Mr Bayle a profane person, and a traitor engaged in a conspiracy against the state. As soon as Mr Bayle had read this libel against him, he went to the grand schout of Rotterdam, and offered to go to prison, provided his accuser would accompany him, and undergo the punishment he deserved if the accusation was found unjust. He published also an answer to Mr Jurieu's charge; and as his reputation, nay his very life, was at stake in case the accusation of treason was proved, he therefore thought himself not obliged to keep any terms with the accuser, and attacked him with the utmost severity. Mr Jurieu lost all patience: he applied himself to the magistrates of Amsterdam; who advised him to a reconciliation with Mr Bayle, and enjoined them not to publish any thing against each other till it was examined by Mr Boyer, the pensioner of Rotterdam. But notwithstanding this prohibition, Mr Jurieu attacked Mr Bayle again with so much passion, that he forced him to write a new vindication of himself.

In November 1690, M. de Beauval advertised in his Journal, *A scheme for a Critical Dictionary*. This was the work of Mr Bayle. The articles of the three first letters of the alphabet were already prepared; but a dispute happening betwixt him and M. de Beauval, obliged him for some time to lay aside the work. Nor did he resume it till May 1692, when he published his scheme: but the public not approving of his plan, he threw it into a different form; and the first volume was published in August 1695, and the second in October following. The work was extremely well received by the public; but it engaged him in fresh disputes, particularly with Mr Jurieu and the abbé Renaudot. Mr Jurieu published a piece, wherein he endeavoured to engage the ecclesiastical assemblies to condemn the dictionary; he presented it to the senate sitting at Delft, but they took no notice of the affair. The consistory of Rotterdam granted Mr Bayle a hearing; and after having heard his answers to their remarks on his dictionary, declared themselves satisfied, and advised him to communicate this to the public. Mr Jurieu made another attempt with the consistory in 1698; and so far he prevailed with them, that they exhorted Mr Bayle to be more cautious with regard to his principles in the second edition of his dictionary; which was published in 1702, with many additions and improvements.

Mr Bayle was a most laborious and indefatigable writer. In one of his letters to Maizeux, he says, that since his 20th year he hardly remembers to have had any leisure. His intense application contributed perhaps to impair his constitution, for it soon began to decline. He had a decay of the lungs, which weakened him considerably; and as this was a distemper which had cut off several of his family, he judged it to be mortal, and would take no remedies. He died the 28th of December 1706, after he had been writing the greatest part of the day. He wrote several books besides what we have mentioned, many of which were in his own defence against attacks he had received from the abbé Renaudot, Mr Clerk, M. Jaquelot, and others. Among the productions which do honour to the age of Louis XIV. M. Voltaire has not omitted the Critical Dictionary of our author: "It is the first work of the kind (he says) in which a man may learn to think." He censures indeed those articles which contain only a detail of minute facts, as unworthy either of Bayle, an understanding reader, or posterity. "In placing him (continues the same author) amongst the writers who do honour to the age of Louis XIV. notwithstanding his being a refugee in Holland, I only conform to the decree of the parliament of Toulouse, which, when it declared his will valid in France, notwithstanding the rigour of the laws, expressly said, *that such a man could not be considered as a foreigner*."

BAYLY, LEWIS, author of that most memorable book, entitled "The Practice of Piety." He was born at Caermarthen in Wales, educated at Oxford, made minister of Evesham in Worcestershire about 1611, became chaplain to King James, and was promoted to the see of Bangor in 1616. His book is dedicated to the high and mighty prince, Charles prince of Wales; and the author tells his highness, "that he had endeavoured to extract out of the chaos of endless controversies the old practice of true piety, which flourished before these controversies were hatched." The design was good; and the reception this book has met with may be known from the number of its editions, that in 8vo, 1734, being the fifty-ninth. This prelate died in 1632.

BAYON, a town of France, in Lorrain, now the department

department of Meurthe, seated on the river Moselle. E. Long. 14. 42. N. Lat. 48. 30.

BAYON, or *Bayona*, a town of Galicia, in Spain, seated on a small gulf of the Atlantic ocean, about 12 miles from Tuy. It has a very commodious harbour, and the country about it is fertile. W. Long. 9. 30. N. Lat. 43. 3.

BAYONET, in the military art, a short broad dagger, formerly with a round handle fitted for the bore of a firelock, to be fixed there after the soldier had fired; but they are now made with iron handles and rings, that go over the muzzle of the firelock; and are screwed fast, so that the soldier fires with his bayonet on the muzzle of his piece, and is ready to act against the horse. This use of the bayonet fastened on the muzzle of the firelock was a great improvement, first introduced by the French, and to which, according to M. Folard, they owed a great part of their victories in the last century; and to the neglect of this in the next succeeding war, and trusting to their fire, the same author attributes most of the losses they sustained. At the siege of Malta, a weapon called *pila ignea* was contrived to oppose the bayonets, being in some measure the converse thereof; as the latter consists of a dagger added to a fire-arm, the former consisted of a fire-arm added to a pilum or pike.

Of late the bayonet has come into very general use; and battles have been won by it without firing a shot. This way of fighting was chiefly restored by the late king of Prussia, who made his troops rush forward at once with bayonets on the enemy.

BAYONNE, a city of Gascony, in France, now the department of the Lower Pyrenees; seated near the mouth of the river Adour, which forms a good harbour. In 1815 it contained 18,600 inhabitants, including the suburbs. It is divided into three parts. The great town is on this side the river Nive; the little town is between the Nive and the Adour; and the suburb of Saint Esprit is beyond this last river. Both the former are surrounded with an old wall and a dry ditch, and there is a small castle in each. That of Great Bayonne is flanked with four round towers, and is the place where the governor resides. The new castle is flanked with four towers, in the form of bastions. The first enclosure is covered with another, composed of eight bastions, with a great horn-work, and a half-moon; all which are encompassed with a ditch, and a covered way. There is communication between the city and the suburbs by a bridge, and the suburbs are well fortified. The citadel is seated beyond the Adour, on the side of the suburbs above mentioned. The public buildings have nothing remarkable; it is the only city in the kingdom that has the advantage of two rivers, wherein the tide ebbs and flows. The river Nive is deeper than the Adour, but less rapid, by which means ships come up into the middle of the city. There are two bridges over the river, by which the old and new towns communicate with each other. The trade of this town is the more considerable, on account of its neighbourhood to Spain, and the great quantity of wines which are brought hither from the adjacent country. The Dutch carry off a great number of pipes in exchange for spices and other commodities, which they bring thither. The inhabitants had formerly the privilege of guarding two of their three gates, and the third was kept by the king. W. Long. 1. 20. N. Lat 43. 20.

BAYS, in *Commerce*, a sort of open woollen stuff, having a long nap, sometimes frized, and sometimes not. This stuff is without wale; and is wrought in a loom with two treddles, like flannel. It is chiefly manufactured at Colchester and Bockin in Essex, where there is a hall called the *Dutch-bay hall* or *raw-hall*. This manufacture was first introduced into England, with that of says, serges, &c. by the Flemings; who being persecuted by the duke of Alva for their religion, fled thither about the fifth of Queen Elizabeth's reign; and had afterwards peculiar privileges granted them by act of parliament 12 Charles II. 1660, which the bays-makers in the above places still enjoy. The exportation of bays was formerly much more considerable than at present when the French have learned to imitate them. However, the English bays are still sent in great quantities to Spain and Portugal, and even to Italy. Their chief use is for dressing the monks and nuns, and for linings, especially in the army. The looking-glass makers also use them behind their glasses, to preserve the tin or quicksilver; and the casemakers to line their cases. The breadth of bays is commonly a yard and a half, a yard and three quarters, or two yards, by 42 to 48 in length. Those of a yard and three quarters are most proper for the Spanish trade.

BAZAR, or BASAR, a denomination among the Turks and Persians, given to a kind of exchanges, or places where their finest stuffs and other wares are sold. These are also called *bezestins*. The word *bazar* seems of Arabic origin, where it denotes sale, or exchange of goods. Some of the eastern bazars are open, like the market-places in Europe, and serve for the same uses, more particularly for the sale of the bulky and less valuable commodities. Others are covered with lofty ceilings, or even domes, pierced to give light; and it is in these the jewellers, goldsmiths, and other dealers in the richer wares, have their shops. The bazar or maidan of Ispahan is one of the finest places in Persia, and even surpasses all the exchanges in Europe; yet notwithstanding its magnificence, it is excelled by the bazar of Tauris, which is the largest that is known, having several times held 30,000 men ranged in order of battle. At Constantinople, there is the old and the new bazar, which are large square buildings, covered with domes, and sustained by arches and pilasters.

BAZAS, a town of Guienne in France, now the department of Gironde, and formerly a bishop's see. It is built on a rock, five miles from the Garonne, and 42 south-east of Bourdeaux, in W. Long. 0. 30. N. Lat. 44. 20.

BAZAT, or BAZA, in *Commerce*, a long, fine spun cotton, which comes from Jerusalem, whence it is also called *Jerusalem-cotton*.

BAZEEGURS, a tribe of Indians in Hindostan. See SUPPLEMENT.

BAZGENDGES, in *Natural History*, the name of a substance used by the Turks and other eastern nations in their scarlet-dyeing. They mix it for this purpose with cochineal and tartar; the proportions being two ounces of the bazgendges to one ounce of cochineal. These are generally esteemed a sort of fruit, that are produced

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produced on certain trees in Syria and other places; and it is usually supposed, that the scarcity and dearness of them is the only thing that makes them not used in Europe. But the bazgendges seem to be no other than the horns of the turpentine tree in the eastern parts of the world; and it is not only in Syria that they are found, but China also affords them. Many things of this kind were sent over to Mr Geoffroy at Paris from China as the substances used in the scarlet-dyeing of that country, and they all proved wholly the same with the Syrian and Turkish bazgendges, and with the common turpentine horns. The lentisk, or mastic tree, is also frequently found producing many horns of a like kind with these, and of the same origin, all being owing to the pucerons, which make their way into the leaves to breed their young there.

BDELLIUM, a gummy resinous juice, produced by a tree in the East Indies, of which we have no satisfactory account. It is brought into Europe both from the East Indies and Arabia. It is in pieces of different sizes and figures, externally of a dark reddish brown, somewhat like myrrh; internally it is clear, and not unlike to glue; to the taste it is slightly bitterish and pungent; its odour is very agreeable. If held in the mouth, it soon becomes soft and tenacious, sticking to the teeth. Laid on a red-hot iron, it readily catches flame, and burns with a crackling noise, and in proportion to its goodness it is more or less fragrant. Near half of its substance dissolves either in water or in spirit of wine; but the tincture made with spirit is somewhat stronger, and by much more agreeable. Vinegar, or verjuice, dissolves it wholly. The simple gum is a better medicine than any preparation from it. It is one of the weakest of the deobstruent gums, but is used as a pectoral and an emmenagogue.

BEACHY-HEAD, a promontory on the coast of Sussex, between Hastings and Shoreham, where the French defeated the English and Dutch fleet in 1690.

BEACON, a signal for the better securing the kingdom from foreign invasions. See SIGNAL.

On certain eminent places of the country are placed long poles erect, whereon are fastened pitch-barrels to be fired by night, and smoke made by day, to give notice in a few hours to the whole kingdom of an approaching invasion. These are commonly called *beacons*; whence also comes *beaconage*.—We find beacons familiarly in use among the primitive Britons and Western Highlanders. The besieged capital of one of our northern isles in the third century actually lighted up a fire upon a tower; and Fingal instantly knew "the green flame edged with smoke" to be a token of attack and distress *. And there are to this day several cairns or heaps of stones upon the heights along the coasts of the Harries, on which the inhabitants used to burn heath as a signal of an approaching enemy.

* Ossian, vol. i. p. 198.

BEACONS are also marks and signs erected on the coasts, for guiding and preserving vessels at sea, by night as well as by day.

The erection of beacons, light-houses, and sea-marks, is a branch of the royal prerogative. The king hath the exclusive power, by commission under his great seal, to cause them to be erected in fit and convenient places, as well upon the lands of the subject as upon the demesnes of the crown: which power is usually vested by letters patent in the office of lord high admiral. And by statute 8 Eliz. c. 13. the corporation of the Trinity-house are impowered to set up any beacons or sea-marks wherever they shall think them necessary; and if the owner of the land or any other person shall destroy them, or shall take down any steeple, tree, or other known sea-mark, he shall forfeit 100l. or, in case of inability to pay it, shall be *ipso facto* outlawed.

BEACONAGE, money paid towards the maintenance of a beacon. See BEACON.—The word is derived from the Saxon *beacnian*, to nod, or show by a sign; hence also the word *beckon*.

BEACONSFIELD, a town of Buckinghamshire in England, seated on a hill in the road between London and Oxford. It contained 1461 inhabitants in 1811. W. Long. 0. 25. N. Lat. 51. 36.

BEAD, a small globule or ball used in necklaces; and made of different materials, as pearl, steel, garnet, coral, diamond, amber, crystal, pastes, glass, &c.—The Romanists make great use of beads in rehearsing their *Ave-Marias*, and *Pater-nosters*; and the like usage is found among the dervises and other religious throughout the East, as well Mahometan as Heathen. The ancient Druids appear also to have had their beads, many of which are still found; at least if the conjecture of an ingenious author may be admitted, who takes those antique glass globules, having a snake painted round them, and called *adder-beads*, or *snake-buttons*, to have been the beads of our ancient Druids. See ANGUIS, OPHIOLOGY *Index*.

BEADS are also used in speaking of those glass globules vended to the savages on the coast of Africa; thus denominated, because they are strung together for the convenience of traffic.

The common black glass of which beads are made for necklaces, &c. is coloured with manganese only: one part of manganese is sufficient to give a black colour to near twenty of glass.

BEAD, in *Architecture*, a round moulding, commonly made upon the edge of a piece of stuff, in the Corinthian and Roman orders, cut or carved in short embossments, like beads in necklaces.

BEAD-Makers, called by the French *paternostriers*, are those employed in the making, stringing, and selling of beads. At Paris before the revolution there were three companies of paternostriers, or bead-makers; one who made them of glass or crystal; another in wood and horn; and the third in amber, coral, jet, &c.

BEAD-Proof, a term used by our distillers to express that sort of proof of the standard strength of spirituous liquors, which consists in their having, when shaken in a phial, or poured from on high into a glass, a crown of bubbles, which stand on the surface some time after. This is esteemed a proof that the spirit consists of equal parts of rectified spirits and phlegm. This is a fallacious rule as to the degree of strength in the goods; because any thing that will increase the tenacity of the spirit, will give it this proof, though it be under the due strength. Our malt-distillers spoil the greater part of their goods, by leaving too much of the stinking oil of the malt in their spirit, in order to give it this proof when somewhat under the standard strength. But this is a great deceit on the purchasers of malt spirits, as they have them by this means not only weaker than they ought to be, but stinking with an oil that they

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they are not easily cleared of afterwards. On the other hand, the dealers in brandy, who usually have the art of sophisticating it to a great nicety, are in the right when they buy it by the strongest bead-proof, as the grand mark of the best; for being a proof of the brandy containing a large quantity of its oil, it is, at the same time, a token of its high flavour, and of its being capable of bearing a very large addition of the common spirits of our own produce, without betraying their flavour, or losing its own. We value the French brandy for the quantity of this essential oil of the grape which it contains; and that with good reason, as it is with us principally used for drinking as an agreeably flavoured cordial: but the French themselves, when they want it for any curious purposes, are as careful in the rectification of it, and take as much pains to clear it from this oil, as we do to free our malt spirits from that nauseous and fetid oil which it originally contains.

Bead-Roll, among Papists, a list of such persons, for the rest of whose souls they are obliged to repeat a certain number of prayers, which they count by means of their beads.

Bead-Tree. See Melia, Botany *Index*.

BEADLE, (from the Saxon *bydel*, a *messenger*), a crier or messenger of a court, who cites persons to appear and answer. Called also a *summoner* or *apparitor*. —*Beadle* is also an officer at an university, whose chief business is to walk before the masters with a mace, at all public processions.—There are also *church beadles*, whose office is well known.

BEAGLES, a small sort of hounds or hunting dogs. Beagles are of divers kinds; as the *southern beagle*, something less and shorter, but thicker than the deep-mouthed hound; the *fleet northern* or *cat beagle*, smaller, and of a finer shape than the southern, and a harder runner. From the two, by crossing the strains, is bred a third sort held preferable to either. To these may be added a still smaller sort of beagles, scarce bigger than lap-dogs, which make pretty diversion in hunting the coney, or even the small hare in dry weather; but otherwise unserviceable, by reason of their size.

BEAK, the bill or nib of a bird. See Ornithology *Index*.

Beak, or *Beak-head*, of a ship, that part without the ship, before the fore-castle, which is fastened to the stem, and is supported by the main-knee.

The beak, called by the Greeks εμϐολον, by the Latins *rostrum*, was an important part in the ancient ships of war, which were hence denominated *naves rostratæ*. The beak was made of wood; but fortified with brass, and fastened to the prow, serving to annoy the enemy's vessels. Its invention is attributed to Pisæus an Italian. The first beaks were made long and high; but afterwards a Corinthian, named *Aristo*, contrived to make them short and strong, and placed so low, as to pierce the enemies vessels under water. By the help of these great havock was made by the Syracusans in the Athenian fleet.

BEAKED, in *Heraldry*, a term used to express the beak or bill of a bird. When the beak and legs of a fowl are of a different tincture from the body, we say *beaked and membered of such a tincture*.

BEALE, Mary, particularly distinguished by her skill in painting, was the daughter of Mr Craddock, minister of Waltham upon Thames, and learned the rudiments of her art from Sir Peter Lely. She painted in oil, water-colours, and crayons, and had much business; her portraits were in the Italian style, which she acquired by copying pictures and drawings from Sir Peter Lely's and the royal collections. Her master, says Mr Walpole, was supposed to have had a tender attachment to her; but as he was reserved in communicating to her all the resources of his pencil, it probably was a gallant rather than a successful one. Dr Woodfall wrote several pieces to her honour, under the name of *Belesia*. Mrs Beale died in Pall-mall, on the 28th of December 1697, aged 65. Her paintings have much nature, but the colouring is stiff and heavy.

BEALT, Bealth, or *Builth*, a town of Brecknockshire in South Wales, pleasantly seated on the river Wye. It contained 815 inhabitants in 1811, who are chiefly employed in the manufacture of stockings. W. Long. 4. 10. N. Lat. 52. 4.

BEAM, in *Architecture*, the largest piece of wood in a building, which lies cross the walls, and serves to support the principal rafters of the roof, and into which the feet of these rafters are framed. No building has less than two of these beams, viz. one at each end; and into these the girders of the garret roof are also framed. The proportions of beams in or near London, are fixed by statute, as follows: a beam 15 feet long, must be 7 inches on one side its square, and 5 on the other; if it be 16 feet long, one side must be 8 inches, the other 6, and so proportionally to their lengths. In the country, where wood is more plenty, they usually make their beams stronger.

Beams of a Ship are the great main cross-timbers which hold the sides of the ship from falling together, and which also support the decks and orlops: the main beam is next the main-mast, and from it they are reckoned by first, second, third beam, &c.: the greatest beam of all is called the *midship beam*.

Beam-Compass, an instrument consisting of a square wooden or brass beam, having sliding sockets, that carry steel or pencil points; they are used for describing large circles, where the common compasses are useless.

Beam-Bird, or *Petty-chaps*. See Motacilla.

Beam also denotes the lath, or iron, of a pair of scales: sometimes the whole apparatus for weighing of goods is so called: Thus we say, it weighs so much at the king's beam.

Beam of a Plough, that in which all the parts of the plough-tail are fixed. See Plough, Agriculture *Index*.

Beam, or *Roller*, among weavers, a long and thick wooden cylinder, placed lengthwise on the back-part of the loom of those who work with a shuttle. That cylinder, on which the stuff is rolled as it is weaved, is also called the *beam* or *roller*, and is placed on the fore-part of the loom.

BEAMINSTER, a town of Dorsetshire in England, seated on the river Bert. Population 2290 in 1811. W. Long. 2. 50. N. Lat. 52. 45.

BEAN. See Vicia, Botany *Index*.

The ancients made use of beans in gathering the votes of the people, and for the election of magistrates. A white bean signified *absolution*, and a black one *condemnation*. Beans had a mysterious use in the *lemuralia* and *parentalia*; where the master of the family, after washing, was to throw a sort of black beans

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beans over his head, still repeating the words, "I redeem myself and family by these beans." Ovid * gives a lively description of the whole ceremony in verse.—Abstinence from beans was enjoined by Pythagoras, one of whose symbols is, κυαμων απεχεσθαι, *abstine à fabis.* The Egyptian priests held it a crime to look at beans, judging the very sight unclean. The *flamen dialis* was not permitted even to mention the name. The precept of Pythagoras has been variously interpreted: some understand it of forbearing to meddle in trials and verdicts, which were then by throwing beans into an urn, others, building on the equivoque of the word κυαμος, which equally signifies a *bean* and a human *testicle*, explain it by abstaining from venery. Clemens Alexandrinus grounds the abstinence from beans on this, that they render women barren; which is confirmed by Theophrastus, who extends the effect even to plants. Cicero suggests another reason for this abstinence, viz. that beans are great enemies to tranquillity of mind. For a reason of this kind it is, that Amphiaraus is said to have abstained from beans, even before Pythagoras, that he might enjoy a clearer divination by dreams.

* Fast. lib. v. 4. 435.

Beans, as food for horses. See Farriery.

Bean-Caper. See Zygophyllum, Botany *Index.*

Bean-Cod, a small fishing vessel, or pilot-boat, common on the sea-coasts and in the rivers of Portugal. It is extremely sharp forward, having its stem bent inward above into a great curve: the stem is also plated on the fore-side with iron, into which a number of bolts are driven, to fortify it, and resist the stroke of another vessel, which may fall athwart-hause. It is commonly navigated with a large lateen sail, which extends over the whole length of the deck, and is accordingly well fitted to ply to windward.

Bean-Flour, called by the Romans *lomentum*, was of some repute among the ancient ladies as a cosmetic, wherewith to smooth the skin, and take away wrinkles.

Bean-Fly, in *Natural History*, the name given by authors to a very beautiful fly, of a pale purple colour, frequently found on bean-flowers. It is produced from the worm or maggot called by authors *mida.*

Bean-Goose. See Anas, Ornithology *Index.*

Kidney-Bean. See Phaseolus.

Malacca-Beans, or *Anacardia*, the fruit of a tree growing in Malabar and other parts of the East Indies, supposed by some to be the Avicennia *tomentosa;* by others, the Bontia *germinans.* The fruit is of a shining black colour, of the shape of a heart flattened, about an inch long, terminating at one end in an obtuse point, and adhering by the other to a wrinkled stalk: it contains within two shells a kernel of a sweetish taste: betwixt the shells is lodged a thick and acrid juice.

The medicinal virtues of anacardia have been greatly disputed. Many have attributed to them the faculty of comforting the brain and nerves, fortifying the memory, and quickening the intellect: and hence a confection made from them has been dignified with the title of *confectio sapientum:* others think it better deserves the name of *confectio stultorum*, and mention instances of its continued use having rendered people maniacal. But the kernel of anacardium is not different in quality from that of almonds. The ill effects attributed to this fruit belong only to the juice contained betwixt the kernels, whose acrimony is so great, that it is said to be employed by the Indians as a caustic. This juice is recommended externally for tetters, freckles, and other cutaneous deformities; which it removes only by exulcerating or excoriating the part, so that a new skin comes underneath.

BEAR, in *Zoology.* See Ursus, Mammalia *Index.*

Sea-Bear. See Phoca, Mammalia *Index.*

Bear, in *Astronomy.* See Ursa, Astronomy *Index.*

Order of the Bear was a military order in Switzerland, erected by the emperor Frederick II. in 1213, by way of acknowledgment for the service the Swiss had done him, and in favour of the abbey of St Gal. To the collar of the order hung a medal, on which was represented a bear raised on an eminence of earth.

Bear's-Breech. See Acanthus, Botany *Index.*

Bear's Flesh was much esteemed by the ancients: even at this day, the paw of a bear salted and smoked, is served up at the tables of princes.

Bear's-Grease was formerly esteemed a sovereign remedy against cold disorders, especially rheumatisms. It is now much used in dressing ladies and gentlemen's hair.

Bear's-Skin makes a fur in great esteem, and on which depends a considerable article of commerce, being used in housings, on coach-boxes, &c. In some countries, clothes are made of it, more especially bags wherein to keep the feet warm in severe colds. Of the skins of bears cubs are made gloves, muffs, and the like.

BEARALSTON, a small town of Devonshire, which, however, is a borough by prescription, and sends two members to parliament.

BEARD, the hair growing on the chin and adjacent parts of the face, chiefly of adults and males.

Various have been the ceremonies and customs of most nations in regard of the beard. The Tartars, out of a religious principle, waged a long and bloody war with the Persians, declaring them infidels, merely because they would not cut their whiskers after the rite of Tartary; and we find, that a considerable branch of the religion of the ancients consisted in the management of their beards. The Greeks wore their beards till the time of Alexander the Great; that prince having ordered the Macedonians to be shaved, for fear it should give a handle to their enemies. According to Pliny, the Romans did not begin to shave till the year of Rome 454, when P. Ticinius brought over a stock of barbers from Sicily.—Persons of quality had their children shaved the first time by others of the same or greater quality, who, by this means, became godfather or adoptive father of the children. Anciently, indeed, a person became godfather of the child by barely touching his beard: thus historians relate, that one of the articles of the treaty between Alaric and Clovis was, that Alaric should touch the beard of Clovis to become his godfather.

As to ecclesiastics, the discipline has been very different on the article of beards: sometimes they have been enjoined to wear them, from a notion of too much effeminacy in shaving, and that a long beard was more suitable to the ecclesiastical gravity; and sometimes again they were forbid it, as imagining pride to lurk

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beneath a venerable beard. The Greek and Roman churches have been long together by the ears about their beards; since the time of their separation, the Romanists seem to have given more into the practice of shaving, by way of opposition to the Greeks; and have even made some express constitutions *de radendis barbis*. The Greeks, on the contrary, espouse very zealously the cause of long beards, and are extremely scandalized at the beardless images of saints in the Roman churches. By the statutes of some monasteries, it appears, that the lay-monks were to let their beards grow, and the priests among them to shave; and that the beards of all that were received into the monasteries, were blessed with a great deal of ceremony. There are still extant the prayers used in the solemnity of consecrating the beard to God, when an ecclesiastic was shaven.

Le Compte observes, that the Chinese affect long beards extravagantly; but nature has balked them, and only given them very little ones, which, however, they cultivate with infinite care: the Europeans are strangely envied by them on this account, and esteemed the greatest men in the world. Chrysostom observes, that the kings of Persia had their beards wove or matted together with gold thread; and some of the first kings of France had their beards knotted and buttoned with gold.

Among the Turks, it is more infamous for any one to have his beard cut off, than among us to be publicly whipt or branded with a hot iron. There are abundance in that country, who would prefer death to this kind of punishment. The Arabs make the preservation of their beards a capital point of religion, because Mahomet never cut his. Hence the razor is never drawn over the Grand Signior's face. The Persians, who clip them, and shave above the jaw, are reputed heretics. It is likewise a mark of authority and liberty among them, as well as among the Turks. They who serve in the seraglio, have their beards shaven, as a sign of their servitude. They do not suffer it to grow till the sultan has set them at liberty, which is bestowed as a reward upon them, and is always accompanied with some employment.

The most celebrated ancient writers, and several modern ones, have spoken honourably of the fine beards of antiquity. Homer speaks highly of the white beard of Nestor and that of old King Priam. Virgil describes Mezentius's to us, which was so thick and long as to cover all his breast; Chrysippus praises the noble beard of Timothy, a famous player on the flute. Pliny the Younger tells us of the white beard of Euphrates, a Syrian philosopher; and he takes pleasure in relating the respect mixed with fear with which it inspired the people. Plutarch speaks of the long white beard of an old Laconian, who being asked why he let it grow so, replied, *'Tis that, seeing continually my white beard, I may do nothing unworthy of its whiteness.* Strabo relates, that the Indian philosophers, the Gymnosophists, were particularly attentive to make the length of their beards contribute to captivate the veneration of the people. Diodorus, after him, gives a very particular and circumstantial history of the beards of the Indians. Juvenal does not forget that of Antilochus the son of Nestor. Fenelon, in describing a priest of Apollo in all his magnificence, tells us that he had a white beard down to his girdle. But Persius seems to outdo all these authors: this poet was so convinced that a beard was the symbol of wisdom, that he thought he could not bestow a greater encomium on the divine Socrates, than by calling him the bearded master, *Magistrum barbatum.*

While the Gauls were under their sovereignty, none but the nobles and Christian priests were permitted to wear long beards. The Franks having made themselves masters of Gaul, assumed the same authority as the Romans; the bondsmen were expressly ordered to shave their chins; and this law continued in force until the entire abolishment of servitude in France. So likewise, in the time of the first race of kings, a long beard was the sign of nobility and freedom. The kings, as being the highest nobles in their kingdom, were emulous likewise to have the largest beard: Eginard, secretary to Charlemagne, speaking of the last kings of the first race, says, they came to the assemblies in the Field of Mars in a carriage drawn by oxen, and sat on the throne with their hair dishevelled, and a very long beard, *crine profuso, barba submissa, solio residerent, et speciem dominantis effingerent.*

To touch any one's beard, or cut off a bit of it, was, among the first French, the most sacred pledge of protection and confidence. For a long time all letters that came from the sovereign had, for greater sanction, three hairs of his beard in the seal. There is still in being a charter of 1121, which concludes with the following words: *Quod ut ratum et stabile perseveret in posterum, præsentis scripto sigilli mei robur apposui cum tribus pilis barbæ meæ.*

Several great men have honoured themselves with the surname of *Bearded.* The emperor Constantine is distinguished by the epithet of *Pogonata*, which signifies *the Bearded.* In the time of the Crusades, we find there was a *Geffrey the Bearded:* Baldwin IV. earl of Flanders, was surnamed *Handsome beard;* and, in the illustrious house of Montmorenci, there was a famous *Bouchard*, who took a pride in the surname of *Bearded:* he was always the declared enemy of the monks, without doubt, because of their being shaved.

In the tenth century, we find, that King Robert (of France) the rival of Charles the Simple, was not more famous for his exploits than for his long white beard. In order that it might be more conspicuous to the soldiers when he was in the field, he used to let it hang down outside his cuirass: this venerable sight encouraged the troops in battle, and served to rally them when they were defeated.

A celebrated painter in Germany, called *John Mayo*, had such a large beard that he was nicknamed *John the Bearded;* it was so long that he wore it fastened to his girdle; and though he was a very tall man, it would hang upon the ground when he stood upright. He took the greatest care of this extraordinary beard; sometimes he would untie it before the emperor Charles V. who took great pleasure to see the wind make it fly against the faces of the lords of his court.

In England, the famous chancellor Thomas More, one of the greatest men of his time, being on the point of falling a victim to court intrigues, was able, when on the fatal scaffold, to procure respect to his beard in presence of all the people, and saved it, as one may say,

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Beard.

say, from the fatal stroke which he could not escape himself. When he had laid his head on the block, he perceived that his beard was likely to be hurt by the axe of the executioner; on which he took it away, saying, *My beard has not been guilty of treason; it would be an injustice to punish it.*

But let us turn our eyes to a more flattering object, and admire the beard of the best of kings, the ever precious beard of the great Henry IV. of France, which diffused over the countenance of that prince a majestic sweetness and amiable openness, a beard ever dear to posterity, and which should serve as a model for that of every great king, as the beard of his illustrious minister should for that of every minister. But what dependence is there to be put on the stability of the things of this world? By an event, as fatal as unforeseen, the beard, which was arrived at its highest degree of glory, all of a sudden lost its favour, and was at length entirely proscribed. The unexpected death of Henry the Great, and the youth of his successor, were the sole causes of it.

Louis XIII. mounted the throne of his glorious ancestors without a beard. Every one concluded immediately, that the courtiers, seeing their young king with a smooth chin, would look upon their own as too rough. The conjecture proved right; for they presently reduced their beards to whiskers, and a small tuft of hair under the nether lip.

The people at first would not follow this dangerous example. The duke of Sully never would adopt this effeminate custom. This man, both great as a general and a minister, was likewise so in his retirement; he had the courage to keep his long beard, and to appear with it at the court of Louis XIII. where he was called to give his advice in an affair of importance. The young crop-bearded courtiers laughed at the sight of his grave look and old-fashioned phiz. The duke, nettled at the affront put on his fine beard, said to the king, "Sir, when your father, of glorious memory, did me the honour to consult me on his great and important affairs, the first thing he did was to send away all the buffoons and stage-dancers of his court."

The Czar Peter, who had so many claims to the surname of *Great*, seems to have been but little worthy of it on this occasion. He had the boldness to lay a tax on the beards of his subjects. He ordered that the noblemen and gentlemen, tradesmen and artisans (the priests and peasants excepted) should pay 100 rubles to be able to retain their beards; that the lower class of people should pay a copeck for the same liberty; and he established clerks at the gates of the different towns to collect these duties. Such a new and singular impost troubled the vast empire of Russia. Both religion and manners were thought in danger. Complaints were heard from all parts; they even went so far as to write libels against the sovereign; but he was inflexible, and at that time powerful. Even the fatal scenes of St Bartholomew were renewed against these unfortunate beards, and the most unlawful violences were publicly exercised. The razor and scissars were everywhere made use of. A great number, to avoid these cruel extremities, obeyed with reluctant sighs. Some of them carefully preserved the sad trimmings of their chins; and, in order to be never separated from these dear locks, ordered that they should be placed with them in their coffins.

Example, more powerful than authority, produced in Spain, what it had not been able to bring about in Russia without great difficulty. Philip V. ascended the throne with a shaved chin. The courtiers imitated the prince, and the people, in turn, the courtiers. However, though this revolution was brought about without violence and by degrees, it caused much lamentation and murmuring; the gravity of the Spaniards lost by the change. The favourite customs of a nation can never be altered without incurring displeasure. They have this old saying in Spain: *Desde que no hay barba, no hay mas alma.* "Since we have lost our beards, we have lost our souls."

Among the European nations that have been most curious in beards and whiskers, we must distinguish Spain. This grave romantic nation has always regarded the beard as the ornament which should be most prized; and the Spaniards have often made the loss of honour consist in that of their whiskers. The Portuguese, whose national character is much the same, are not the least behind them in that respect. In the reign of Catherine queen of Portugal, the brave John de Castro had just taken in India the castle of Diu: victorious, but in want of every thing, he found himself obliged to ask the inhabitants of Goa to lend him a thousand pistoles for the maintenance of his fleet; and, as a security for that sum, he sent them one of his whiskers, telling them, "All the gold in the world cannot equal the value of this natural ornament of my valour; and I deposit it in your hands as a security for the money." The whole town was penetrated with his heroism, and every one interested himself about this invaluable whisker: even the women were desirous to give marks of their zeal for so brave a man: several sold their bracelets to increase the sum asked for; and the inhabitants of Goa sent him immediately both the money and his whisker. A number of other examples of this kind might be produced, which do as much honour to whiskers as to the good faith of those days.

In Louis XIII.'s reign, whiskers attained the highest degree of favour, at the expence of the expiring beards. In those days of gallantry, not yet empoisoned by wit, they became the favourite occupation of lovers. A fine black whisker, elegantly turned up, was a very powerful mark of dignity with the fair sex. Whiskers were still in fashion in the beginning of Louis XIV.'s reign. This king, and all the great men of his reign, took a pride in wearing them. They were the ornament of Turenne, Conde, Colbert, Corneille, Moliere, &c. It was then no uncommon thing for a favourite lover to have his whiskers turned up, combed, and pomatumed, by his mistress; and, for this purpose, a man of fashion took care to be always provided with every little necessary article, especially whisker-wax. It was highly flattering to a lady to have it in her power to praise the beauty of her lovers's whiskers: which, far from being disgusting, gave his person an air of vivacity: several even thought them an incitement to love. It seems the levity of the French made them undergo several changes both in form and name; there were *Spanish*, *Turkish*, *guard-dagger*, &c.

whiskers;

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whiskers; in short, *royal* ones, which were the last worn; their smallness proclaimed their approaching fall.

Consecration of the BEARD was a ceremony among the Roman youth, who, when they were shaved the first time, kept a day of rejoicing, and were particularly careful to put the hair of their beard into a silver or gold box, and make an offering of it to some god, particularly to Jupiter Capitolinus, as was done by Nero, according to Suetonius.

Kissing the BEARD. The Turkish wives kiss their husbands beards, and children their fathers, as often as they come to salute them. The men kiss one another's beards reciprocally on both sides, when they salute in the streets, or come off from any journey.

The Fashion of the BEARD has varied in different ages and countries; some cultivating and entertaining one part of it, some another. Thus the Hebrews wear a beard on their chin; but not on the upper lip or cheeks. Moses forbids them to cut off entirely the angle or extremity of their beard; that is, to manage it after the Egyption fashion, who left only a little tuft of beard at the extremity of their chin; whereas the Jews to this day suffer a little fillet of hair to grow from the lower end of their ears to their chins, where, as well as on their lower lips, their beards are in a pretty long bunch. The Jews, in time of mourning, neglected to trim their beards, that is, to cut off what grew superfluous on the upper lips and cheeks. In time of grief and great affliction they also plucked off the hair of their beards.

Anointing the BEARD with unguents was an ancient practice both among the Jews and Romans, and still continues in use among the Turks; where one of the principal ceremonies observed in serious visits is to throw sweet-scented water on the beard of the visitant, and to perfume it afterwards with aloes-wood, which sticks to this moisture, and gives it an agreeable smell, &c. In middle-age writers we meet with *adlentare barbam*, used for stroking and combing it, to render it soft and flexible. The Turks, when they comb their beards, hold a handkerchief on their knees, and gather very carefully the hairs that fall; and when they have got together a certain quantity, they fold them up in paper, and carry them to the place where they bury the dead.

BEARD *of a Comet*, the rays which the comet emits towards that part of the heaven to which its proper motion seems to direct it; in which the beard of a comet is distinguished from the tail, which is understood of the rays emitted towards that part from whence its motion seems to carry it.

BEARD *of a Horse*, that part underneath the lower mandible on the outside and above the chin, which bears the curb. It is also called the *chuck*. It should have but little flesh upon it, without any chops, hardness, or swelling; and be neither too high raised nor too flat, but such as the curb may rest in its right place.

BEARD *of a Muscle, Oyster*, or the like, denotes an assemblage of threads or hairs, by which these animals fasten themselves to stones. The hairs of this beard terminate in a flat spongy substance, which being applied to the surface of a stone, sticks thereto, like the wet leather used by boys.

BEARDS, in the history of insects, are two small, oblong, fleshy bodies, placed just above the trunk, as in the gnats, and in the moths and butterflies.

BEARDED, denotes a person or thing with a beard, or some resemblance thereof. The faces on ancient Greek and Roman medals are generally bearded. Some are denominated *pogonati*, as having long beards, e. g. the Parthian kings. Others have only a lanugo about the chin, as the Seleucid family. Adrian was the first of the Roman emperors who nourished his beard; hence all imperial medals before him are *beardless*; after him, *bearded*.

BEARDED *Women* have been all observed to want the menstrual discharge; and several instances are given by Hippocrates, and other physicians, of grown women, especially widows, in whom the menses coming to stop, beards appeared. Eusebius Nierembergius mentions a woman who had a beard reaching to her navel.

Of women remarkably bearded we have several instances. In the cabinet of curiosities of Stutgard in Germany, there is the portrait of a woman called *Bartel Graetje*, whose chin is covered with a very large beard. She was drawn in 1587, at which time she was but 25 years of age. There is likewise in the same cabinet another portrait of her when she was more advanced in life, but likewise with a beard.—It is said, that the duke of Saxony had the portrait of a poor Swiss woman taken, remarkable for her long bushy beard; and those who were at the carnival at Venice in 1726, saw a female dancer astonish the spectators not more by her talents than by her chin covered with a black bushy beard.—Charles XII. had in his army a female grenadier: it was neither courage nor a beard that she wanted to be a man. She was taken at the battle of Pultowa, and carried to Petersburg, where she was presented to the Czar in 1724: her beard measured a yard and a half. We read in the Trévoux Dictionary, that there was a woman seen at Paris, who had not only a bushy beard on her face, but her body likewise covered all over with hair. Among a number of other examples of this nature, that of Margaret, the governess of the Netherlands, is very remarkable. She had a very long stiff beard, which she prided herself on; and being persuaded that it contributed to give her an air of majesty, she took care not to lose a hair of it. This Margaret was a very great woman.—It is said, that the Lombard women, when they were at war, made themselves beards with the hair of their heads, which they ingeniously arranged on their cheeks, in order that the enemy, deceived by the likeness, might take them for men. It is asserted, after Suidas, that in a similar case the Athenian women did as much. These women were more men than our Jemmy Jessamy countrymen.—About a century ago, the French ladies adopted the mode of dressing their hair in such a manner that curls hung down their cheeks as far as their bosom. These curls went by the name of *whiskers*. This custom undoubtedly was not invented after the example of the Lombard women, to fright the men. Neither is it with intention to carry on a very bloody war, that in our time they have affected to bring forward the hair of the temple on the cheeks.

BEARERS, in *Heraldry*. See SUPPORTERS.

BEARING, in *Navigation*, an arch of the horizon intercepted between the nearest meridian and any distinct

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stinct object, either discovered by the eye, or resulting from the finical proportion; as in the first case, at 4 P. M. Cape Spado, in the isle of Candia, bore S. by W. by the compass. In the second, the longitudes and latitudes of any two places being given, and consequently the difference of latitude and longitude between them, the bearing from one to the other is discovered by the following analogy:

As the meridional difference of latitude
Is to the difference of longitude;
So is the radius
To the tangent bearing.

Bearing is also the situation of any distant object, estimated from some part of the ship according to her position. In this sense, an object so discovered must be either ahead, astern, abreast on the bow, or on the quarter. These bearings, therefore, which may be called *mechanical*, are on the beam, before the beam, abaft the beam, on the bow, on the quarter, ahead, or astern. If the ship sails with a side-wind, it alters the names of such bearings in some measure, since a distant object on the beam is then said to be to leeward or to windward; on the lee-quarter or bow, and on the weather-quarter or bow.

Bearing, in the sea-language. When a ship sails towards the shore, before the wind, she is said to *bear in* with the land or harbour. To let the ship sail more before the wind, is to *bear up*. To put her right before the wind, is to *bear round*. A ship that keeps off from the land, is said to *bear off*. When a ship that was to windward comes under a ship's stern, and so gives her the wind, she is said to *bear under her lee*, &c. There is another sense of this word, in reference to the burden of a ship; for they say a ship bears, when having too slender or lean a quarter, she will sink too deep into the water with an overlight freight, and thereby can carry but a small quantity of goods.

Bearings, in *Heraldry*, a term used to express a coat of arms, or the figures of armories by which the nobility and gentry are distinguished from the vulgar and from one another. See Heraldry.

Bearing Claws, among cock-fighters, denote the foremost toes, on which the bird goes; and if they be hurt or gravelled, he cannot fight.

Bearing of a Stag, is used in respect of the state of his head or the croches which he bears on his horns. If you be asked what a stag bears, you are only to reckon the croches, and never to express an odd number; as, if he have four croches on his near horn and five on his far, you must say he bears ten; a false right on his near horn: if but four on the near horn and six on the far horn, you must say he bears twelve; a double false right on the near horn.

BEARN, a late province of France, bounded on the east by Bigorre, on the south by the mountains of Arragon, on the west by Soule and part of Navarre, and on the north by Gascony and Armagnac. It lies at the foot of the Pyrenean mountains, being about 16 leagues in length and 12 in breadth. It is in general a barren country; yet the plains yield considerable quantities of flax, and a good quantity of Indian corn called *mailloc*. The mountains are rich in mines of iron, copper, and lead; some of them also are covered with vines, and others with pine trees; and they give rise to several mineral springs, and two considerable rivers, the one called the *Gave of Oleron*, and the other the *Gave of Bearn*. Some wine is exported from this country; and the Spaniards buy up great numbers of the horses and cattle, together with most of their linen, of which there is a considerable manufactory. The principal places are Pau, Lescar, Ortez, Novarreins, Sallies, and Oleron. This province, with Basques, forms the department of the Lower Pyrenees.

BEAST, in a general sense, an appellation given to all four-footed animals, fit either for food, labour, or sport.

Beasts of Burden, in a commercial sense, all four-footed animals which serve to carry merchandises on their backs. The beasts generally used for this purpose are, elephants, dromedaries, camels, horses, mules, asses, and the sheep of Mexico and Peru.

Beasts of the Chase are five, viz. the buck, the doe, the fox, the roe, and the marten.

Beasts and Fowls of the Warren, are the hare, the coney, the pheasant, and partridge.

Beasts of the Forest, are the hart, hind, hare, boar, and wolf.

Beast, among gamesters, a game at cards, played in this manner: The best cards are the king, queen, &c. whereof they make three heaps, the king, the play, and troilet. Three, four, or five, may play; and to every one is dealt five cards. However, before the play begins, every one stakes to the three heaps. He that wins most tricks, takes up the heap called the *play*; he that hath the king takes up the heap so called; and he that hath three of any sort, that is, three fours, three fives, three sixes, &c. takes up the troilet heap.

BEAT, in a general signification, signifies to chastise, strike, knock, or vanquish.

This word has several other significations in the manufactures, and in the arts and trades. Sometimes it signifies to forge and hammer; in which sense smiths and farriers say, to *beat iron*. Sometimes it means to pound, to reduce into powder: thus we say, to *beat drugs*, to *beat pepper*, to *beat spices*; that is to say, to *pulverize them*.

Beat, in fencing denotes a blow or stroke given with the sword. There are two kinds of beats; the first performed with the foible of a man's sword on the foible of his adversary's, which in the schools is commonly called *baterie*, from the French *batre*, and is chiefly used in a pursuit, to make an open upon the adversary. The second and best kind of beat, is performed with the fort of a man's sword upon the foible of his adversary's, not with a spring, as in binding, but with a jerk or dry beat; and is therefore most proper for the parades without or within the sword, because of the rebound a man's sword has thereby from his adversary's, whereby he procures to himself the better and surer opportunity of risposting.

Beat, in the manege. A horse is said *to beat the dust*, when at each stroke or motion he does not take in ground or way enough with his fore-legs. He is more particularly said to beat the dust at *terra à terra*, when he does not take in ground enough with his shoulders, making his strokes or motions too short, as if he made them all in one place. He *beats the dust at curvets*, when he does them too precipitately and too low. He *beats upon a walk*, when he walks too short, and

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and thus rids but little ground, whether it be in straight lines, rounds, or passings.

Beat of Drum, in the military art, is to give notice by beat of drum of a sudden danger; or, that scattered soldiers may repair to their arms and quarters, is to beat an alarm, or to arms. Also to signify, by different manners of sounding a drum, that the soldiers are to fall on the enemy; to retreat before, in, or after, an attack; to move or march from one place to another; to permit the soldiers to come out of their quarters at break of day; to order to repair to their colours, &c. is to beat a charge, a retreat, a march, &c.

Beat, in clock-making. See Beats.

Beat, *St*, a town of France, in the department of Upper Garonne, at the confluence of the Garonne and the Pique. It is seated between two mountains which are close to the town on each side. The houses are chiefly built with marble. W. Long. 1. 6. N. Lat. 42. 50.

BEATER is applied, in matters of commerce, to divers sorts of workmen, whose business is to hammer or flatten certain matters, particularly metals.

Gold-Beaters, are artisans, who, by beating gold and silver with a hammer on a marble in moulds of vellum and bullocks guts, reduce them to thin leaves fit for gilding or silvering of copper, iron, steel, wood, &c. Gold-beaters differ from flatters of gold or silver; as the former bring their metal into leaves by the hammer, whereas the latter only flatten it by pressing it through a mill preparatory to beating.

There are also *Tin-Beaters* employed in the looking-glass trade, whose business is to beat tin on large blocks of marble till it be reduced to thin leaves fit to be applied with quicksilver behind looking-glasses. See Foliating, *Gold-Beating*.

BEATIFICATION, an act by which the pope declares a person beatified or blessed after his death. It is the first step towards canonization, or raising any one to the honour and dignity of a saint. No person can be beatified till 50 years after his or her death. All certificates or attestations of virtues and miracles, the necessary qualifications for saintship, are examined by the congregation of rites. This examination often continues for several years; after which his holiness decrees the beatification. The corps and relics of the future saint are from henceforth exposed to the veneration of all good Christians; his images are crowned with rays, and a particular office is set apart for him; but his body and relics are not carried in procession: indulgences likewise, and remission of sins, are granted on the day of his beatification; which though not so pompous as that of canonization, is however very splendid.

BEATING, or Pulsation, in *Medicine*, the reciprocal agitation or palpitation of the heart or pulse.

Beating Flax or *Hemp*, is an operation in the dressing of these matters, contrived to render them more soft and pliant. When hemp has been swingled a second time, and the hurds laid by, they take the strikes, and dividing them into dozens and half dozens, make them up into large thick rolls, which being broached on long strikes, are set in the chimney corner to dry; after which they lay them in a round trough made for the purpose, and there with beetles beat them well till they handle both without and within as pliant as possible, without any hardness or roughness to be felt; that done, they take them from the trough, open and divide the strikes as before; and if any be found not sufficiently beaten, they roll them up and beat them over as before.

Beating hemp is a punishment inflicted on loose or disorderly persons.

Beating, in book-binding, denotes the knocking a book in quires on a marble block, with a heavy broad-faced hammer, after folding, and before binding or stitching it. On the beating it properly, the elegance and excellence of the binding, and the easy opening of the book, principally depend.

Beating, in the paper-works, signifies the beating of paper on a stone with a heavy hammer, with a large smooth head and short handle, in order to render it more smooth and uniform, and fit for writing.

Beating the Wind, was a practice in use in the ancient method of trial by combat. If either of the combatants did not appear in the field at the time appointed, the other was to beat the wind, or make so many flourishes with his weapon; by which he was entitled to all the advantages of a conqueror.

Beating the Hands or *Feet*, by way of praise or approbation. See Applause.

Beating Time, in *Music*, a method of measuring and marking the time for performers in concert, by a motion of the hand and foot up or down successively and in equal times. Knowing the true time of a crotchet, and supposing the measure actually subdivided into four crotchets, and the half measure into two, the hand or foot being up, if we put it down with the very beginning of the first note or crotchet, and then raise it with the third, and then down with the beginning of the next measure; this is called *beating the time*; and, by practice, a habit is acquired of making this motion very equal. Each down and up is sometimes called a *time* or *measure*. The general rule is to contrive the division of the measure so, that every down and up of the beating shall end with a particular note, on which very much depends the distinctness, and, as it were, the sense of the melody. Hence the beginning of every time or beating in the measure is reckoned the accented part thereof.

Beating time is denoted, in the Italian music, by the term *à battuta*, which is usually put after what they call *recitativo*, where little or no time is observed, to denote, that here they are to begin again to mark or beat the time exactly.

The Romans aimed at somewhat of harmony in the strokes of their oars; and had an officer called *portisculus* in each galley, whose business was to beat time to the rowers, sometimes by a pole or mallet, and sometimes by his voice alone.

The ancients marked the rhime in their musical compositions: but to make it more observable in the practice, they beat the measure or time, and this in different manners. The most usual consisted in a motion of the foot, which was raised from, and struck alternately against, the ground, according to the modern method. Doing this was commonly the province of the master of the music, who was thence called μεσοχορος and κορυφαιος, because placed in the middle of the choir of muscians, and in an elevated situation, to be seen and heard more easily by the whole company. These beaters of measure were also called by the

Greeks ποδοκτυποι and ποδοψοφοι, because of the noise of their feet; and συιλεσμαριοι, because of the uniformity or monotony of the rhythm. The Latins denominated them *pedarii*, *podarii*, and *pedicularii*. To make the beats or strokes more audible, their feet were generally shod with a sort of sandals either of wood or iron, called by the Greeks κρουπεζια, κρουπαλα, κρουπετα, and by the Latins *pedicula*, *scabella*, or *scabilla*, because like to little stools or footstools. Sometimes they beat upon sonorous footstools, with the foot shod with a wooden or iron sole. They beat the measure not only with the foot, but also with the right hand, all the fingers whereof they joined together, to strike into the hollow of the left. He who thus marked the rhythm, was called *manuductor*. The ancients also beat time or measure with shells, as oyster shells and bones of animals, which they struck against one another, much as the moderns now use castanets, and the like instruments. This the Greeks called κρεμβαλιαζειν, as is noted by Hesychius. The scholiast on Aristophanes speaks much to the same purpose. Other noisy instruments, as drums, cymbals, citterns, &c. were also used on the same occasion. They beat the measure generally in two equal or unequal times; at least this holds of the usual rhythm of a piece of music, marked either by the noise of sandals, or the slapping of the hands. But the other rhythmic instruments last-mentioned, and which were used principally to excite and animate the dancers, marked the cadence after another manner; that is, the number of their percussions equalled, or even sometimes surpassed, that of the different sounds which composed the air or song played.

BEATING, with hunters, a term used of a stag, which runs first one way and then another. He is then said *to beat up and down*.—The noise made by conies in rutting time is also called *beating* or *tapping*.

BEATING, in *Navigation*, the operation of making a progress at sea against the direction of the wind, in a zig-zag line or traverse, like that in which we ascend a steep hill. See TACKING.

BEATITUDE imports the supreme good, or the highest degree of happiness human nature is suceptible of; or the most perfect state of a rational being, wherein the soul has attained to the utmost excellency and dignity it is framed for. In which sense, it amounts to the same with what we otherwise call *blessedness* and *sovereign felicity;* by the Greeks, ευδαιμονια; and by the Latins, *summum bonum*, *beatitudo*, and *beatitas*.

BEATITUDE, among divines, denotes the beatific vision, or the fruition of God in a future life to all eternity.

BEATITUDE is also used in speaking of the theses contained in Christ's sermon on the mount, whereby he pronounces blessed the poor in spirit, those that mourn, the meek, &c.

BEATON, DAVID, archbishop of St Andrew's, and a cardinal of Rome, in the early part of the 16th century, was born in 1494. Pope Paul III. raised him to the degree of a cardinal in December 1538; and being employed by James V. in negociating his marriage with the court of France, he was there consecrated bishop of Mirepoix. Soon after his instalment as archbishop of St Andrew's, he promoted a furious persecution of the reformers in Scotland; when the king's death put a stop, for a time, to his arbitrary proceedings, he being then excluded from affairs of government, and confined. He raised, however, so strong a party, that, upon the coronation of the young Queen Mary, he was admitted of the council, made chancellor, and procured commission as legate *à latere* from the court of Rome. He now began to renew his persecution of heretics; and among the rest, of the famous Protestant preacher Mr George Wishart, whose sufferings at the stake the cardinal viewed from his window with apparent exultation. It is pretended, that Wishart at his death foretold the murder of Beaton; which indeed happened shortly after, he being assassinated in his chamber, May 29. 1547. He was a haughty bigotted churchman, and thought severity the proper method of suppressing heresy; he had great talents, and great vices. See SCOTLAND.

BEATORUM INSULA, in *Ancient Geography*, seven days journey to the west of Thebæ, a district of the Nomos Oasites; called an *island*, because surrounded with sand, like an island in the sea, (Ulpian); yet abounding in all the necessaries of life, though encompassed with vast sandy deserts, (Strabo); which some suppose to be a third Oasis, in the Regio Ammoniaca; and the site of the temple of Ammon answers to the above description, as appears from the writers on Alexander's expedition thither. It was a place of relegation or banishment for criminals. (Ulpian).

BEATTIE, JAMES, an eminent Scottish poet and moralist. See SUPPLEMENT.

BEATS, in a watch or clock, are the strokes made by the fangs or pallets of the spindle of the balance, or of the pads in a royal pendulum. See CLOCK and WATCH.

BEAUCAIRE, a town of France, in the department of Gard, on the Rhone, opposite Tarascon, with which it has a communication by a bridge of boats. One of the most celebrated fairs in Europe is annually held here. E. Long. 5. 49. N. Lat. 43. 39.

BEAUCE, a late province of France, lying between the Isle of France, Blasois, and Orleannois. It is so very fertile in wheat, that it is called the *Granary* of Paris. Chartres is the principal town. It now forms the department of Eure and Loire.

BEAVER, in *Zoology*. See CASTOR, MAMMALIA *Index*.

BEAVER *Skins*, in commerce. Of these, merchants distinguish three sorts; the new, the dry, and the fat.

The new beaver, which is also called the *white beaver*, or *Muscovy beaver*, because it is commonly kept to be sent into Muscovy, is that which the savages catch in their winter hunting. It is the best, and the most proper for making fine furs, because it has lost none of its hair by shedding.

The dry beaver, which is sometimes called *lean beaver*, comes from the summer hunting, which is the time when these animals lose part of their hair. Though this sort of beaver be much inferior to the former, yet it may also be employed in furs; but it is chiefly used in the manufacture of hats. The French call it *summer castor*, or *beaver*.

The fat beaver is that which has contracted a certain gross and oily humour, from the sweat which exhales from the bodies of the savages, who wear it for some

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some time. Though this sort be better than the dry beaver, yet it it used only in the making of hats.

Besides hats and furs, in which the beaver's hair is commonly used, they attempted in France, in the year 1699, to make other manufactures of it: and accordingly they made cloths, flannels, stockings, &c. partly of beavers hair, and partly of Segovia wool. This manufactory, which was set up at Paris, in the suburb of St Anthony, succeeded at first pretty well; and according to the genius of the French, the novelty of the thing brought into some repute the stuffs, stockings, gloves, and cloth, made of beavers hair. But they went out of fashion on a sudden, because it was found, by experience, that they were of a very bad wear, and besides that the colours faded very much; when they had been wet, they became dry and hard, like felt, which occasioned the miscarriage of the manufactory for that time.

When the hair has been cut off from the beavers skins, to be used in the manufacturing of hats, those skins are still employed by several workmen; namely, by the trunk-makers, to cover trunks and boxes; by the shoemakers, to put into slippers; and by turners, to make sieves for sifting grain and seeds.

BEAUFORT, a town of France, in the department of Maine and Loire, with a castle, near the river Authion. It contains two parishes, and formerly had a convent of Recolets, and contained about 6000 inhabitants in 1815. W. Long. 0. 3. N. Lat. 47. 26.

Beaufort gives title of duke in England to the noble family of Somerset, who are lineally descended from John of Gaunt duke of Lancaster, whose duchess resided in this town.

BEAUFORT, a strong town of Savoy in Italy, on the river Oron. E. Long. 6. 48. N. Lat. 45. 40.

BEAUGENCY, a town of France in the department of Loire, seated on the river Loire. It is famous for its wines. E. Long. 1. 46. N. Lat. 47. 48.

BEAUJEU, a town of France, in the department of Rhone and Loire, with an old castle. It is seated on the river Ardieres, at the foot of a mountain, in E. Long. 4. 40. N. Lat. 46. 9.

BEAUJOLOIS, a district of France, now included in the department of Rhone and Loire. It is 25 miles in length, and 20 in breadth; and Ville Franche is the capital town.

BEAULIEU, SEBASTIAN DE PONTAULT DE, a celebrated French engineer, and field-marshal under Louis XIV. He published plans of all the military expeditions of his master, with military lectures annexed. He died in 1674.

BEAUMARCHAIS, P. A. C. a French dramatic writer. See SUPPLEMENT.

BEAUMARIS, a market town of Anglesey in North Wales, which sends one member to parliament. W. Long. 4. 15. N. Lat. 53. 25.

It is pleasantly seated on a low land at the water's edge; is neat and well built, and contained 1510 inhabitants in 1811. Edward I. created the place; for after founding the castles of Caernarvon and Conway, he discovered that it was necessary to put another curb on the Welch. He therefore built a fortress here in 1295; and fixed on a marshy spot, near the chapel of St Meugan, such as gave him opportunity of forming a great foss round the castle, and of filling it with water from the sea. He also cut a canal, in order to permit vessels to discharge their lading beneath the walls: and as a proof of the existence of such a convenience, there were within this century iron rings affixed to them, for the purpose of mooring the ships or boats. The marsh was in early times of far greater extent than at present, and covered with fine bulrushes. The first governor was Sir William Pickmore, a Gascon knight appointed by Edward I. There were a constable of the castle, and a captain of the town. The first had an annual fee of forty pounds, the last of twelve pounds three shillings and fourpence; and the porter of the gate of Beaumaris had nine pounds two shillings and sixpence. Twenty-four soldiers were allowed for the guard of the castle and town, at fourpence a-day to each. The constable of the castle was always captain of the town, except in one instance: in the 36th of Henry IV. Sir John Boteler held the first office, and Thomas Norreys the other. The castle was extremely burthensome to the country; quarrels were frequent between the garrison and the country people. In the time of Henry VI. a bloody fray happened, in which David ap Evan ap Howel of Llwydiarth, and many others, were slain. From the time of Sir Rowland Villeville, *alias* Britayne, reputed base son of Henry VII. and constable of the castle, the garrison was withdrawn till the year 1642, when Thomas Cheadle, deputy to the earl of Dorset, then constable, put into it men and ammunition. In 1643, Thomas Bulkeley, Esq. soon after created Lord Bulkeley, succeeded: his son Colonel Richard Bulkeley, and several gentlemen of the county, held it for the king till June 1646, when it surrendered on honourable terms to General Mytton, who made Captain Evans his deputy-governor. In 1653, the annual expence of the garrison was seventeen hundred and three pounds. Edward I. when he built the town, surrounded it with walls, made it a corporation, and endowed it with great privileges, and lands to a considerable value. He removed the ancient freeholders by exchange of property into other counties. Henllys, near the town, was the seat of Gwerydd ap Rhys Goch, one of fifteen tribes, and of his posterity till this period, when Edward removed them to Boddle Wyddan in Flintshire, and bestowed their ancient patrimony on the corporation. It sends one member to parliament. Its first representative was Maurice Griffydd, who sat in the seventh year of Edward VI. There is very good anchorage for ships in the bay which lies before the town, and has seven fathom water even at the lowest ebb. Vessels often find security here in hard gales. The town has no trade of any kind, yet has its customhouse for the casual reception of goods. The ferry lies near the town, and is passable at low water. It was granted by charter to the corporation in the 4th of Queen Elizabeth. There is an order from Edward II. to Robert Power, chamberlain of North Wales, to inspect into the state of the boat, which was then out of repair; and in case it was feasible, to cause it to be made fit for use, at the expence of the bailiwick: but if the boat proved past repair, a new one was to be built, and the expence allowed by the king. It appeared that the people of Beaumaris paid annually for the privilege of a ferry thirty shillings into the exchequer; but by this order it

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Beaumaris, Beaumont. it seems that the king was to find the boat. After passing the channel, the distance over the sands to Aber in Caernarvonshire, the point the passenger generally makes for, is four miles. The sands are called *Traeth Telavan*, and *Wylofaen*, or the *place of weeping*, from the shrieks and lamentations of the inhabitants when it was overwhelmed by the sea, in the days of Helig ap Clunog. The church is dependant on Llandegvan, which is in the gift of Lord Bulkeley. The former is called the *chapel of the blessed virgin;* yet in ancient writings one aisle is called *St Mary's chapel*, and another that of *St Nicholas*.

BEAUMONT, Sir John, the elder brother of Mr Francis Beaumont the famous dramatic poet, was born in the year 1582, and in 1626 had the dignity of a baronet conferred upon him by King Charles I. In his youth he applied himself to the Muses with good success; and wrote, The Crown of Thorns, a poem, in eight books: a miscellany, entitled *Bosworth Field:* Translations from the Latin poets: and several poems on religions and political subjects; as, On the Festivals; On the Blessed Trinity; A Dialogue between the World, a Pilgrim, and Virtue; Of the miserable State of Man; Of sickness, &c. He died in 1628. His poetic genius was celebrated by Ben Johnson, Michael Drayton, and others.

Beaumont and Fletcher, two celebrated English dramatic writers, who flourished in the reign of James I. and so closely connected both as authors and as friends, that it has been judged not improper to give them under one article.

Mr Francis Beaumont was descended from an ancient family of his name at Grace-dieu in Leicestershire, where he was born about the year 1585 or 1586, in the reign of Queen Elizabeth. His grandfather, John Beaumont, was master of the rolls, and his father Francis Beaumont one of the judges of the common-pleas. He was educated at Cambridge, and afterwards admitted of the Inner Temple. It is not, however, apparent that he made any great proficiency in the law, that being a study probably too dry and unentertaining to be attended to by a man of his fertile and sprightly genius. And indeed we should scarcely be surprised to find that he had given no application to any study but poetry, nor attended on any court but that of the Muses: but, on the contrary, our admiration might fix itself on the opposite extreme, and fill us with astonishment at the extreme assiduity of his genius and rapidity of his pen, when we look back on the voluminousness of his works, and then inquire into the time allowed him for them; works that might well have taken up a long life to have executed. For although, out of 53 plays which are collected together as the labours of these united authors, Mr Beaumont was concerned in much the greater part of them, yet he did not live to complete his 30th year, the king of terrors summoning him away in the beginning of March 1615, on the 9th day of which he was interred in the entrance of St Benedict's chapel in Westminster-Abbey. There is no inscription on his tomb: But there are two epitaphs to his memory; one by his elder brother Sir John Beaumont:

On death, thy murderer, this revenge I take;
I slight his terrors, and just question make,
Which of us two the best precedence have,
Mine to this wretched world, thine to the grave?
Thou should'st have follow'd me; but death, to blame,
Miscounted years, and measur'd age by fame.
So dearly hast thou bought thy precious lines;
Their praise grew swiftly, so thy life declines.
Thy muse, the hearer's queen, the reader's love,
All ears, all hearts (but death's), could please and move.
Bosworth Field, p. 164.

Beaumont.

The other is by Bishop Corbet. (*Poems*, p. 68.)

He that hath such acuteness and such wit,
As would ask ten good heads to husband it:
He that can write so well, that no man dare
Resume it for the best; let him beware:
Beaumont is dead; by whose sole death appears,
Wit's a disease consumes men in few years.

He left a daughter, Frances Beaumont, who died in Leicestershire since the year 1700. She had in her possession several poems of her father's writing; but they were lost at sea in her voyage from Ireland, where she had lived for some time in the duke of Ormond's family.

Mr John Fletcher was not more meanly descended than his poetical colleague; his father, the Rev. Dr Fletcher, having been first made bishop of Bristol, by Queen Elizabeth, and afterwards by the same monarch, in the year 1593, translated to the rich see of London. Our poet was born in 1576; and was, as well as his friend, educated at Cambridge, where he made a great proficiency in his studies, and was accounted a very good scholar. His natural vivacity of wit, for which he was remarkable, soon rendered him a devotee to the muses; and his close attention to their service, and fortunate connection with a genius equal to his own, soon raised him to one of the highest places in the temple of poetical fame. As he was born near ten years before Mr Beaumont, so did he also survive him by an equal number of years; the general calamity of a plague, which happened in the year 1625, involved him in its great destruction, he being at that time 49 years of age.

During the joint lives of these two great poets, it appears that they wrote nothing separately, excepting one little piece by each, which seemed of too trivial a nature for either to require assistance in, viz. The Faithful Shepherd, a pastoral, by Fletcher; and the Masque of Gray's-Inn Gentlemen, by Beaumont. Yet what share each had in the writing or designing of the pieces thus composed by them jointly, there is no possibility of determining. It is however generally allowed, that Fletcher's peculiar talent was *wit*, and Beaumont's, though much the younger man, *judgment*. Nay, so extraordinary was the latter property in Mr Beaumont, that it is recorded of the great Ben Johnson, who seems moreover to have had a sufficient degree of self-opinion of his own abilities, that he constantly, so long as this gentleman lived, submitted his own writings to his censure, and, as it is thought, availed himself of his judgment at least in the correcting, if not even in the contriving all his plots. It is probable, therefore, that the forming the plots and contriving the conduct of the fable, the writing of the more serious and pathetic parts, and lopping the redundant branches of Fletcher's wit,

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wit, whose luxuriance, we are told, frequently stood in need of castigation, might be in general Beaumont's portion in the work: while Fletcher, whose conversation with the *beau monde* (which indeed both of them from their births and stations in life had been ever accustomed to), added to the volatile and lively turn he possessed, rendered him perfectly master of dialogue and polite language, might execute the designs formed by the other, and raise the superstructure of those lively and spirited scenes which Beaumont had only laid the foundation of; and in this he was so successful, that though his wit and raillery were extremely keen and poignant, yet they were at the same time so perfectly genteel, that they used rather to please than disgust the very persons on whom they seemed to reflect. Yet that Fletcher was not entirely excluded from a share in the conduct of the drama, may be gathered from a story related by Winstanley, viz. that our two bards having concerted the rough draught of a tragedy over a bottle of wine at a tavern, Fletcher said, he would undertake to *kill the king;* which words being overheard by the waiter, who had not happened to have been witness to the context of their conversation, he lodged an information of treason against them. But on their explanation of it only to mean the destruction of a theatrical monarch, their loyalty moreover being unquestioned, the affair ended in a jest.

On the whole, the works of these authors have undoubtedly very great merit, and some of their pieces deservedly stand on the list of the present ornaments of the theatre. The plots are ingenious, interesting, and well managed; the characters strongly marked; and the dialogue sprightly and natural: yet there is in the latter a coarseness which is not suitable to the politeness of the present age; and a fondness of repartee, which frequently runs into obscenity; and which we may suppose was the vice of that time, since even the delicate Shakespeare himself is not entirely free from it. But as these authors have more of that kind of wit than the last-mentioned writer, it is not to be wondered if their works were in the licentious reign of Charles II. preferred to his. Now, however, to the honour of the present taste be it spoken, the tables are entirely turned; and while Shakespeare's immortal works are our constant and daily fare, those of Beaumont and Fletcher, though delicate in their kind, are only occasionally served up; and even then great pains are taken to clear them of that *fumet*, which the *haut gout* of their contemporaries considered as their supremest relish, but which the more undepraved taste of ours has been justly taught to look on as, what it really is, no more than a corrupt and unwholesome taint.

Some of their plays were printed in quarto during the lives of the authors; and in the year 1645 there was published in folio a collection of such plays as had not been printed before, amounting to between thirty and forty. This collection was published by Mr Shirley, after the shutting up of the theatres; and dedicated to the earl of Pembroke by ten of the most famous actors. In 1679 there was an edition of all their plays published in folio; another edition in 1711 by Mr Tonson, in seven volumes 8vo, and the last in 1751.

Beaumont, a town of the Netherlands, in Hainault, on the confines of the territory of Liege. It was ceded to the French in 1684; and taken in 1691 by the English, who blew up the castle. It is situated between the rivers Maese and Sambre, in E. Long. 4. 1. N. Lat. 50. 12.

Beaumont le Roger, a town of Upper Normandy in France. E. Long. 0. 56. N. Lat. 49. 2.

Beaumont le Vicompte, a town of Maine in France. E. Long. 0. 10. N. Lat. 48. 12.

Beaumont sur Oise, a town in the Isle of France, seated on the declivity of a hill, with a bridge over the river Oise. E. Long. 2. 29. N. Lat. 49. 9.

BEAUNE, a handsome town of France, in the department of Coté d'Or, remarkable for its excellent wine, and for an hospital founded here in 1443. Its collegiate church is also one of the finest in France; the great altar is adorned with a table enriched with jewels; and its organs are placed on a piece of architecture which is the admiration of the curious. E. Long. 4. 50. N. Lat. 47. 2.

BEAUSOBRE, Isaac de, a learned Protestant writer, of French original, was born at Niort in 1659. He was forced into Holland to avoid the execution of a sentence upon him, which condemned him to make the *amende honourable;* and this for having broken the royal signet, which was put upon the door of a church of the Reformed, to prevent the public profession of their religion. He went to Berlin in 1694; was made chaplain to the king of Prussia, and counsellor of the royal consistory. He died in 1738, aged 79, after having published several works: as, 1. *Defense de la Doctrine des Reformes.* 2. A Translation of the New Testament and Notes, jointly with M. Lenfant; much esteemed by the Reformed. 3. *Dissertation sur les Adamites de Boheme;* a curious work. 4. *Histoire Critique de Manichee et du Manicheisme*, 2 tom. in 4to. This has been deemed by philosophers an interesting question, and nobody has developed it better than this author. 5. Several dissertations in the *Bibliotheque Britannique.*—Mr Beausobre had strong sense with profound erudition, and was one of the best writers among the Reformed; he preached as he wrote, and he did both with warmth and spirit.

BEAUTY, in its native signification, is appropriated to objects of sight. Objects of the other senses may be agreeable, such as the sounds of musical instruments, the smoothness and softness of some surfaces; but the agreeableness called *beauty* belongs to objects of sight.

Objects of sight are more complex than those of any other sense: in the simplest we perceive colour, figure, length, breadth, thickness. A tree is composed of a trunk, branches, and leaves; it has colour, figure, size, and sometimes motion: by means of each of these particulars, separately considered, it appears beautiful; but a complex perception of the whole greatly augments the beauty of the object. The human body is a composition of numberless beauties arising from the parts and qualities of the object, various colours, various motions, figures, size, &c. all united in one complex object, and striking the eye with combined force. Hence it is, that beauty, a quality so remarkable in visible objects, lends its name to every thing that is eminently agreeable. Thus, by a figure of speech, we say, a *beautiful sound*, a *beautiful thought*, a *beautiful discovery*, &c.

Considering

Beauty.

Considering attentively the beauty of visible objects, two kinds are discovered. The first may be termed *intrinsic* beauty, because it is discovered in a single object, without relation to any other: the other may be termed *relative*, being founded on the relation of objects. Intrinsic beauty is a perception of sense merely; for to perceive the beauty of a spreading oak, or of a flowing river, no more is required but singly an act of vision. Relative beauty is accompanied with an act of understanding and reflection: for we perceive not the relative beauty of a fine instrument or engine until we learn its use and destination. In a word, intrinsic beauty is ultimate; and relative beauty is that of means relating to some good end or purpose. These different beauties agree in one capital circumstance, that both are equally perceived as belonging to the object; which will be readily admitted with respect to intrinsic beauty, but is not so obvious with respect to the other. The utility of the plough, for example, may make it an object of admiration or of desire; but why should utility make it beautiful? A natural propensity of the human mind will explain this difficulty: By an easy transition of ideas, the beauty of the effect is transferred to the cause, and is perceived as one of the qualities of the cause. Thus a subject void of intrinsic beauty appears beautiful by its utility; a dwelling-house void of all regularity is however beautiful in the view of convenience; and the want of symmetry in a tree will not prevent its appearing beautiful, if it be known to produce good fruit.

When these two beauties concur in any object, it appears delightful. Every member of the human body possesses both in a high degree.

The beauty of utility, being accurately proportioned to the degree of utility, requires no illustration: But intrinsic beauty, being more complex, cannot be handled distinctly without being analyzed. If a tree be beautiful by means of its colour, figure, motion, size, &c. it is in reality possessed of so many different beauties. The beauty of colour is too familiar to need explanation. The beauty of figure is more: for example, viewing any body as a whole, the beauty of its figure arises from regularity and simplicity; viewing the parts with relation to each other, uniformity, proportion, and order, contribute to its beauty. The beauties of grandeur and motion are considered separately. See GRANDEUR and MOTION.

We shall here make a few observations on simplicity, which may be of use in examining the beauty of single objects. A multitude of objects crowding into the mind at once, disturb the attention, and pass without making any lasting impression: In the same manner, even a single object, consisting of a multiplicity of parts, equals not, in strength of impression, a more simple object comprehended in one view. This justifies simplicity in works of art, as opposed to complicated circumstances and crowded ornaments.

It would be endless to enumerate the effects that are produced by the various combinations of the principles of beauty. A few examples will be sufficient to give the reader some idea of this subject. A circle and a square are each perfectly regular: a square, however, is less beautiful than a circle; and the reason is, that the attention is divided among the sides and angles of a square; whereas the circumference of a circle, being a single object, makes one entire impression: And thus simplicity contributes to beauty. For the same reason a square is more beautiful then a hexagon or octagon. A square is likewise more beautiful than a parallelogram, because it is more regular and uniform. But this holds with respect to intrinsic beauty only: for in many instances, as in the doors and windows of a dwelling-house, utility turns the scales on the side of the parallelogram.

Again, a parallelogram depends, for its beauty, on the proportion of its sides: A great inequality of its sides annihilates its beauty: Approximation toward equality hath the same effect; for proportion there degenerates into perfect uniformity, and the figure appears an unsuccessful attempt toward a square. And hence proportion contributes to beauty.

An equilateral triangle yields not to a square in regularity nor in uniformity of parts, and it is more simple. But an equilateral triangle is less beautiful than a square; which must be owing to inferiority of order in the position of its parts; the order arising from the equal inclination of the sides of such an angle is more obscure than the parallelism of the sides of a square. And hence order contributes to beauty not less than simplicity, regularity, or proportion.

Uniformity is singular in one circumstance, that it is apt to disgust by excess. A number of things destined for the same use, as windows, chairs, &c. cannot be too uniform. But a scrupulous uniformity of parts in a large garden or field is far from being agreeable.

In all the works of nature simplicity makes a capital figure. It also makes a figure in works of art: Profuse ornament in painting, gardening, or architecture, as well as in dress or in language, shows a mean or corrupted taste. Simplicity in behaviour and manners has an enchanting effect, and never fails to gain our affection. Very different are the artificial manners of modern times. A gradual progress from simplicity to complex forms and profuse ornament, seems to be the fate of all the fine arts; resembling behaviour, which from original candour and simplicity has degenerated into duplicity of heart and artificial refinements. At present, literary productions are crowded with words, epithets, figures: In music, sentiment is neglected for the luxury of harmony, and for difficult movement.

With regard to the final cause of beauty, one thing is evident, that our relish of regularity, uniformity, proportion, order, and simplicity, contributes greatly to enhance the beauty of the objects that surround us, and of course tends to our happiness. We may be confirmed in this thought, upon reflecting, that our taste for these particulars is not accidental, but uniform and universal, making a branch of our nature. At the same time, regularity, uniformity, order, and simplicity, contribute each of them to readiness of apprehension, and enable us to form more distinct ideas of objects than can be done where these particulars are wanting. In some instances, as in animals, proportion is evidently connected with utility, and is the more agreeable on that account.

Beauty, in many instances, promotes industry; and as it is frequently connected with utility, it proves an additional incitement to enrich our fields and improve our manufactures. These, however, are but slight effects,

effects, compared with the connections that are formed among individuals in society by means of beauty. The qualifications of the head and heart are undoubtedly the most solid and most permanent foundations of such connections: But as external beauty lies more in view, and is more obvious to the bulk of mankind, than the qualities now mentioned, the sense of beauty has a more extensive influence in forming these connections. At any rate, it concurs in an eminent degree with mental qualifications, in producing social intercourse, mutual good will, and consequently mutual aid and support, which are the life of society; it must not however be overlooked, that the sense of beauty does not tend to advance the interests of society, but when in a due mean with respect to strength. Love, in particular, arising from a sense of beauty, loses, when excessive, its social character: the appetite for gratification, prevailing over affection for the beloved object, is ungovernable, and tends violently to its end, regardless of the misery that must follow. Love, in this state, is no longer a sweet agreeable passion: it becomes painful, like hunger or thirst; and produceth no happiness but in the instant of fruition. This suggests an important lesson, that moderation in our desires and appetites, which fits us for doing our duty, contributes at the same time the most to happiness; even social passions, when moderate, are more pleasant than when they swell beyond proper bounds.

Human or Personal BEAUTY, only slightly touched upon in the preceding article, merits more particular discussion; and may be considered under these four heads: Colour, Form, Expression, and Grace; the two former being, as it were, the Body, the two latter the Soul, of beauty.

1. *Colour*. Although this be the lowest of all the constituent parts of beauty, yet it is vulgarly the most striking and the most observed. For which there is a very obvious reason to be given; that "every body can see, and very few can judge;" the beauties of colour requiring much less of judgment than either of the other three.

As to the colour of the body in general, the most beautiful perhaps that ever was imagined, was that which Apelles expressed in his famous Venus; and which, though the picture itself be lost, Cicero has in some degree preserved to us, in his excellent description of it. It was (as we learn from him, a fine red, beautifully intermixed and incorporated with white; and diffused, in its due proportions, through each part of the body. Such are the descriptions of a most beautiful skin, in several of the Roman poets; and such often is the colouring of Titian, and particularly in his sleeping Venus, or whatever other beauty that charming piece was meant to represent.

The reason why these colours please so much, is not only their natural liveliness, nor the much greater charms they obtain from their being properly blended together, but is also owing in some degree to the idea they carry with them of good health; without which all beauty grows languid and less engaging: and with which it always recovers an additional life and lustre.

As to the colour of the face in particular, a great deal of beauty is owing (beside the causes already mentioned) to variety; that being designed by nature for the greatest concourse of different colours, of any part in the human body. Colours please by opposition; and it is in the face that they are the most diversified, and the most opposed.

It is an observation apparently whimsical, but perhaps not unjust, that the same thing which makes a fine evening, makes a fine face; that is, as to the particular part of beauty now under consideration.

The beauty of an evening sky, about the setting of the sun, is owing to the variety of colours that are scattered along the face of the heavens. It is the fine red clouds, intermixed with white, and sometimes darker ones, with the azure bottom appearing here and there between them, which makes all that beautiful composition that delights the eye so much, and gives such a serene pleasure to the heart. In the same manner, if you consider some beautiful faces, you may observe that it is much the same variety of colours which gives them that pleasing look; which is so apt to attract the eye, and but too often to engage the heart. For all this sort of beauty is resolvable into a proper variation of flesh colour and red, with the clear blueness of the veins pleasingly intermixed about the temples and the going off of the cheeks, and set off by the shades of full eyebrows; and of the hair, when it falls in a proper manner round the face.

It is for much the same reason that the best landscape painters have been generally observed to choose the autumnal part of the year for their pieces, rather than the spring. They prefer the variety of shades and colours, though in their decline, to all the freshness and verdure in their infancy; and think all the charms and liveliness even of the spring, more than compensated by the choice, opposition, and richness of colours, that appear almost on every tree in the autumn.

Though one's judgment is apt to be guided by particular attachments (and that more perhaps in this part of beauty than any other), yet the general persuasion seems well founded, that a complete brown beauty is really preferable to a perfect fair one; the bright brown giving a lustre to all the other colours, a vivacity to the eyes, and a richness to the whole look, which one seeks in vain in the whitest and most transparent skins. Raphael's most charming Madonna is a brunette beauty; and his earlier Madonnas (or those of his middle style) are generally of a lighter and less pleasing complexion. All the best artists in the noblest age of painting, about Leo the tenth's time, used this deeper and richer kind of colouring; and perhaps one might add, that the glaring lights introduced by Guido, went a great way towards the declension of that art; as the enfeebling of the colours by Carlo Marat (or his followers) hath since also completed the fall of it in Italy.

Under this article *colour*, it seems doubtful whether some things ought not to be comprehended which are not perhaps commonly meant by that name. As that appearing softness or silkiness of some skins: that (A) Magdalen-

(A) The look here meant is most frequently expressed by the best painters in their Magdalens; in which, if there were no tears on the face, you would see, by the humid redness of the skin, that she had been weeping extremely.

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Magdalen-look in some fine faces, after weeping; that brightness, as well as tint, of the hair; that lustre of health that shines forth upon the features; that luminousness that appears in some eyes, and that fluid fire, or glistening, in others: Some of which are of a nature so much superior to the common beauties of colour, that they make it doubtful whether they should not have been ranked under a higher class, and reserved for the expressions of the passions. They are, however, mentioned here; because even the most doubtful of them appear to belong partly to this head, as well as partly to the others.

2. *Form.* This takes in the turn of each part, as well as the symmetry, of the whole body, even to the turn of an eye-brow, or the falling of the hair. Perhaps, too, the attitude, while fixed, ought to be reckoned under this article: By which is not only meant the posture of the person, but the position of each part; as the turning of the neck, the extending of the hand, the placing of a foot, and so on to the most minute particulars.

The general cause of beauty in the form or shape in both sexes is a proportion, or a union and harmony, in all parts of the body.

The distinguishing character of beauty in the female form, is delicacy and softness; and in the male, either apparent strength or agility. The finest exemplars that can be seen for the former, is the Venus of Medici; and for the two latter, the Hercules Farnese and the Apollo Belvedere.

There is one thing indeed in the last of these figures which exceeds the bounds of our present inquiry; what an Italian artist called *Il sovra umano;* and what we may call the transcendent, or celestial. It is something distinct from all human beauty, and of a nature greatly superior to it; something that seems like an air of divinity: Which is expressed, or at least is to be traced out, in but very few works of the artists; and of which scarcely any of the poets have caught any ray in their descriptions (or perhaps even in their imagination), except Homer and Virgil, among the ancients; and our Shakespeare and Milton among the moderns.

The beauty of the mere human form is much superior to that of colour; and it may be partly for this reason, that when one is observing the finest works of the artists at Rome (where there is still the noblest collection of any in the world), one feels the mind more struck and more charmed with the capital statues, than with the pictures of the greatest masters.

One of the old Roman poets, in speaking of a very handsome man, who was candidate for the prize in some of the public games, says, that he was much expected and much admired by all the spectators at his first appearance; but that, when he flung off his robes, and discovered the whole beauty of his shape altogether, it was so superior, that it quite extinguished the beauties they had before so much admired in his face. Much the same effect may be felt in viewing the Venus of Medici. If you observe the face only, it appears extremely beautiful: but if you consider all the other elegancies of her make, the beauty of her face becomes less striking, and is almost lost in such a multiplicity of charms.

Whoever would learn what makes the beauty of each part of the human body, may find it laid down pretty much at large, by (B) *Felibiens;* or may study it with more pleasure to himself, in the finest pictures and statues;

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extremely. There is a very strong instance of this in a Magdalen by Le Brun, in one of the churches at Paris; and several by Titian, in Italy; the very best of which is at the Barberino palace at Venice. In speaking of which, Rosalba hardly went too far, when she said, "It wept all over;" or (in the very words she used) "Elle pleure jusqu' aux bouts de doigts."

(B) In his *Entretiens*, vol. ii. p. 14—45. The chief of what he says there, on the beauty of the different parts of the female form, is as follows: That the head should be well rounded; and look rather inclining to small than large. The forehead, white, smooth, and open (not with the hair growing down too deep upon it); neither flat nor prominent, but like the head, well rounded; and rather small in proportion than large. The hair either bright black or brown; not thin, but full and waving; and if it falls in moderate curls the better. The black is particularly useful for setting off the whiteness of the neck and skin. The eyes black, chesnut, or blue; clear, bright, and lively; and rather large in proportion than small. The eye-brows, well divided, rather full than thin; semicircular, and broader in the middle than at the ends; of a neat turn, but not formal. The cheeks should not be wide; should have a degree of plumpness, with the red and white finely blended together; and should look firm and soft. The ear should be rather small than large; well folded, and with an agreeable tinge of red. The nose should be placed so as to divide the face into two equal parts; should be of a moderate size, straight, and well-squared; though sometimes a little rising in the nose, which is but just perceivable, may give a very graceful look to it. The mouth should be small; and the lips not of equal thickness. They should be well turned, small rather than gross; soft even to the eye; and with a living red in them. A truly pretty mouth is like a rose-bud that is beginning to blow. The teeth should be middle-sized, white, well-ranged, and even. The chin of a moderate size; white, soft, and agreeably rounded. The neck should be white, straight, and of a soft, easy, and flexible make, rather long than short; less above, and increasing gently toward the shoulders: The whiteness and delicacy of its skin should be continued, or rather go on improving to the bosom. The skin in general should be white, properly tinged with red; with an apparent softness, and a look of thriving health in it. The shoulders should be white, gently spread, and with a much softer appearance of strength than in those of men. The arm should be white, round, firm, and soft; and more particularly so from the elbow to the hand. The hand should unite insensibly with the arm; just as it does in the statue of the Venus of Medici. They should be long and delicate, and even the joints and nervous part of them should be without either any hardness or dryness. The fingers should be fine, long, round, and soft; small, and lessening towards the tips of them:

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statues; for in life we commonly see but a small part of the human body, most of it being either disguised or altered by what we call dress.

In fact we do not only thus, in a great measure, hide beauty; but even injure, and kill it, by some parts of dress. A child is no sooner born into the world, than it is bound up, almost as firmly as an old Egyptian mummy, in several folds of linen. It is in vain for him to give all the signs of distress that nature has put in his power, to show how much he suffers whilst they are thus imprisoning his limbs; or all the signs of joy, every time they are set at liberty. In a few minutes, the old witch who presides over his infirmest days falls to tormenting him afresh, and winds him up again in his destined confinement. When he comes to be drest like a man, he has ligatures applied to his arms, legs, and middle, in short all over him, to prevent the natural circulation of his blood, and make him less active and healthy: and if it be a child of the tenderer sex, she must be bound yet more straitly about the waist and stomach, to acquire a disproportion that nature never meant in her shape.

The two other constituent parts of beauty, are expression and grace; the former of which is common to all persons and faces; but the latter is to be met with in very few.

3. *Expression.* By this is meant the expression of the passions; the turns and changes of the mind, so far as they are made visible to the eye by our looks or gestures.

Though the mind appears principally in the face and attitudes of the head; yet every part almost of the human body, on some occasion or other, may become expressive. Thus the languishing hanging of the arm, or the vehement exertion of it; the pain expressed by the fingers of one of the sons in the famous group of Laocoon, and in the toes of the dying gladiator. But this again is often lost among us by our dress; and indeed is of the less concern, because the expression of the passions passes chiefly in the face, which we (by good luck) have not as yet concealed.

The parts of the face in which the passions most frequently make their appearance, are the eyes and mouth; but from the eyes they diffuse themselves very strongly about the eye-brows: as, in the other case, they appear often in the parts all round the mouth.

Philosophers may dispute as much as they please about the seat of the soul; but wherever it resides, we are sure that it speaks in the eyes. Perhaps it is injuring the eye-brows, to make them only dependents on the eye: for they, especially in lively faces, have, as it were, a language of their own; and are extremely varied, according to the different sentiments and passions of the mind.

Degree of pleasure may be often discerned in a lady's eye-brow, though she have address enough not to let it appear in her eyes; and at other times may be discovered so much of her thoughts, in the line just above her eye-brows, that she would probably be amazed how any body could tell what passed in her mind, and (as she thought) undiscovered by her face, so particularly and distinctly.

Homer makes the eye-brows the seat of (C) majesty, Virgil of (D) dejection, Horace of (E) modesty, and Juvenal of (F) pride; and it is not certain whether every one of the passions be not assigned, by one or other of the poets, to the same part.

Having hitherto spoken only of the passions in general, we will now consider a little which of them add to beauty, and which of them take from it.

We may say, in general, that all the tender and kind passions add to beauty; and all the cruel and unkind ones add to deformity: And it is on this account that good nature may very justly be said to be "the best feature even in the finest face."

Mr Pope has included the principal passion of each sort in two very pretty lines:

> Love, hope, and joy, fair pleasure's smiling train;
> Hate, fear, and grief, the family of pain.

The former of which naturally give an additional lustre and

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them: and the nails long, rounded at the ends, and pellucid. The bosom should be white and charming; and the breasts equal in roundness, whiteness, and firmness; neither too much elevated nor too much depressed; rising gently, and very distinctly separated; in one word, just like those of the Venus of Medici. The sides should be long, and the hips wider than the shoulders; and turn off as they do in the same Venus; and go down rounding and lessening gradually to the knee. The knee should be even and well rounded; the legs straight, but varied by a proper rounding of the more fleshy part of them, and the feet finely turned, white, and little.

(C) Η, και κυανεησιν επ' οφρυσι νευσε Κρονιων·
Αμβροσιαι δ' αρα χαιται επερρωσαντο ανακτος
Κρατος απ' αθανατοιο· μεγαν δ' ελελιξεν Ολυμπον. *Iliad.* i. 528.

It was from this passage that Phidias borrowed all the ideas of that majesty which he had expressed so strongly in his famous statues of the Jupiter Olympius; and Horace, probably, his——Cuncta supercilio moventis. *Lib.* iii. *Od.* 1. 8.

(D) Frons læta parum, et dejecto lumina vultu. *Virgil Æn.* vi. 863.

(E) Deme supercilio nubem; plerumque modestus
Occupat obscuri speciem. *Horat.* lib. i. epist. 18. 95.

(F) Malo Venusinam, quam te, Cornelia, mater
Gracchorum; si cum magnus virtutibus affers
Grande supercilium, et numeras in dote triumphos. *Juvenal, Sat.* vi. 168.

It is here that the Romans used the word *superciliosus* (as we do from it the word *supercilious*) for proud and arrogant persons.

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and enlivening to beauty; as the latter are too apt to fling a gloom and cloud over it.

Yet in these, and all the other passions, moderation ought perhaps to be considered in a great measure the rule of their beauty, almost as far as moderation in actions is the rule of virtue. Thus an excessive joy may be too boisterous in the face to be pleasing; and a degree of grief in some faces, and on some occasions, may be extremely beautiful. Some degrees of anger, shame, surprise, fear, and concern, are beautiful; but all excess is hurtful; and all excess ugly. Dulness, austerity, impudence, pride, affectation, malice, and envy, are always ugly.

The finest union of passions that can perhaps be observed in any face, consists of a just mixture of modesty, sensibility, and sweetness; each of which when taken singly is very pleasing; but when they are all blended together, in such a manner as either to enliven or correct each other, they give almost as much attraction as the passions are capable of adding to a very pretty face.

The prevailing passion in the Venus of Medici is modesty; it is exprest by each of her hands, in her looks, and in the turn of her head. And by the way it may be questioned, whether one of the chief reasons why side-faces please one more than full ones, be not from the former having more of the air of modesty than the latter. This at least is certain, that the best artists usually choose to give a side-face rather than a full one; in which attitude, the turn of the neck too has more beauty, and the passions more activity and force. Thus, as to hatred and affection in particular, the look that was formerly supposed to carry an infection with it from malignant eyes, was a slanting regard; like that which Milton gives to Satan, when he is viewing the happiness of our first parents in paradise; and the fascination, or stroke of love, is most usually conveyed, at first in a side-glance.

It is owing to the great force of pleasingness which attends all the kinder passions, "that lovers do not only seem, but are really, more beautiful to each other than they are to the rest of the world;" because when they are together, the most pleasing passions are more frequently exerted in each of their faces than they are in either before the rest of the world. There is then (as a certain French writer very well expresses it) "A soul upon their countenances," which does not appear when they are absent from each other; or even when they are together conversing with other persons, that are indifferent to them, or rather lay a restraint upon their features.

The superiority which the beauty of the passions has over the two parts of beauty first mentioned, will probably be now pretty evident: or if this should appear still problematical to any one, let him consider a little the following particulars, of which every body must have met with several instances in their lifetime: That there is a great deal of difference in the same face, according as a person is in a better or worse humour, or in a greater or less degree of liveliness: That the best complexion, the finest features, and the exactest shape, without any thing of the mind expressed on the face, are as insipid and unmoving as the waxen figure of the fine duchess of Richmond in Westminster-Abbey: That the finest eyes in the world, with an excess of malice or rage in them, will grow as shocking as they are in that fine face of Medusa on the famous seal in the Strozzi family at Rome: That a face without any good features in it, and with a very indifferent complexion, shall have a very taking air; from the sensibility of the eyes, the general good-humoured turn of the look, and perhaps a little agreeable smile about the mouth. And these three things perhaps would go a great way toward accounting for the *Je ne sçai quoi*, or that inexplicable pleasingness of the face (as they choose to call it), which is so often talked of and so little understood; as the greater part, and perhaps all the rest of it, would fall under the last article, that of grace.

Thus it appears that the passions can give beauty without the assistance of colour or form; and take it away where they have united the most strongly to give it. And hence the superiority of this part of beauty to the other two.

This, by the way, may help us to account for the justness of what Pliny asserts in speaking of the famous statue of Laocoon and his two sons: He says, it was the finest piece of art in Rome; and to be preferred to all the other statues and pictures, of which they had so noble a collection in his time. It had no beauties of colour to vie with the paintings and other statues there; and the Apollo Belvedere and the Venus of Medici, in particular, were as finely proportioned as the Laocoon: But this had much greater variety of expression even than those fine ones; and it must be on that account alone that it could have been preferable to them and all the rest.

Before quitting this head, two things before mentioned deserve to be repeated: That the chief rule of the beauty of the passions is moderation; and that the part in which they appear most strongly is the eyes. It is there that love holds all his tenderest language: It is there that virtue commands, modesty charms, joy enlivens, sorrow engages, and inclination fires the hearts of the beholders: It is there that even fear, and anger, and confusion, can be charming. But all these, to be charming, must be kept within their due bounds and limits; for too sullen an appearance of virtue, a violent and prostitute swell of passion, a rustic and overwhelming modesty, a deep sadness, or too wild and impetuous a joy, become all either oppressive or disagreeable.

4. The last finishing and noblest part of beauty is *Grace;* which every body is accustomed to speak of as a thing inexplicable; and in a great measure perhaps it is so. We know that the soul is, but we scarce know what it is: every judge of beauty can point out grace; but no one seems even yet to have fixed upon a definition for it.

Grace often depends on some very little incidents in a fine face; and in actions it consists more in the manner of doing things than in the things themselves. It is perpetually varying its appearance, and is therefore much more difficult to be considered than in any thing fixed and steady. While you look upon one, it steals from under the eye of the observer; and is succeeded perhaps by another that flits away as soon and as imperceptibly. It is on this account that grace is better to be studied in Corregio's, Guido's, and Raphael's pictures, than in real life.

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Beauty.

But though one cannot punctually say what grace is, we may point out the parts and things in which it is most apt to appear.

The chief dwelling-place of grace is about the mouth; though at times it may visit every limb or part of the body. But the mouth is the chief seat of grace, as much as the chief seat for the beauty of the passions is in the eyes. Thus, when the French use the expression of *une bouche fort gracieuse*, they mean it properly of grace: but when they say, *des yeux tres gracieux*, it then falls to the share of the passions; and it means kind or favourable.

In a very graceful face, by which we do not so much mean a majestic as a soft and pleasing one, there is now and then (for no part of beauty is either so engaging or so uncommon) a certain deliciousness that almost always lives about the mouth, in something not quite enough to be called a smile, but rather an approach towards one, which varies gently about the different lines there like a little fluttering Cupid, and perhaps sometimes discovers a little dimple, that after just lightening upon you disappears and appears again by fits.

The grace of attitudes may belong to the position of each part as well as to the carriage or disposition of the whole body: but how much more it belongs to the head than to any other part may be seen in the pieces of the most celebrated painters; and particularly in those of Guido, who has been rather too lavish in bestowing this beauty on almost all his fine women; whereas nature has given it in so high a degree but to very few.

The turns of the neck are extremely capable of grace, and are very easy to be observed, though very difficult to be accounted for.

How much of this grace may belong to the arms and feet, as well as to the neck and head, may be seen in dancing. But it is not only in genteel motions that a very pretty woman will be graceful; and Ovid (who was so great a master in all the parts of beauty) had very good reason for saying, That when Venus, to please her gallant, imitated the hobbling gait of her husband, her very lameness had a great deal of prettiness and grace in it.

De arte Amandi, ii. 570.

"Every motion of a graceful woman (says another writer of the same age) is full of grace." She designs nothing by it perhaps, and may even not be sensible of it herself: and indeed she should not be so too much; for the moment that any gesture or action appears to be affected, it ceases to be graceful.

Tibullus, lib. iv. l. 2. 8.

Horace and Virgil seem to extend grace so far as to the flowing of the hair, and Tibullus even to the dress of his mistress; but then he assigns it more to her manner of putting on and appearing in whatever she wears than to the dress itself. It is true, there is another wicked poet (Ovid) who has said (with much less decency) "that dress is the better half of the woman:"

—— *Pars minima est ipsa puella sui.* OVID.

There are two very distinct (and, as it were, opposite) sorts of grace; the majestic and the familiar. The former belongs chiefly to the very *fine* women, and the latter to the very *pretty* ones: *That* is more commanding, and *this* the more delightful and engaging. The Grecian painters and sculptors used to express the former most strongly in the looks and attitudes of their Minervas, and the latter in those of Venus.

Xenophon, in his Choice of Hercules (or at least the excellent translator of that piece), has made just the same distinction in the personages of Wisdom and Pleasure; the former of which he describes as moving on to that young hero with the majestic sort of grace; and the latter with the familiar:

Graceful, yet each with different grace they move;
This striking sacred awe, that softer winning love.

No poet seems to have understood this part of beauty so well as our own Milton. He speaks of these two sorts of grace very distinctly; and gives the majestic to his Adam, and both the familiar and majestic to Eve, but the latter in a less degree than the former:

Two of far nobler shape, erect and tall,
Godlike erect, with native honour clad,
In naked majesty, seem'd lords of all;
And worthy seem'd. For in their looks divine
The image of their glorious Maker shone:
Truth, wisdom, sanctitude severe and pure;
Severe, but in true filial freedom plac'd:
Whence true authority in men: Though both
Not equal, as their sex not equal, seem'd;
For contemplation he, and valour, form'd;
For softness she, and sweet attractive grace.
MILTON'S *Par. Lost*, book iv. 298.

———— I espy'd thee, fair indeed and tall,
Under a plantain; yet methought less fair,
Less winning soft, less amiably mild,
Than that smooth wat'ry image——
(*Eve, of Adam and herself*) *Ib.* ver. 480.

———————— Her heav'nly form
Angelic, but more soft and feminine;
Her graceful innocence; her ev'ry air
Of gesture, or least action.—— B. ix. 461.

Grace was in all her steps; Heav'n in her eye;
In every gesture, dignity and love. B. viii. 489.

Speaking or mute, all comeliness and grace
Attends thee; and each word, each motion, forms.
Ib. 223.

Though grace is so difficult to be accounted for in general, yet there are two particular things which seem to hold universally in relation to it.

The first is, "That there is no grace without motion; that is, without some genteel or pleasing motion, either of the whole body or of some limb, or at least of some feature. And it may be hence that Lord Bacon calls grace by the name of decent motion; just as if they were equivalent terms: "In beauty, that of favour is more than that of colour; and that of gracious and decent motion, more than that of favour."

Works, vol iii. p. 312.

Virgil in one place points out the majesty of Juno, and in another the graceful air of Apollo, by only saying that they move; and possibly he means no more when he makes the motion of Venus the principal thing by which Æneas discovers her under all her disguise:

Æn. i. 46. iv. 47. Æn. i. 405.

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Beauty.

disguise: though the commentators, as usual, would fain find out a more dark and mysterious meaning for it.

All the best statues are represented as in some action or motion; and the most graceful statue in the world (the Apollo Belvedere) is so much so, that when one faces it at a little distance, one is almost apt to imagine that he is actually going to move on toward you.

All graceful heads, even in the portraits of the best painters, are in motion; and very strongly on those of Guido in particular; which are all either casting their looks up toward heaven, or down toward the ground, or side-way, as regarding some object. A head that is quite unactive, and flung flat upon the canvas (like the faces on medals after the fall of the Roman empire, or the Gothic heads before the revival of the arts), will be so far from having any grace, that it will not even have any life in it.

The second observation is, "That there can be no grace with impropriety;" or, in other words, that nothing can be graceful that is not adapted to the characters of the person.

The graces of a little lively beauty would become ungraceful in a character of majesty: as the majestic airs of an empress would quite destroy the prettiness of the former. The vivacity that adds a grace to beauty in youth would give an additional deformity to old age; and the very same airs which would be charming on some occasions may be quite shocking when extremely mistimed or extremely misplaced.

The inseparable union of propriety and grace seems to have been the general sense of mankind, as we may guess from the languages of several nations; in which some words that answer to our proper or becoming, are used indifferently for beautiful or graceful. Thus, among the Greeks the words Πρεπον and Καλον, and among the Romans *pulchrum* and *decens*, or *decorum*, are used indifferently for one another.

It appears wrong, however, to think (as some have done) that grace consists entirely in propriety; because propriety is a thing easy enough to be understood, and grace (after all we can say about it) very difficult. Propriety, therefore, and grace are no more one and the same thing than grace and motion are. It is true, it cannot subsist without either; but then there seems to be something else, which cannot be explained, that goes to the composition, and which possibly may give it its greatest force and pleasingness.

Whatever are the causes of it, this is certain, that grace is the chief of all the constituent parts of beauty: and so much so, that it seems to be the only one which is absolutely and universally admired: All the rest are only relative. One likes a brunette beauty better than a fair one; I may love a little woman, and you a large one, best; a person of a mild temper will be fond of the gentler passions in the face, and one of a bolder cast may choose to have more vivacity and more vigorous passions expressed there: But grace is found in few, and is pleasing to all. Grace, like poetry, must be born with a person, and is never wholly to be acquired by art. The most celebrated of all the ancient painters was Apelles; and the most celebrated of all the modern Raphael: And it is remarkable, that the distinguishing character of each of them was grace. Indeed, that alone could have given them so high a pre-eminence over all their other competitors.

Grace has nothing to do with the lowest part of beauty or colour; very little with shape, and very much with the passions; for it is she who gives their highest zest, and the most delicious part of their pleasingness to the expressions of each of them.

All the other parts of beauty are pleasing in some degree, but grace is pleasingness itself. And the old Romans in general seem to have had this notion of it, as may be inferred from the original import of the names which they used for this part of beauty: *Gratia* from *gratus*, or "pleasing;" and *decor* from *decens*, or "becoming."

The Greeks as well as the Romans must have been of this opinion; when in settling their mythology, they made the Graces the constant attendants of Venus, or the cause of love. In fact, there is nothing causes love so generally and so irresistibly as grace. It is like the cestus of the same goddess, which was supposed to comprehend every thing that was winning and engaging in it; and beside all, to oblige the heart to love by a secret and inexplicable force like that of some magic charm.

She said; with awe divine, the queen of love
Obey'd the sister and the wife of Jove:
And from her fragrant breast the zone unbrac'd,
With various skill and high embroidery grac'd.
In this was every art, and every charm,
To win the wisest, and the coldest warm:
Fond love, the gentle vow, the gay desire,
The kind deceit, the still reviving fire.
Persuasive speech, and more persuasive sighs,
Silence that spoke, and eloquence of eyes.
This on her hand the Cyprian goddess laid;
Take this, and with it all thy wish, she said:
With smiles she took the charm; and smiling prest
The powerful Cestus to her snowy breast.

POPE, *Il.* xiv. 256.

Although people in general are more capable of judging right of beauty, at least in some parts of it, than they are of most other things; yet there are a great many causes apt to mislead the generality in their judgements of beauty. Thus if the affection is entirely engaged by any one object, a man is apt to allow all perfections to that person, and very little in comparison to any body else; or if they ever commend others highly, it is for some circumstance in which they bear some resemblance to their favourite object.

Again, people are very often misled in their judgements, by a similitude either of their own temper or personage in others. It is hence that a person of a mild temper is more apt to be pleased with the gentler passions in the face of his mistress; and one of a very lively turn would choose more of spirit and vivacity in his: that little people are inclined to prefer pretty women, and larger people majestic ones; and so on in a great variety of instances. This may be called falling in love with ourselves at second hand; and self-love (whatever other love may be) is sometimes so false-sighted, that it may make the most plain, and even the most disagreeable things, seem beautiful and pleasing.

Sometimes an idea of usefulness may give a turn to our ideas of beauty; as the very same things are reckoned

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koned beauties in a coach horse which would be so many blemishes in a race horse.

But the greatest and most general misleader of our judgments, in relation to beauty, is custom, or the different national tastes for beauty, which turn chiefly on the two lower parts of it, colour and form.

It was from the most common shape of his countrywomen, that Rubens, in his pictures, delights so much in plumpness; not to give it a worse name. Whenever he was to represent the most beautiful women, he is sure it give them a good share of corpulence. It seems as if nobody could be a beauty with him under two hundred weight. His very Graces are all fat.

But this may go much farther than mere bulk; it will reach even to very great deformities, which sometimes grow into beauties, where they are habitual and general. One of our own countrymen (who was a particularly handsome man) in his travelling over the Alps, was detained by a fever in one of those villages, where every grown person has that sort of swellings in the neck which they call *goitres;* and of which some are very near as big as their heads. The first Sunday that he was able, he went to their church (for he was a Roman catholic) to return thanks to heaven for his recovery. A man of so good a figure, and so well drest, had probably never before been within the walls of that chapel. Every body's eyes were fixed upon him: and as they went out, they cried out loud enough for him to hear them, "O how completely handsome would that man be, if he had but a *goitre!*"

In some of the most military nations of Africa, no man is reckoned handsome that has not five or six scars in his face. This custom might possibly at first be introduced among them to make them less afraid of wounds in that part in battle: but however that was, it grew at last to have so great a share in their idea of beauty, that they now cut and slash the faces of their poor little infants, in order to give them those graces, when they are grown up, which are so necessary to win the hearts of their mistresses; and which, with the assistance of some jewels or ingots of gold in their noses, ears, and lips, must certainly be irresistible to the ladies of that country.

The covering each cheek all over with a burning sort of red colour, has long been looked upon in a neighbouring country to be as necessary to render a fine lady's face completely beautiful, as these scars are for the beaux in Africa.

The natural complexion of the Italian ladies is of a higher glow than ours usually are; and yet Mr Addison is very just, in making a Numidian call the ladies of the same country *pale unripened beauties.*

The glowing dames of Zama's royal court
Have faces flusht with more exalted charms:
The sun, that rolls his chariot o'er their heads,
Works up more fire and colour in their cheeks:
Were you with these, my prince, you'd soon forget
The pale unripen'd beauties of the north!

Syphax to *Juba:* in *Cato*, act i. scene 4.

The prince of Anamaboo, who had been so long and latterly so much used to the European complexion, yet said of a certain lady a little before he left London, "That she would be the most charming woman in the world if she was but a negro."

In an account of some of the farthest travels that any of our people have made up the river Gambia, we are informed, that when they came to some villages where probably no Europeans had ever been before, the women ran frightened and screaming from them, on taking them to be devils, merely on account of the whiteness of their complexion.

We cannot avoid observing, however, that heaven is very good and merciful to mankind, even in making us capable of all this variety of mistakes. If every person judged exactly right of beauty, every man that was in love in such a district, would be in love with the same woman. The superior beauty of each ham'et would be the object of the hate and malice of all the rest of her own sex in it, and the cause of dissension and murders among all of the other. If this would hold in one town, it would hold for the same reasons in every other town or district; and of course there would be nothing more wanting than this universal right judgment of beauty, to render the whole world one continued scene of blood and misery.

But now that fancy has perhaps more to do with beauty than judgment, there is an infinity of tastes, and consequently an infinity of beauty; for to the mind of the lover, supposed beauty is full as good as real. Every body may now choose out what happens to hit his own turn and cast. This increases the extent of beauty vastly, and makes it in a manner universal: for there are but few people in comparison that are truly beautiful; but every body may be beautiful in the imagination of some one or other. Some may delight themselves in a black skin, and others in a white; some in a gentle natural rosiness of complexion, others in a high exalted artificial red; some nations in waists disproportionably large, and others in waists as disproportionably small. In short, the most opposite things imaginable may each be looked upon as beautiful in whole different countries, or by different people in the same country.

We should perhaps make a distinction here again, as to the two former parts of beauty and the two latter. Fancy has much more to do in the articles of form and colour than in those of the passions and grace. The good passions, as they are visible on the face, are apparent goodness; and that must be generally amiable: and true grace, wherever it appears to any degree, one should think must be pleasing to every human creature; or perhaps this may never appear in the women of any nation, where the men are grown so savage and brutal as to have lost all taste of it.

Yet even as to grace itself, under the notion of pleasingness, it may become almost universal, and be as subject to the dominion of fancy as any of the less significant parts of beauty. A parent can see gentleness in the most awkward child perhaps that ever was born; and a person who is truly in love, will be pleased with every motion and air of the person beloved; which is the most distinguishing character that belongs to grace. See this subject more fully considered in the article Beauty in the Supplement.

Beauty, in *Architecture*, *Painting*, and other arts, is the harmony and justness of the whole composition taken together.

BEAUVAIS, an episcopal city of France, in the department of Oise. The cathedral church, which is

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is dedicated to St Peter, is much admired for its fine architecture. It contains a great number of relics, and a library of curious books. The town was ineffectually besieged by the English in 1443, and by the duke of Burgundy with an army of 80,000 men. In this last siege the women signalized themselves under the conduct of Jean Hachette, who set up a standard yet preserved in the church of the Jacobins. The duke was obliged to raise the siege; and in memory of this exploit, the women walk first in a procession on the 10th of July, the anniversary of their deliverance. The town had 12,800 inhabitants in 1815. Beauvais is situated on the river Therin, 42 miles north of Paris, in E. Long. 2. 15. N. Lat. 49. 26.

BEAUVAIS, a town of France in Upper Languedoc, seated on the river Tescou. E. Long. 1. 43. N. Lat. 44. 2.

BEAUVIN, a city of Burgundy in France, in E. Long. 4. 50. N. Lat. 47.

BEAUVOIR *sur Mer*, a maritime town of France, in the department of Vendee, 25 miles south-west of Nantes. W. Long. 1. 5. N. Lat. 46. 45.

BEAUVOISIS, a territory of France, formerly part of Picardy, now included under the department of Oise.

BEBELINGUEN, a town of Suabia, in the kingdom of Wirtemberg in Germany, seated on a lake from which proceeds the river Worm. E. Long. 9. 8. N. Lat. 48. 45.

BEBRYCIA, in *Ancient Geography*, an ancient name of Bithynia, so called from the Bebryces its inhabitants. The Bebryces were afterwards driven out by the Thracians, viz. the Bithyni and Thyni: from whom, in process of time, the country took the name of *Bithynia*. See BITHYNIA.

BEC, a town of France, in the department of Lower Seine, seated on a tongue of land, at the confluence of two rivers. E. Long. 0. 52. N. Lat. 48. 45.

BECAH, or BEKAH, a Jewish coin, being half a shekel. In Dr Arbuthnot's table of reductions, the bekah amounts to 13$\frac{11}{16}$d.; in Dr Prideaux's computation to 1s. 6d. Every Israelite paid an hundred bekahs a head annually for the support of the temple.

BECALM, in a general sense, signifies to appease, to allay.

BECALM, in the sea language. A ship is said to be becalmed when there is not a breath of wind to fill the sails.

BECANOR, a town of India, in Asia, seated on the river Ganges, in E. Long. 83. 5. N. Lat. 27. 40.

BECCABUNGA, BROOKLIME; the trivial name of a species of veronica. See VERONICA, BOTANY *Index*.

BECCARIA, CÆSAR BONESANA, MARQUIS OF, an Italian writer on jurisprudence. See SUPPLEMENT.

BECCARIA, *Giambattista*, an Italian natural philosopher. See SUPPLEMENT.

BECCLES, a town of Suffolk in England, containing 2979 inhabitants in 1811. E. Long. 1. 30. N. Lat. 52. 38.

BECHER, JOHN JOACHIM, a celebrated chemist, was born at Spires, in 1645. He was connected with the most learned men in Europe; and the emperor, the electors of Mentz and Bavaria, and other persons of high rank, furnished him with the means of making experiments in mathematics, natural philosophy, medicine, and chemistry. As his thoughts were very judicious and uncommon with respect to economy and to increasing the revenues of a state, he was invited to Vienna, where he contributed greatly to the establishment of several manufactures, a chamber of commerce, and an India company; but the jealousy of some of the ministers occasioned his disgrace and ruin. He was not less unhappy at Mentz, Munich, and Wurtzburg; which determined him to go to Haerlem, where he invented a machine for working a great quantity of silk in a little time, and with few hands: but new misfortunes made him come to England, and he died at London in 1685. He wrote many works; the principal of which are, 1. *Physica Subterranea*, which was reprinted at Leipsic in 1703, and 1739, in octavo, with a small treatise, by E. Stahl, entitled *Specimen Becherianum*. 2. *Experimentum chymicum novum*, 8vo. 3. *Character pro Notitia Linguarum universali*. 4. *Institutiones Chymicæ, seu Manuductio ad Philosophiam Hermeticam*, 4to. 5. *Institutiones Chymicæ prodromæ*, 12mo. 6. *Experimentum novum ac curiosum de Minera arenaria perpetua*, &c.

BECHIN, a town of Bohemia, in the circle of the same name. It was taken and burnt by General Bequoi in 1619. It is seated on the river Lausuics, in E. Long. 15. 12. N. Lat. 49. 14.

BECK, or BEKE, a word which imports a small stream of water issuing from some burn or spring. Hence *Hell-becks*, little brooks in the rough and wild mountains about Richmond near Lancashire, so called on account of their ghastliness and depth.

BECK is chiefly used among us in the composition of names of places originally situated on rivulets: hence Walbeck, Bournbeck, &c. The Germans use *bech* in the same manner.

BECK, *David*, an eminent portrait painter, was born at Arnheim in Guelderland in 1621, and became a disciple of Vandyck; from whom he acquired a fine manner of penciling, and that sweet style of colouring which is peculiar to that great master and to all the disciples trained up under his direction. He possessed besides, that freedom of hand, and readiness, or rather rapidity of execution, for which Vandyck was so remarkably famous; and King Charles I. when he observed the expeditious manner of Beck's painting, was so exceedingly surprised, that he told Beck, it was his opinion, he could paint if he was riding post. He was appointed portrait-painter and chamberlain to Queen Christina of Sweden; and by her recommendation, most of the illustrious persons in Europe sat to him for their pictures. He was agreeable, handsome, and polite, and lived in the highest favour with his royal mistress: but, having an earnest desire to visit his friends in Holland, and leaving the court of Sweden much against the queen's inclination, she apprehended that he intended never to return; and, as he died soon after at the Hague, it was suspected that he was poisoned. This happened in 1656, when he was aged only 35 years. A very singular adventure happened to this painter as he travelled through Germany, which seems not unworthy of being recited. He was suddenly and violently taken ill at the inn where he lodged, and was laid out as a corpse, seeming to all appearance quite dead. His valets expressed the strongest marks of grief for the loss of their master, and while they sat beside his bed, they drank very freely by way of consolation.

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At last one of them, who grew much intoxicated, said to his companions, Our master was fond of his glass while he was alive, and out of gratitude let us give him a glass now he is dead. As the rest of the servants assented to the proposal, he raised up the head of his master, and endeavoured to pour some of the liquor into his mouth. By the fragrance of the wine, or probably by a small quantity that imperceptibly got down his throat, Beck opened his eyes; and the servant being excessively drunk, and forgetting that his master was considered as dead, compelled him to swallow what wine remained in the glass. The painter gradually revived, and by proper management and care recovered perfectly, and escaped a premature interment. How highly the works of this master were esteemed, may appear from the many marks of distinction and honour which were shown him; for he received from different princes, as an acknowledgment of his singular merit, nine gold chains, and several medals of gold, of a very large size.

BECKET, Thomas, lord chancellor of England, archbishop of Canterbury in the 12th century. The story of his birth is as extraordinary as that of his life. It is related that his father Gilbert Becket, some time sheriff of London, went on a pilgrimage to Jerusalem, where being surprised and enslaved by a party of Saracens, his master's daughter fell in love with him; and that when he made his escape she followed him to London. So singular an instance of heroic affection struck him; and after consulting with some bishops, he baptized her by the name of Matilda, and married her; from which marriage proceeded the haughty Thomas Becket. Being raised to the archbishopric, he began the great dispute between the crown and the mitre, and sided with the pope: at which King Henry II. was greatly offended; and calling an assembly of the bishops at Westminster, offered six articles against papal encroachments, which he urged Becket to assent to. Becket, at the importunities of several lords, signed them; but relapsing, he was ordered to be tried as a traitor: upon which he fled into Flanders. The king banished all his relations, and Becket excommunicated all his opposers. At last, after seven years, by the intercession of the French king and the pope, he returned; but refused to absolve these bishops and others he had excommunicated: whereupon the king grew enraged, and is reported to have dropped these expressions: "That he was an unhappy prince, who maintained a great number of lazy insignificant persons about him, none of whom had gratitude or spirit enough to revenge him on a single insolent prelate who gave him so much disturbance." These words of the king put four gentlemen of his court on forming a design against the archbishop's life, which they executed in the cathedral church of Canterbury, on the 29th of December 1171. They endeavoured to drag him out of the church; but finding they could not do this without difficulty, killed him there. The assassins being afraid they had gone too far, durst not return to the king's court at Normandy, but retired to Knaresborough in Yorkshire; where everybody avoided their company, hardly any person even choosing to eat or drink with them. They at length took a voyage to Rome, and being admitted to penance by Pope Alexander III. they went to Jerusalem; where, according to the pope's order, they spent their lives in penitential austerities, and died in the Black Mountain. They were buried at Jerusalem, without the church door belonging to the Templars. King Henry was, or affected to be, much disturbed at the news of Becket's death, and despatched an embassy to Rome to clear himself from the imputation of being the cause of it. Immediately all divine offices ceased in the church of Canterbury, and this for a year, excepting nine days; at the end of which, by order of the pope, it was reconsecrated. Two years after, Becket was canonized; and the following year, Henry returning to England, went to Canterbury, where he did penance as a testimony of his regret for the murder of Becket. When he came within sight of the church where the archbishop was buried, he alighted off his horse, and walked barefoot, in the habit of a pilgrim, till he came to Becket's tomb; where, after he had prostrated himself and prayed for a considerable time, he submitted to be scourged by the monks, and passed all that day and night without any refreshment, and kneeling upon the bare stone. In 1221 Becket's body was taken up, 50 years after his murder, in the presence of King Henry III. and a great concourse of the nobility and others, and deposited in a rich shrine, erected at the expence of Stephen Langton archbishop of Canterbury, which was soon visited from all parts, and enriched with the most costly gifts and offerings; and the miracles said to be wrought at his tomb were so numerous, that Gervase of Canterbury tells us, there were two large volumes of them kept in that church. The monks used to raise his body every year; and the day on which this ceremony was performed, which was called the *day of his translation*, was a general holiday: every 50th year there was celebrated a jubilee to his honour, which lasted 15 days: plenary indulgences were then granted to all that visited his tomb; and 100,000 pilgrims have been registered at a time in Canterbury. The devotion towards him had quite effaced in that town the adoration of the Deity; nay, even that of the Virgin. At God's altar, for instance, there were offered in one year 3l. 2s. 6d.; at the Virgin's, 63l. 5s. 6d.; at St Thomas's, 832l. 12s. 3d. But next year the disproportion was still greater: there was not a penny offered at God's altar; the Virgin's gained only 4l. 1s. 8d.; but St Thomas had got for his share 954l. 6s. 3d. Louis VII. of France had made a pilgrimage to this miraculous tomb, and had bestowed on the shrine a jewel which was esteemed the richest in Christendom. Henry VIII. to whom it may easily be imagined how obnoxious a saint of this character behoved to appear, and how much contrary to all his projects for degrading the authority of the court of Rome, not only pillaged the rich shrine dedicated to St Thomas, but made the saint himself be cited to appear in court, and be tried and condemned as a traitor: he ordered his name to be struck out of the kalendar; the office for his festival to be expunged from all breviaries; and his bones to be burnt, and the ashes thrown in the air. From Mr Thomas Warton we learn, that Becket was the subject of poetical legends. *The Lives of the Saints* in verse, in Bennet's library (Number CLXV.), contain his martyrdom and translation. This manuscript is supposed to be of the 14th century. The same ingenious writer informs us, from Peter de Blois, that the palace

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palace of Becket was perpetually filled with bishops highly accomplished in literature, who passed their time there in reading, disputing, and deciding important questions of the state. "These prelates, though men of the world, were a society of scholars; yet very different from those who frequented the universities, in which nothing was taught but words and syllables, unprofitable subtleties, elementary speculations, and trifling distinctions. De Blois was himself eminently learned, and one of the most distinguished ornaments of Becket's attendants. We know that John of Salisbury, his intimate friend, the companion of his exile, and the writer of his life, was scarcely exceeded by any man of his time for his knowledge in philological and polite literature."

BECKINGHAM, Charles, an English dramatic writer, was the son of a linen-draper in London, and born in 1699. He was educated at that great nursery of learning Merchant Taylor's school, under the learned Dr Smith, where he made a very great proficiency in all his studies, and gave the strongest testimonials of very extraordinary abilities. In poetry more particularly he very early discovered an uncommon genius, two dramatic pieces of his writing being represented on the stage before he had completed his 20th year: and those not such as required the least indulgence or allowance on account of his years; but such as bore evidence to a boldness of sentiment, and accuracy of diction, an ingenuity of conduct, and a maturity of judgement, which would have done honour to a much more ripened age. The titles of his plays, both of which are tragedies, are, 1. Henry IV. of France. 2. Scipio Africanus. At the representation of the last-mentioned piece, which indeed was the first he wrote, his schoolmaster Dr Smith gave all his boys a holiday on the afternoon of the author's benefit, in order to afford an opportunity to such of them as pleased to pay their compliments to their school-fellow on that occasion. Besides these dramatic pieces, he wrote several other poems: but his genius was not permitted any very long period to expand itself in; for he died on the 18th of February 1730, in the 32d year of his age.

BECKMAN, John, an eminent German writer. See Supplement.

BECKUM, a town of the bishopric of Munster, in Germany, seated at the source of the river Verse, in E. Long. 8. 18. N. Lat. 51. 46.

BECSANGIL, anciently Bithynia, a province of Natolia in Asia; bounded on the north by the Black sea; on the west, by the sea of Marmora; on the south, by Natolia Proper: and on the east, by the province of Bolli. The principal town is Bursa.

BECTASSE, an order or sect of religious among the Turks, denominated from their founder *Bectash*, preacher to Sultan Amurath. All the Janizaries belonging to the Porte are of the religion of Bectasse, being even said to have derived their origin from the founder of this sect. The habit of the Bectasse is white: on their heads they wear white caps of several pieces, with turbans of wool twisted rope-fashion. They observe constantly the hour of prayer, which they perform in their own assemblies, and make frequent declarations of the unity of God.

BED, a convenience for stretching and composing the body on, for ease, rest, or sleep, consisting generally of feathers enclosed in a ticken case. There are varieties of beds, as a standing-bed, a settee-bed, a tent-bed, a truckle-bed, &c.

It was universally the practice, in the first ages, for mankind to sleep upon skins of beasts. It was originally the custom of the Greeks and Romans. It was particularly the custom of the ancient Britons before the Roman invasion; and these skins were spread on the floor of their apartments. Afterwards they were changed for loose rushes and heath, as the Welsh a few years ago lay on the former, and the Highlanders of Scotland sleep on the latter to this present moment. In process of time, the Romans suggested to the interior Britons the use, and the introduction of agriculture supplied them with the means, of the greater conveniency of straw beds. The beds of the * Roman gentry at this period were generally filled with feathers, and those of the inns with the soft down of reeds. But for many ages the beds of the Italians had been constantly composed of straw; it still formed those of the soldiers and officers at the conquest of Lancashire; and from both, our countrymen learnt their use. But it appears to have been taken up only by the gentlemen, as the common Welsh had their beds thinly stuffed with rushes as late as the conclusion of the 12th century; and with the gentlemen it continued many ages afterwards. Straw was used even in the royal chambers of England as late as the close of the 13th. Most of the peasants about Manchester lie on chaff at present, as do likewise the common people all over Scotland: In the Highlands heath also is very generally used as bedding, even by the gentry; and the repose on a heath bed has been celebrated by travellers as a peculiar luxury, superior to that yielded by down: In France and Italy, straw beds remain general to this day. But after the above period, beds were no longer suffered to rest upon the ground. The better mode, that had anciently prevailed in the east, and long before been introduced into Italy, was adopted in Britain; and they were now mounted on pedestals †. This, however, was equally confined to the gentlemen. The bed still continued on the floor among the common people. And the gross custom, that had prevailed from the beginning was retained by the lower Britons to the last; and these ground-beds were laid along the walls of their houses, and formed one common dormitory for all the members of the family. The fashion continued universally among the inferior ranks of the Welsh within these four or five ages, and with the more uncivilized part of the Highlanders down to our own times. And even at no great distance from Manchester, in the neighbouring Buxton, and within these 60 or 70 years, the persons that repaired to the bath are all said to have slept in one long chamber together; the upper part being allotted to the ladies, and the lower to the gentlemen, and only partitioned from each other by a curtain.

Whittaker's History of Manchester.

* Pliny, lib. viii. c. 48. and xvi. c. 36.

† Gen. xlix.

Dining-Bed, *lectus tricliniaris* or *discubitorius*, that whereon the ancients lay at meals. The dining or discubitory beds were four or five feet high. Three of these beds were ordinarily ranged by a square table, (whence both the table and the room where they ate were called *triclinium*) in such a manner that one of the sides of the table remained open and accessible to the waiters. Each bed would hold three or four, rarely five persons. These beds were unknown before the se-

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tion, with other literary donations. In 1629, he obtained the bishopric of Kilmore and Ardagh in Ireland; and finding these dioceses in great disorder, applied himself vigorously to reform the abuses there. He was no persecutor of Papists, but laboured with great success to convert the better sort of the Popish clergy: he procured an Irish translation of the Common Prayer Book, which he caused to be read in his cathedral every Sunday; and the New Testament having been translated by Archbishop Daniel, he procured one of the Old Testament; which he having been prevented from printing himself, was afterwards executed at the expence of the great Mr Robert Boyle. He published, in 1624, a controversial book against the Roman Catholics, which he dedicated to Charles prince of Wales; and assisted the archbishop of Spalatro in finishing his famous work *De Republica Ecclesiastica*.—When the bloody rebellion broke out in Ireland in Oct. 1641, the bishop at first did not feel the violence of its effects; for the very rebels had conceived a great veneration for him, and they declared he should be the last Englishman they would drive out of Ireland. His was the only house in the county of Cavan that was inviolated, and it was filled with the people who fled to him for shelter. About the middle of December, however, the rebels, pursuant to orders received from their council of state at Kilkenny, required him to dismiss the people that were with him; which he refused to do, declaring he would share the same fate with the rest. Upon this, they seized him, his two sons, and Mr Clogy who had married his daughter-in-law, and carried them prisoners to the castle of Cloughboughter, surrounded by a deep water, where they put them all, except the bishop, in irons; after some time, however, this part of their severity was abated. After being confined for about three weeks, the bishop and his two sons, and Mr Clogy, were exchanged for some of the principal rebels: but the bishop died soon after, on the 7th of February 1642, his death being chiefly occasioned by his late imprisonment, and the weight of sorrows which lay upon his mind. The Irish did him unusual honours at his burial; for the chief of the rebels gathered their forces together, and with them accompanied his body to the church-yard.

BEDER, a strong town of Asia, in the dominions of the Great Mogul. E. Long. 81. 10. N. Lat. 16. 50.

BEDFORD, the county town of Bedfordshire in England, seated on both sides of the river Ouse, over which there is a stone bridge; in W. Long. 0. 20. N. Lat. 52. 6. It is an ancient town, and pleasantly situated, but not very large nor well built, though the buildings are much improved of late, and the river made navigable. It sends two members to parliament, and gives the title of *duke* to the noble family of Russel. At this place the Britons were overthrown in a great battle in 572, by Cuthwulf the Saxon king; and here was a strong castle, built in the time of the Normans by Pagan de Beauchamp, the third baron of Bedford. It was reduced by King Stephen after a long siege; and afterwards taken by King John, after a siege of 60 days, from Fulco de Brent, who rebelled against his sovereign, notwithstanding he had taken this castle before from the barons, and had it bestowed upon him by the king. The town is a very ancient corporation. The number of inhabitants in 1811 was 4605. The voters are said to be 1400. It is governed at present by a mayor, recorder, two bailiffs, twelve aldermen, two chamberlains, a town-clerk, and three serjeants. The neighbouring country is very fruitful in wheat, great quantities of which are carried from hence to Hitchen and Hertford markets, sold, ground, and conveyed to London. The town has five churches, a free school, and several hospitals, and enjoys a good trade in corn by the way of Lynn. When the river is swelled with rains, especially in winter, it is usual in Cambridgeshire to say, *the bailiff of Bedford is coming;* meaning that it is going to lay their fens under water.

BEDFORDSHIRE, an inland county of England. When the Romans landed in Britain, 55 years before Christ, it was included in the district inhabited by the Catieuchlani, whose chief or governor Cassibelinus headed the forces of the whole island against Cæsar, and the year following was totally defeated. In 310 the emperor Constantine divided Britain into five Roman provinces, when this county was included in the third division, called *Flavia Cæsariensis;* in which state it continued 426 years, when the Romans quitted Britain. At the establishment of the kingdom of Mercia (one of the divisions of the Saxon heptarchy) it was considered as part of that kingdom; and so continued from 582 to 827, when with the other petty kingdoms of the island it became subject to the West Saxons under Egbert, and the whole was named *England*. In 889, Alfred held the sovereignty, when England was divided into counties, hundreds, and tythings, and Bedfordshire first received its present name. It is in the Norfolk circuit, the province of Canterbury, and bishopric of Lincoln. Its form is oval, being about 33 miles long, 16 broad, and nearly 73 in circumference; containing an area of 275,000, or according to others of 307,200 square acres. It supplies 400 men to the national militia. It contains 124 parishes, 58 vicarages, and 11 market-towns, viz. Bedford, Ampthill, Biggleswade, Dunstable, Leighton, Beaudesart, Luton, Potton, Shefford, Tuddington, and Woburn, and 55 villages. The total number of inhabitants, in 1811, amounted to 70,213, and the number of houses to 13,286, occupied by 14,927 families. It is divided into nine hundreds, sends two members to parliament, and pays seven parts of 513 of the land tax. Its principal river, the Ouse, is navigable to Bedford; and divides the county into two parts, of which that to the south is the most considerable. In its course, which is very meandering, it receives several small streams; the principal one is the Ivel, which takes its rise in the southern part of the county. The air is healthy, and the soil in general a deep clay. The north side of the Ouse is fruitful and woody, but the south side is less fertile: yet producing great quantities of wheat and barley, excellent in their kind, and woad for dyers. The soil yields plenty of fullers earth for our woollen manufactory. The chief manufactures of the county are thread, lace, and straw ware. In this county there are many remains of Roman, Saxon, and Norman antiquities; and a few Roman stations, viz. Sandys near Potton, and the Magiovinum of Antoninus, by others supposed to be the ancient Salenæ, containing 30 acres, where many urns, coins, &c. have been dug up. Another at Madining-bowre, or Maiden-bower, one mile from Dunstable, containing about nine acres, which Camden supposes to have been a Roman station, from coins of

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BEDELL, Dr William, a learned prelate, born in Essex in 1570. He went with Sir Henry Wotton the English ambassador to the republic of Venice, as his chaplain, in 1604; and continuing eight years in that city, contracted an intimate acquaintance with the famous Father Paul, of whom he learned Italian so well as to translate the English Common Prayer Book into that language: in return he drew up an English grammar for Father Paul, who declared he had learned more from him in all parts of divinity than from any one beside. He was accordingly much concerned when Bedell left Venice; and at his departure presented him with his picture, the MSS. of his History of the Council of Trent, his History of the Interdict and Inquisition,

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tion, with other literary donations. In 1629, he obtained the bishopric of Kilmore and Ardagh in Ireland; and finding these dioceses in great disorder, applied himself vigorously to reform the abuses there. He was no persecutor of Papists, but laboured with great success to convert the better sort of the Popish clergy: he procured an Irish translation of the Common Prayer Book, which he caused to be read in his cathedral every Sunday; and the New Testament having been translated by Archbishop Daniel, he procured one of the Old Testament; which he having been prevented from printing himself, was afterwards executed at the expence of the great Mr Robert Boyle. He published, in 1624, a controversial book against the Roman Catholics, which he dedicated to Charles prince of Wales; and assisted the archbishop of Spalatro in finishing his famous work *De Republica Ecclesiastica*.—When the bloody rebellion broke out in Ireland in Oct. 1641, the bishop at first did not feel the violence of its effects; for the very rebels had conceived a great veneration for him, and they declared he should be the last Englishman they would drive out of Ireland. His was the only house in the county of Cavan that was inviolated, and it was filled with the people who fled to him for shelter. About the middle of December, however, the rebels, pursuant to orders received from their council of state at Kilkenny, required him to dismiss the people that were with him; which he refused to do, declaring he would share the same fate with the rest. Upon this, they seized him, his two sons, and Mr Clogy who had married his daughter-in-law, and carried them prisoners to the castle of Cloughboughter, surrounded by a deep water, where they put them all, except the bishop, in irons; after some time, however, this part of their severity was abated. After being confined for about three weeks, the bishop and his two sons, and Mr Clogy, were exchanged for some of the principal rebels: but the bishop died soon after, on the 7th of February 1642, his death being chiefly occasioned by his late imprisonment, and the weight of sorrows which lay upon his mind. The Irish did him unusual honours at his burial; for the chief of the rebels gathered their forces together, and with them accompanied his body to the church-yard.

BEDER, a strong town of Asia, in the dominions of the Great Mogul. E. Long. 81. 10. N. Lat. 16. 50.

BEDFORD, the county town of Bedfordshire in England, seated on both sides of the river Ouse, over which there is a stone bridge; in W. Long. 0. 20. N. Lat. 52. 6. It is an ancient town, and pleasantly situated, but not very large nor well built, though the buildings are much improved of late, and the river made navigable. It sends two members to parliament, and gives the title of *duke* to the noble family of Russel. At this place the Britons were overthrown in a great battle in 572, by Cuthwulf the Saxon king; and here was a strong castle, built in the time of the Normans by Pagan de Beauchamp, the third baron of Bedford. It was reduced by King Stephen after a long siege; and afterwards taken by King John, after a siege of 60 days, from Fulco de Brent, who rebelled against his sovereign, notwithstanding he had taken this castle before from the barons, and had it bestowed upon him by the king. The town is a very ancient corporation. The number of inhabitants in 1811 was 4605. The voters are said to be 1400. It is governed at present by a mayor, recorder, two bailiffs, twelve aldermen, two chamberlains, a town-clerk, and three serjeants. The neighbouring country is very fruitful in wheat, great quantities of which are carried from hence to Hitchen and Hertford markets, sold, ground, and conveyed to London. The town has five churches, a free school, and several hospitals, and enjoys a good trade in corn by the way of Lynn. When the river is swelled with rains, especially in winter, it is usual in Cambridgeshire to say, *the bailiff of Bedford is coming*; meaning that it is going to lay their fens under water.

BEDFORDSHIRE, an inland county of England. When the Romans landed in Britain, 55 years before Christ, it was included in the district inhabited by the Catieuchlani, whose chief or governor Cassibelinus headed the forces of the whole island against Cæsar, and the year following was totally defeated. In 310 the emperor Constantine divided Britain into five Roman provinces, when this county was included in the third division, called *Flavia Cæsariensis*; in which state it continued 426 years, when the Romans quitted Britain. At the establishment of the kingdom of Mercia (one of the divisions of the Saxon heptarchy) it was considered as part of that kingdom; and so continued from 582 to 827, when with the other petty kingdoms of the island it became subject to the West Saxons under Egbert, and the whole was named *England*. In 889, Alfred held the sovereignty, when England was divided into counties, hundreds, and tythings, and Bedfordshire first received its present name. It is in the Norfolk circuit, the province of Canterbury, and bishopric of Lincoln. Its form is oval, being about 33 miles long, 16 broad, and nearly 73 in circumference; containing an area of 275,000, or according to others of 307,200 square acres. It supplies 400 men to the national militia. It contains 124 parishes, 58 vicarages, and 11 market-towns, viz. Bedford, Ampthill, Biggleswade, Dunstable, Leighton, Beaudesart, Luton, Potton, Shefford, Tuddington, and Woburn, and 55 villages. The total number of inhabitants, in 1811, amounted to 70,213, and the number of houses to 13,286, occupied by 14,927 families. It is divided into nine hundreds, sends two members to parliament, and pays seven parts of 513 of the land tax. Its principal river, the Ouse, is navigable to Bedford; and divides the county into two parts, of which that to the south is the most considerable. In its course, which is very meandering, it receives several small streams; the principal one is the Ivel, which takes its rise in the southern part of the county. The air is healthy, and the soil in general a deep clay. The north side of the Ouse is fruitful and woody, but the south side is less fertile: yet producing great quantities of wheat and barley, excellent in their kind, and woad for dyers. The soil yields plenty of fullers earth for our woollen manufactory. The chief manufactures of the county are thread, lace, and straw ware. In this county there are many remains of Roman, Saxon, and Norman antiquities; and a few Roman stations, viz. Sandys near Potton, and the Magiovinum of Antoninus, by others supposed to be the ancient Salenæ, containing 30 acres, where many urns, coins, &c. have been dug up. Another at Madining-bowre, or Maiden-bower, one mile from Dunstable, containing about nine acres, which Camden supposes to have been a Roman station, from coins of

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of the emperors having been frequently dug up there, and calls it *Magintum*. Leighton Beaudesart is supposed to have been a Roman camp. There is another at Arlesey near Shefford; and a Roman amphitheatre may be traced near Bradford Magna. The Roman road, Icknield-street, crosses this county, entering at Leighton Beaudesart, from whence it passes Dunstable, where it inclines northward, over Wardon-hills, to Badlock in Hertfordshire. The Watling-street enters this county near Luton from St Albans, passes a little north of Dunstable, where it crosses the Icknield-street, and from thence to Stoney Stratford in Buckinghamshire. A Roman road also enters near Potton, passes on to Sandy, and from thence to Bedford, where it crosses the Ouse, and proceeds to Newport Pagnell in Buckinghamshire. The following antiquities in this county are worthy of notice: Bedford Bridge and Priory; Chicksand Abbey near Shefford; Dunstable Priory near Luton; Eaton Park House or Eaton Bray; Five Knolls near Dunstable; Newnham Priory near Bedford; Northill Church, three miles from Biggleswade; Summeris Tower near Luton; Wardon Abbey near Shefford; Woburn Abbey. See BEDFORDSHIRE, SUPPLEMENT.

BEDLOE, WILLIAM, who assumed the title of *Captain*, was an infamous adventurer of low birth, who had travelled over a great part of Europe under different names and disguises, and had passed among several ignorant persons for a man of rank and fortune. Encouraged by the success of Oates, he turned evidence, gave an account of Godfrey's murder, and added many circumstances to the narrative of the former. These villains had the boldness to accuse the queen of entering into a conspiracy against the king's life. A reward of 500l. was voted to Bedloe by the commons. He is said to have asserted the reality of the plot on his deathbed: but it abounds with absurdity, contradiction, and perjury; and still remains one of the greatest problems in the British annals. He died at Bristol 20th August 1680. Giles Jacob informs us, that he was author of a play called "The Excommunicated Prince, or the False Reliet," 1679. The printer of it having, without the author's knowledge, added a second title, and called it "The Popish Plot in a Play," greatly excited the curiosity of the public, who were, however, much disappointed when they found the plan of the piece to be founded on a quite different story. Anthony Wood will not allow the captain the merit of this play; but asserts that it was written partly, if not entirely, by one Tho. Walter, M. A. of Jesus college, Oxford.

BEDOUINS, or BEDOUIS, a modern name of the wild Arabs, whether in Asia or Africa. When speaking of the Arabs, we should distinguish whether they are cultivators or pastors; for this difference in their mode of life occasions so great a one in their manners and genius, that they become almost foreign nations with respect to each other. In the former case, leading a sedentary life, attached to the same soil, and subject to regular governments, the social state in which they live, very nearly resembles our own. Such are the inhabitants of Yemen; and such also are the descendants of those ancient conquerors who have either entirely, or in part, given inhabitants to Syria, Egypt, and the Barbary states. In the second instance, having only a transient interest in the soil, perpetually removing their tents from one place to another, and under subjection to no laws, their mode of existence is neither that of polished nations nor of savages; and therefore more particularly merits our attention. Such are the Bedouins, or inhabitants of the vast deserts which extend from the confines of Persia to Morocco. Though divided into independent communities or tribes, not unfrequently hostile to each other, they may still be considered as forming one nation. The resemblance of their language is a manifest token of this relationship. The only difference that exists between them is, that the African tribes are of a less ancient origin, being posterior to the conquest of these countries by the caliphs or successors of Mahomet; while the tribes of the desert of Arabia, properly so called, have descended by an uninterrupted succession from the remotest ages. To these the orientals are accustomed to appropriate the name of *Arabs*, as being the most ancient and the purest race. The term *Bedaoui* is added as a synonymous expression, signifying, "inhabitants of the Desert."

It is not without reason that the inhabitants of the desert boast of being the purest and the best preserved race of all the Arab tribes: for never have they been conquered, nor have they mixed with any other people by making conquests; for those by which the general name of Arabs has been rendered famous, really belong only to the tribes of Hedjaz and Yemen. Those who dwelt in the interior of the country never emigrated at the time of the revolution effected by Mahomet; or if they did take any part in it, it was confined to a few individuals, detached by motives of ambition. Thus we find the prophet in his Khoran continually styling the Arabs of the desert *rebels* and *infidels*; nor has so great a length of time produced any very considerable change. We may assert they have in every respect retained their primitive independence and simplicity. See ARABIA.

The wandering life of these people arises from the very nature of their deserts. To paint to himself these deserts (says M. Volney), the reader must imagine a sky almost perpetually inflamed, and without clouds, immense and boundless plains, without houses, trees, rivulets, or hills, where the eye frequently meets nothing but an extensive and uniform horizon like the sea, though in some places the ground is uneven and stony. Almost invariably naked on every side, the earth presents nothing but a few wild plants thinly scattered, and thickets, whose solitude is rarely disturbed but by antelopes, hares, locusts, and rats. Such is the nature of nearly the whole country, which extends six hundred leagues in length and three hundred in breadth, and stretches from Aleppo to the Arabian sea, and from Egypt to the Persian gulf. It must not, however, be imagined that the soil in so great an extent is everywhere the same; it varies considerably in different places. On the frontiers of Syria, for example, the earth is in general fat and cultivable, nay even fruitful. It is the same also on the banks of the Euphrates: but in the internal parts of the country, and towards the south, it becomes white and chalky, as in the parallel of Damascus; rocky, as in the Tih and the Hedjaz; and a pure sand, as to the eastward of Yemen. This variety in the qualities of the soil is productive

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Bedouins. ductive of some minute differences in the condition of the Bedouins. For instance, in the more sterile countries, that is, those which produce but few plants, the tribes are feeble and very distant: which is the case in the desert of Suez, that of the Red sea, and the interior of the great desert called the *Najd*. When the soil is more fruitful, as between Damascus and the Euphrates, the tribes are more numerous and less remote from each other; and, lastly, in the cultivable districts, such as the pachalics of Aleppo, the Hauran, and the neighbourhood of Gaza, the camps are frequent and contiguous. In the former instances, the Bedouins are purely pastors, and subsist only on the produce of their herds, and on a few dates and flesh meat, which they eat either fresh, or dried in the sun and reduced to a powder. In the latter, they sow some land, and add cheese, barley, and even rice, to their flesh and milk meats.

In those districts where the soil is stony and sandy, as in the Tih, the Hedjaz, and the Najd, the rains make the seeds of the wild plants shoot, and revive the thickets, ranunculi, wormwood, and kali. They cause marshes in the lower grounds, which produce reeds and grass; and the plain assumes a tolerable degree of verdure. This is the season of abundance both for the herds and their masters; but on the return of the heats, every thing is parched up, and the earth, converted into a gray and fine dust, presents nothing but dry stems as hard as wood, on which neither horses, oxen, nor even goats can feed. In this state the desert would become uninhabitable, and must be totally abandoned, had not nature formed an animal no less hardy and frugal than the soil is sterile and ungrateful. No creature seems so peculiarly fitted to the climate in which it exists. Designing the camel to dwell in a country where he can find little nourishment, Nature (says M. Volney) has been sparing of her materials in the whole of his formation. She has not bestowed on him the plump fleshiness of the ox, horse, or elephant; but limiting herself to what is strictly necessary, she has given him a small head without ears, at the end of a long neck without flesh. She has taken from his legs and thighs every muscle not immediately requisite for motion; and in short, has bestowed on his withered body only the vessels and tendons necessary to connect its frame together. She has furnished him with a strong jaw, that he may grind the hardest aliments; but lest he should consume too much, she has straitened his stomach, and obliged him to chew the cud. She has lined his foot with a lump of flesh, which sliding in the mud, and being no way adapted to climbing, fits him only for a dry, level, and sandy soil like that of Arabia: she has evidently destined him likewise to slavery, by refusing him every sort of defence against his enemies. Destitute of the horns of the bull, the hoof of the horse, the tooth of the elephant, and the swiftness of the stag, how can the camel resist or avoid the attacks of the lion, the tiger, or even the wolf? To preserve the species, therefore, nature has concealed him in the depth of the vast deserts, where the want of vegetables can attract no game, and whence the want of game repels every voracious animal. Tyranny must have expelled man from the habitable parts of the earth before the camel could have lost his liberty. Become domestic, he has rendered habitable the most barren soil the world contains. He alone supplies all his master's wants. The milk of the camel nourishes the family of the Arab, under the varied forms of curd, cheese, and butter; and they often feed upon his flesh. Slippers and harness are made of his skin, tents and clothing of his hair. Heavy burdens are transported by his means: and when the earth denies forage to the horse, so valuable to the Bedouin, the she camel supplies that deficiency by her milk, at no other cost, for so many advantages, than a few stalks of brambles or wormwood and pounded date kernels. So great is the importance of the camel to the desert, that were it deprived of that useful animal, it must infallibly lose every inhabitant.

Such is the situation in which nature has placed the Bedouins, to make of them a race of men equally singular in their physical and moral character. This singularity is so striking, that even their neighbours the Syrians regard them as extraordinary beings: especially those tribes which dwell in the depth of the deserts, such as the Anaza, Kaibar, Tai, and others, which never approach the towns. When in the time of Shaik Daher, some of their horsemen came as far as Acre, they excited the same curiosity there as a visit from the savages of America would among us. Every body viewed with surprise these men, who were more diminutive, meagre, and swarthy, than any of the known Bedouins. Their withered legs were only composed of tendons, and had no calves. Their bellies seemed to cling to their backs, and their hair was frizzled almost as much as that of the negroes. They on the other hand were no less astonished at every thing they saw; they could neither conceive how the houses and minarets could stand erect, nor how men ventured to dwell beneath them, and always in the same spot; but above all, they were in an ecstacy on beholding the sea, nor could they comprehend what that desert of water could be.

We may imagine that the Arabs of the frontiers are not such novices; there are even several small tribes of them, who living in the midst of the country, as in the valley of Bekaa, that of the Jordan, and in Palestine, approach nearer to the condition of the peasants; but these are despised by the others, who look upon them as bastard Arabs and Rayas, or slaves of the Turks.

In general, the Bedouins are small, meagre, and tawny; more so, however, in the heart of the desert than on the frontiers of the cultivated country; but they are always of a darker hue than the neighbouring peasants. They also differ among themselves in the same camp; and M. Volney remarked, that the shaiks, that is, the rich, and their attendants, were always taller and more corpulent than the common class. He has seen some of them above five feet five and six inches high; though in general they do not (he says) exceed five feet two inches. This difference can only be attributed to their food, with which the former are supplied more abundantly than the latter: And the effects of this are equally evident in the Arabian and Turcoman camels; for these latter, dwelling in countries rich in forage, are become a species more robust and fleshy than the former. It may likewise be affirmed, that the lower class of Bedouins live in a state of habitual wretchedness and famine. It will appear almost incredible to us, but it is an undoubted fact, that the

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Bedouins. the quantity of food usually consumed by the greatest part of them does not exceed six ounces a-day. This abstinence is most remarkable among the tribes of the Najd and the Hedjaz. Six or seven dates soaked in melted butter, a little sweet milk or curds, serve a man a whole day; and he esteems himself happy when he can add a small quantity of coarse flour or a little ball of rice. Meat is preserved for the greatest festivals: and they never kill a kid but for a marriage or a funeral. A few wealthy and generous shaiks alone can kill young camels, and eat baked rice with their victuals. In times of dearth, the vulgar, always half famished, do not disdain the most wretched kinds of food; and eat locusts, rats, lizards, and serpents broiled on briars. Hence are they such plunderers of the cultivated lands, and robbers on the high-roads: hence also their delicate constitution and their diminutive and meagre bodies, which are rather active than vigorous. It may be worth while to remark, that their evacuations of every kind, even perspiration, are extremely small; their blood is so destitute of serosity, that nothing but the greatest heat can preserve its fluidity. This, however, does not prevent them from being tolerably healthy in other respects; for maladies are less frequent among them than among the inhabitants of the cultivated country.

From these facts we are by no means justified in concluding that the frugality of the Bedouins is a virtue purely of choice, or even of climate. The extreme heat in which they live unquestionably facilitates their abstinence, by destroying that activity which cold gives to the stomach. Their being habituated also to so sparing a diet, by hindering the dilatation of the stomach, becomes doubtless a means of their supporting such abstemiousness; but the chief and primary motive of this habit is with them, as with the rest of mankind, the necessity of the circumstances in which they are placed, whether from the nature of the soil, as has been before explained, or that state of society in which they live, and which remains now to be examined.

It has been already remarked, that the Bedouin Arabs are divided into tribes, which constitute so many distinct nations. Each of these tribes appropriates to itself a tract of land forming its domain; in this they do not differ from cultivated nations, except that their territory requires a greater extent, in order to furnish subsistence for their herds throughout the year. Each tribe is collected in one or more camps, which are dispersed through the country, and which make a successive progress over the whole, in proportion as it is exhausted by the cattle; hence it is, that within a great extent a few spots only are inhabited, which vary from one day to another; but as the entire space is necessary for the annual subsistence of the tribe, whoever encroaches on it is deemed a violator of property; this is with them the law of nations. If, therefore, a tribe, or any of its subjects, enter upon a foreign territory, they are treated as enemies and robbers, and a war breaks out. Now, as all the tribes have affinities with each other by alliances of blood or conventions, leagues are formed, which render these wars more or less general. The manner of proceeding on such occasions is very simple. The offence made known, they mount their horses and seek the enemy: when they meet, they enter into a parley, and the matter is frequently made up; if not, they attack either in small bodies, or man to man. They encounter each other at full speed with fixed lances, which they sometimes dart, notwithstanding their length, at the flying enemy: the victory is rarely contested; it is decided by the first shock, and the vanquished take to flight at full gallop over the naked plain of the desert. Night generally favours their escape from the conqueror. The tribe which has lost the battle strikes its tents, removes to a distance by forced marches, and seeks an asylum among its allies. The enemy, satisfied with their success, drive their herds farther on, and the fugitives soon after return to their former situation. But the slaughter made in these engagements frequently sows the seeds of hatreds which perpetuate these dissensions. The interest of the common safety has for ages established a law among them, which decrees that the blood of every man who is slain must be avenged by that of his murderer. This vengeance is called *Tar*, or retaliation; and the right of exacting it devolves on the nearest of kin to the deceased. So nice are the Arabs on this point of honour, that if any one neglects to seek his retaliation he is disgraced for ever. He therefore watches every opportunity of revenge: if his enemy perishes from any other cause, still he is not satisfied, and his vengeance is directed against the nearest relation. These animosities are transmitted as an inheritance from father to children, and never cease but by the extinction of one of the families, unless they agree to sacrifice the criminal, or *purchase the blood* for a stated price, in money, or in flocks. Without this satisfaction, there is neither peace, nor truce, nor alliances, between them, nor sometimes even between whole tribes: *There is blood between us*, say they on every occasion; and this expression is an insurmountable barrier. Such accidents being necessarily numerous in a long course of time, the greater part of the tribes have ancient quarrels, and live in a habitual state of war; which, added to their way of life, renders the Bedouins a military people, though they have made no great progress in war as an art.

Their camps are formed in a kind of irregular circle, composed of a single row of tents, with greater or less intervals. These tents, made of goat or camels hair, are black or brown, in which they differ from those of the Turcomans, which are white. They are stretched on three or four pickets, only five or six feet high, which gives them a very flat appearance; at a distance, one of these camps seems only like a number of black spots: but the piercing eye of the Bedouin is not to be deceived. Each tent inhabited by a family is divided by a curtain into two apartments, one of which is appropriated to the women. The empty space within the large circle serves to fold their cattle every evening. They never have any intrenchments; their only advanced guards and patroles are dogs; their horses remain saddled and ready to mount on the first alarm; but as there is neither order nor regularity, these camps, always easy to surprise, afford no defence in case of an attack; accidents, therefore, very frequently happen, and cattle are carried off every day; a species of marauding war in which the Arabs are very experienced.

The tribes which live in the vicinity of the Turks are

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Bedouins. are still more accustomed to attacks and alarms; for these strangers, arrogating to themselves, in right of conquest, the property of the whole country, treat the Arabs as rebel vassals, or as turbulent and dangerous enemies. On this principle, they never cease to wage secret or open war against them. The pachas study every occasion to harass them. Sometimes they contest with them a territory which they had let them, and at others demand a tribute which they never agreed to pay. Should a family of shaiks be divided by interest or ambition, they alternately succour each party, and conclude by the destruction of both. Frequently too they poison or assassinate those chiefs whose courage or abilities they dread, though they should even be their allies. The Arabs, on their side, regarding the Turks as usurpers and treacherous enemies, watch every opportunity to do them injury. Unfortunately, their vengeance falls oftener on the innocent than the guilty. The harmless peasant generally suffers for the offences of the soldier. On the slightest alarm, the Arabs cut their harvests, carry off their flocks, and intercept their communication and commerce. The peasant calls them thieves, and with reason; but the Bedouins claim the right of war, and perhaps they also are not in the wrong. However this may be, these depredations occasion a misunderstanding between the Bedouins and the inhabitants of the cultivated country, which renders them mutual enemies.

Such is the external situation of the Arabs. It is subject to great vicissitudes, according to the good or bad conduct of their chiefs. Sometimes a feeble tribe raises and aggrandizes itself, whilst another, which was powerful, falls into decay, or perhaps is entirely annihilated: not that all its members perish, but they incorporate themselves with some other; and this is the consequence of the internal constitution of the tribes. Each tribe is composed of one or more principal families, the members of which bear the title of shaiks, i. e. chiefs or lords. These families have a great resemblance to the patricians of Rome and the nobles of modern Europe. One of the shaiks has the supreme command over the others. He is the general of their little army; and sometimes assumes the title of *emir*, which signifies commander and prince. The more relations, children, and allies, he has, the greater is his strength and power. To these he adds particular adherents, whom he studiously attaches to him, by supplying all their wants. But besides this, a number of small families, who, not being strong enough to live independent, stand in need of protection and alliances, range themselves under the banners of this chief. Such an union is called *kabila*, or tribe. These tribes are distinguished from each other by the name of their respective chiefs, or by that of the ruling family; and when they speak of any of the individuals who compose them, they call them the *children* of such a chief, though they may not be all really of his blood, and he himself may have been long since dead. Thus they say, *Beni Temin*, *Oulad Tai*, the children of Temin and of Tai. This mode of expression is even applied, by metaphor, to the names of countries: the usual phrase for denoting its inhabitants being to call them *the children of such a place*. Thus the Arabs say, *Oulad Masr*, the Egyptians; *Oulad Sham*, the Syrians; they would also say, *Oulad Fransa*, the French; *Oulad Mouskou*, the Russians; a remark which is not unimportant to ancient history. Bedouins.

The government of this society is at once republican, aristocratical, and even despotic, without exactly corresponding with any of these forms. It is republican, inasmuch as the people have a great influence in all affairs, and as nothing can be transacted without the consent of a majority. It is aristocratical, because the families of the shaiks possess some of the prerogatives which everywhere accompany power; and, lastly, it is despotic, because the principal shaik has an indefinite and almost absolute authority, which, when he happens to be a man of credit and influence, he may even abuse; but the state of these tribes confines even this abuse to very narrow limits: for if a chief should commit an act of injustice; if, for example, he should kill an Arab, it would be almost impossible for him to escape punishment; the resentment of the offended party would pay no respect to his dignity; the law of retaliation would be put in force; and, should he not pay the blood, he would be infallibly assassinated, which, from the simple and private life the shaiks lead in their camps, would be no difficult thing to effect. If he harasses his subjects by severity, they abandon him and go over to another tribe. His own relations take advantage of his misconduct to depose him and advance themselves to his station. He can have no resource in foreign troops: his subjects communicate too easily with each other to render it possible for him to divide their interests and form a faction in his favour. Besides, how is he to pay them, since he receives no kind of taxes from the tribe; the wealth of the greater part of his subjects being limited to absolute necessaries, and his own confined to very moderate possessions, and those too loaded with great expences?

The principal shaik in every tribe, in fact, defrays the charges of all who arrive at or leave the camp. He receives the visits of the allies, and of every person who has business with them. Adjoining to his tent is a large pavilion for the reception of all strangers and passengers. There are held frequent assemblies of the shaiks and principal men, to determine on encampments and removals; on peace and war; on the differences with the Turkish governors and the villages; and the litigations and quarrels of individuals. To this crowd, which enters successively, he must give coffee, bread baked on the ashes, rice, and sometimes roasted kid or camel; in a word, he must keep open table; and it is the more important to him to be generous, as this generosity is closely connected with matters of the greatest consequence. On the exercise of this depend his credit and his power. The famished Arab ranks the liberality which feeds him before every virtue; nor is this prejudice without foundation; for experience has proved that covetous chiefs never were men of enlarged views: hence the proverb, as just as it is brief, *A close fist, a narrow heart*. To provide for these expences, the shaik has nothing but his herds, a few spots of cultivated ground, the profits of his plunder, and the tribute he levies on the high-roads; the total of which is very inconsiderable. The shaik with whom M. Volney resided in the country of Gaza, about the end of 1784, passed for one of the most powerful of those districts; yet it did not appear to our author that his expenditure was greater than that of an opulent farmer.

His

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Bedouins. His personal effects, consisting of a few pelisses, carpets, arms, horses, and camels, could not be estimated at more than 50,000 livres (a little above 2000l.); and it must be observed, that in this calculation four mares of the breed of racers are valued at 6000 livres (250l.), and each camel at 10l. sterling. We must not therefore, when we speak of the Bedouins, affix to the words *Prince* and *Lord* the ideas they usually convey; we should come nearer to the truth by comparing them to substantial farmers in mountainous countries, whose simplicity they resemble in their dress as well as in their domestic life and manners. A shaik who has the command of 500 horse does not disdain to saddle and bridle his own, nor to give him barley and chopped straw. In his tent, his wife makes the coffee, kneads the dough, and superintends the dressing of the victuals. His daughters and kinswomen wash the linen, and go with pitchers on their head and veils over their faces to draw water from the fountain. These manners agree precisely with the descriptions in Homer and the history of Abraham in Genesis. But it must be owned that it is difficult to form a just idea of them without having ourselves been eye witnesses.

The simplicity, or perhaps more properly the poverty, of the lower class of the Bedouins is proportionate to that of their chiefs. All the wealth of a family consists of moveables; of which the following is a pretty exact inventory; a few male and female camels; some goats and poultry; a mare and her bridle and saddle; a tent; a lance 16 feet long; a crooked sabre; a rusty musket, with a flint and matchlock; a pipe; a portable mill; a pot for cooking; a leathern bucket; a small coffee roaster; a mat; some clothes; a mantle of black wool: and a few glass or silver rings, which the women wear upon their legs and arms. If none of these are wanting, their furniture is complete. But what the poor man stands most in need of, and what he takes most pleasure in, is his mare; for this animal is his principal support. With his mare the Bedouin makes his excursions against hostile tribes, or seeks plunder in the country and on the highways. The mare is preferred to the horse, because she is more docile, and yields milk, which on occasion satisfies the thirst and even the hunger of her master.

Thus confined to the most absolute necessities of life, the Arabs have as little industry as their wants are few; all their arts consist in weaving their clumsy tents and in making mats and butter. Their whole commerce only extends to the exchanging camels, kids, stallions, and milk; for arms, clothing, a little rice or corn, and money, which they bury. They are totally ignorant of all science; and have not even any idea of astronomy, geometry, or medicine. They have not a single book; and nothing is so uncommon among the shaiks as to know how to read. All their literature consists in reciting tales and histories in the manner of the Arabian Nights Entertainments. They have a peculiar passion for such stories, and employ in them almost all their leisure, of which they have a great deal. In the evening they seat themselves on the ground, at the threshold of their tents, or under cover, if it be cold; and there, ranged in a circle round a little fire of dung, their pipes in their mouths, and their legs crossed, they sit a while in silent meditation, till on a sudden one of them breaks forth with *Once upon a time,*—and continues to recite the adventures of some young shaik and female Bedouin; he relates in what manner the youth first got a secret glimpse of his mistress; and how he became desperately enamoured of her: he minutely describes the lovely fair; boasts her black eyes, as large and soft as those of the gazelle; her languid and empassioned looks; her arched eyebrows, resembling two bows of ebony; her waist straight and supple as a lance: he forgets not her steps, light as those of the *young filley;* nor her eyelashes, blackened with *kohl;* nor her lips painted blue; nor her nails, tinged with the golden-coloured *henna;* nor her breasts resembling two pomegranates; nor her words sweet as honey. He recounts the sufferings of the young lover, so *wasted with desire and passion, that his body no longer yields any shadow.* At length, after detailing his various attempts to see his mistress, the obstacles of the parents, the invasions of the enemy, the captivity of the two lovers, &c. he terminates to the satisfaction of the audience, by restoring them, united and happy, to the paternal tent, and by receiving the tribute paid to his eloquence, in the *Ma cha allah* (an exclamation of praise, equivalent to *admirably well!*) he has merited. The Bedouins have likewise their love songs, which have more sentiment and nature in them than those of the Turks and inhabitants of the towns; doubtless, because the former, whose manners are chaste, know what love is: while the latter, abandoned to debauchery, are acquainted only with enjoyment.

When we consider how much the condition of the Bedouins, especially in the depths of the desert, resembles in many respects that of the savages of America, we shall be inclined to wonder why they have not the same ferocity; why, though they so often experience the extremity of hunger, the practice of devouring human flesh was never heard of among them; and why, in short, their manners are so much more sociable and mild. The following reasons are proposed by M. Volney as the true solution of this difficulty.

It seems at first view (he observes), that America, being rich in pasturage, lakes, and forests, is more adapted to the pastoral mode of life than to any other. But if we consider that these forests, by affording an easy refuge to animals, protect them more surely from the power of man, we may conclude that the savage has been induced to become a hunter instead of a shepherd, by the nature of the country. In this state, all his habits have concurred to give him a ferocity of character. The great fatigues of the chase have hardened his body; frequent and extreme hunger, followed by a sudden abundance of game, has rendered him voracious. The habit of shedding blood, and tearing his prey, has familiarized him to the sight of death and sufferings. Tormented by hunger, he has desired flesh; and finding it easy to obtain that of his fellow-creature, he could not long hesitate to kill him to satisfy the cravings of his appetite. The first experiment made, this cruelty degenerates into a habit; he becomes a cannibal, sanguinary and atrocious; and his mind acquires all the insensibility of his body.

The situation of the Arab is very different. Amid his vast naked plains, without water and without forests, he has not been able, for want of game or fish, to become either a hunter or a fisherman. The camel has determined him to a pastoral life, the manners of which have influenced his whole character. Finding

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Bedouins.

at hand a light, but constant and sufficient nourishment, he has acquired the habit of frugality. Content with his milk and his dates, he has not desired flesh; he has shed no blood: his hands are not accustomed to slaughter, nor his ears to the cries of suffering creatures; he has preserved a humane and sensible heart.

No sooner did the savage shepherd become acquainted with the use of the horse, than his manner of life was considerably changed. The facility of passing rapidly over extensive tracts of country, rendered him a wanderer. He was greedy from want, and became a robber from greediness; and such is in fact his present character. A plunderer, rather than a warrior, the Arab possesses no sanguinary courage; he attacks only to despoil; and if he meets with resistance, never thinks a small booty is to be put in competition with his life. To irritate him you must shed his blood; in which case he is found to be as obstinate in his vengeance as he was cautious in avoiding danger.

The Bedouins have often been reproached with this spirit of rapine; but without wishing to defend it, we may observe that one circumstance has not been sufficiently attended to, which is, that it only takes place towards reputed enemies, and is consequently founded on the acknowledged laws of almost all nations. Among themselves they are remarkable for a good faith, a disinterestedness, a generosity, which would do honour to the most civilized people. What is there more noble than that right of asylum so respected among all the tribes? A stranger, nay even an enemy, touches the tent of the Bedouin, and from that instant his person becomes inviolable. It would be reckoned a disgraceful meanness, an indelible shame, to satisfy even a just vengeance at the expence of hospitality. Has the Bedouin consented to eat bread and salt with his guest, nothing in the world can induce him to betray him. The power of the sultan himself would not be able to force a refugee from the protection of a tribe, but by its total extermination. The Bedouin, so rapacious without his camp, has no sooner set his foot within it, than he becomes liberal and generous. What little he possesses he is ever ready to divide. He has even the delicacy not to wait till it is asked: when he takes his repast, he affects to seat himself at the door of his tent, in order to invite the passengers: his generosity is so sincere, that he does not look upon it as a merit, but merely as a duty; and he therefore readily takes the same liberty with others. To observe the manner in which the Arabs conduct themselves towards each other, one would imagine that they possessed all their goods in common. Nevertheless they are no strangers to property; but it has none of that selfishness which the increase of the imaginary wants of luxury has given it among polished nations. Deprived of a multitude of enjoyments which nature has lavished upon other countries, they are less exposed to temptations which might corrupt and debase them. It is more difficult for their shaiks to form a faction to enslave and impoverish the body of the nation. Each individual, capable of supplying all his wants, is better able to preserve his character and independence; and private property becomes at once the foundation and bulwark of public liberty.

This liberty extends even to matters of religion. We observe a remarkable difference between the Arabs of the towns and those of the desert; since, while the former crouch under the double yoke of political and religious despotism, the latter live in a state of perfect freedom from both: it is true, that on the frontiers of the Turks, the Bedouins, from policy, preserve the appearance of Mahometanism; but so relaxed is their observance of its ceremonies, and so little fervour has their devotion, that they are generally considered as infidels, who have neither law nor prophets. They even make no difficulty in saying that the religion of Mahomet was not made for them: "For (add they) how shall we make ablutions who have no water? How can we bestow alms who are not rich? Why should we fast in the Ramadan, since the whole year with us is one continual fast? and what necessity is there for us to make the pilgrimage to Mecca, if God be present everywhere?" In short, every man acts and thinks as he pleases, and the most perfect toleration is established among them.

Bedouins ‖ Bee.

BEDRIACUM, in *Ancient Geography*, a village of Italy, situated, according to Tacitus, between Verona and Cremona, but nearer the latter than the former. For the account given by that historian, Cluverius conjectures that the ancient Bedriacum stood in the place where the city of Caneto now stands. This village was remarkable for the defeat of the emperor Galba by Otho, and afterwards of Otho by Vitellius.

BEDWIN MAGNA, a village five miles south of Hungerford in Berkshire in England. It has neither market nor fair; but is a borough by prescription, and sends two members to parliament. It is said to have been a considerable place in the time of the Saxons, and that the traces of its fortifications are still extant.

BEE, in *Natural History*, a genus of insects, for the chararcters and classification of which see APIS, ENTOMOLOGY *Index*. The mellifica, or domestic honey bee, its history and economy, form the subject of this article.

1 Description of the honey-bee.

This species is furnished with downy hairs; has a dusky coloured breast, and brownish belly: the tibiae of the hind legs are ciliated, and transversely streaked on the inside. Each foot terminates in two hooks, with their points opposite to each other; in the middle of these hooks there is a little thin appendix, which, when unfolded, enables the insects to fasten themselves to glass or the most polished bodies. This part they likewise employ for transmitting the small particles of crude wax, which they find upon flowers, to the cavity in their thigh, hereafter described. The queen and drones, who never collect wax in this manner, have no such cavity. This species is also furnished with a proboscis or trunk, which serves to extract the honey from flowers; and has, besides, a real mouth situated in the fore part of the head, with which it is able to feed on the farina of flowers, from which afterwards is made wax. The belly is divided into six rings or joints; which sometimes shorten the body, by slipping the one over the other. In the inside of the belly there is a small bladder or reservoir, in which the honey is collected, after having passed through the proboscis and a narrow pipe which runs through the head and breast. This bladder, when full of honey, is about the size of a small pea.

The

Bee.

2
Its sting.

The sting, which is situated at the extremity of the belly, is a very curious weapon; and, when examined by the microscope, appears of a surprising structure. It has a horny sheath or scabbard, which includes two bearded darts. This sheath ends in a sharp point, near the extremity of which a slit opens, through which, at the time of stinging, the two bearded darts are protruded beyond the end of the sheath: one of these is a little longer than the other, and fixes its beard first: and the other instantly following, they penetrate alternately deeper and deeper, taking hold of the flesh with their beards or hooks, till the whole sting is buried in the flesh; and then a venomous juice is injected through the same sheath, from a little bag at the root of the sting. Hence the wound occasions an acute pain and swelling of the part, which sometimes continues several days. These effects are best remedied by enlarging the wound directly to give it some discharge. This poison seems to owe its mischievous efficacy to certain pungent salts. Let a bee be provoked to strike its sting against a plate of glass, and there will be a drop of the poison discharged and left upon the glass. This being placed under a double microscope, as the liquor evaporates, the salts will be seen to concrete, forming oblong, pointed, clear crystals.—Mr Derham counted on the sting of a wasp eight beards on the side of each dart, somewhat like the beards of fish-hooks; and the same number is to be counted on the darts of the bee's sting. When these beards are struck deep in the flesh, if the wounded person starts, or discomposes the bee before it can disengage them, the sting is left behind sticking in the wound: but if he have patience to stand quiet, the creature brings the hooks down close to the sides of the darts, and withdraws the weapon: in which case, the wound is always much less painful. The danger of being stung by bees may be in a great measure prevented by a quiet composed behaviour. A thousand bees will fly and buzz about a person without hurting him, if he stand perfectly still, and forbear disturbing them even when near his face; in which case he may observe them for hours together without danger; but if he molests or beats them away, he usually suffers for it. It has been lately affirmed *, that a person is in perfect safety in the midst of myriads of bees, if he but carefully keep his mouth shut, and breathe gently through the nostrils only; the human breath, it would seem, being peculiarly offensive to their delicate organs: and merely with this precaution, it is said, the very hives may be turned up, and even part of the comb cut out, while the bees are at work.

* See *Edinburgh Medical Commentaries*, vol. iv. p. 352.

I. Economy, Instincts, &c. *of the* Honey-Bee.

We may consider a hive of bees as a well-peopled city, in which are commonly found from 15,000 to 18,000 inhabitants. This city is in itself a monarchy;—composed of a *queen;* of males which are the *drones;* and of *working bees*, which have been supposed and called neuters. The combs, which are of pure wax, serve as their magazine of stores, and for the nursing places of their young offspring. There is between the combs a space sufficient for two bees to march abreast, without embarrassing each other; and in some parts it is more spacious. There are also holes, or narrow passes, which cross the combs transversely, and are intended to shorten the way when the bees pass from one comb to another.

3
Queen bee.

The Queen is easily distinguished from the other bees by the form of her body: she is longer and larger than they are, and her wings are much shorter than theirs in proportion to her body; for the wings of the other bees cover their whole body, whereas those of the queen hardly reach beyond her middle, or end at about the third ring of her belly. Her hinder parts are more taper than those of the other bees, terminating sharper. Her belly and legs are of a deep yellow, much resembling the purest gold. She is unwieldy in her flight, a reason for her seldom flying but when she leaves the parent-hive to go and settle a colony. All the bees form her retinue, and like dutiful subjects repair to the place she chooses. She is armed with a vigorous sting. Less passionate however than her subjects, she only uses her sting when long provoked, or when in contest for imperial sway. Never more than one remains in a hive, and that is the conqueror.

4
Attachment of her subjects.

A hive of bees cannot subsist without a queen, as she alone produces their numerous posterity; and on this account their fidelity and attachment to their sovereign are admirable.

5
Mr Wildman's feats by means of the queen.

Mr Wildman, by his dexterity in the management of bees, some years ago, surprised the whole kingdom. He can cause a swarm to light where he pleases, almost instantaneously; he can order them to settle on his head, then remove them to his hand; command them to depart and settle on a window, table, &c. at pleasure. We shall subjoin his method of performing these feats in his own words:

"Long experience has taught me, that as soon as I turn up a hive, and give it some taps on the sides and bottom, the queen immediately appears, to know the cause of this alarm, but soon retires again among her people. Being accustomed to see her so often, I readily perceive her at first glance; and long practice has enabled me to seize her instantly, with a tenderness that does not in the least endanger her person. This is of the utmost importance; for the least injury done to her brings immediate destruction to the hive, if you have not a spare queen to put in her place, as I have too often experienced in my first attempts. When possessed of her, I can without injury to her, or exciting that degree of resentment that might tempt her to sting me, slip her into my other hand, and, returning the hive to its place, hold her there, till the bees missing her, are all on wing, and in the utmost confusion. When the bees are thus distressed, I place the queen wherever I would have the bees to settle. The moment a few of them discover her, they give notice to those near them, and those to the rest; the knowledge of which soon becomes so general, that in a few minutes they all collect themselves round her; and are so happy in having recovered this sole support of their state, that they will long remain quiet in their situation. Nay, the scent of her body is so attractive of them, that the slightest touch of her, along any place or substance, will attach the bees to it, and induce them to pursue any path she takes." This was the only witchcraft used by Mr Wildman, and is that alone which is practised by others who have since made similar exhibitions. In short, seize on the queen, and you are

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are sure of leading all the bees of a hive to any place you please.

6 Consequences of her death, &c.

When a queen dies by an accident, the bees of her hive immediately cease working, consume their own honey, fly about their own and other hives at unusual hours when other bees are at rest, and pine away if not soon supplied with another sovereign. Her loss is proclaimed by a clear and interrupted humming. This sign should be a warning to the owner of the bees, to take what honey remains in the hive, or to procure them another queen. In this last case the flock instantly revives; pleasure and activity are apparent through the whole hive; the presence of the sovereign restores vigour and exertion, and her voice commands universal respect and obedience: of such importance is the queen to the existence and prosperity of the other members of this community.

The dissection of the queen-bee shews evidently that she lays many thousand eggs. It is computed that the ovaria of a queen-bee contain more than 5000 eggs at one time; and therefore it is not difficult to conceive that a queen-bee may produce 10,000 or 12,000 bees, or even more, in the space of two months.

7 Of the drones.

The common DRONES are smaller than the queen, and larger than the working bees; and in flying they make a greater noise. The dissection of the drone gives as great proof of its being the male, as that of the queen does of her being female. In this creature there is no appearance of ovaries or eggs, nor any thing of the structure of the common working bees, but the whole abdomen is filled with transparent vessels, winding about in various sinuosities, and containing a white or milky fluid. This is plainly analogous to that fluid in the males of other animals, which is destined to render the eggs of the female prolific: and this whole apparatus of vessels, which much resembles the turnings and windings of the seminal vessels in other animals, is plainly intended only for the preparation and retention of this matter, till the destined time of its being emitted. On squeezing the hinder parts also, may be forced out the penis, a small and slender fleshy body, contained between two horns of a somewhat harder substance, which join at their base, but gradually part asunder as they are continued in length. These parts, found in all the drones, and none of them in any other bees except these, seem to prove very evidently the difference of sex. If a hive is opened in the beginning of spring, not a single drone will be found in it; from the middle of May till the end of June, hundreds of them will be found, commonly from 200 or 300 to 1000; and from thence to the following spring it would be in vain to seek for them. They go not out till 11 in the morning, and return before six in the evening. But their expeditions are not those of industry. They have no sting, their rostrum and feet are not adapted for collecting wax and honey, nor indeed are they obliged to labour. They only hover upon flowers to extract the sweets, and all their thoughts are pleasure. Their office is, to impregnate the eggs of the queen after they are deposited in the cells. And while their presence is thus necessary, they are suffered to enjoy the sweets of love and life; but as soon as they become useless in the hive, the working bees declare the most cruel war against them, and make terrible slaughter of them. This war affects not only the bees already in life, but even the eggs and maggots; for the law which has pronounced the destruction of the males has no exception, it extends equally to those which do not yet breathe and to those which do; the hive is cleared of every egg, maggot, or nymph; the whole is torn away and carried off. After the season proper for increasing the number of bees is past, and when they should attend only to the supplying of their magazines sufficiently with winter stores, every vestige of the drones is destroyed, to make room for honey. Whenever these drones are observed to remain in a hive late in the autumn, it is held to be a bad sign of the state of the hive.

But besides these larger drones, Maraldi and Reaumur had long ago discovered that there were others of a lesser size, not exceeding that of the common working bees. This fact, however, was not fully ascertained before the late experiments of Mr Debraw, to be afterwards mentioned. It is well known, as has been already noticed, that the large drones never appear in the hive before the middle of April; that they are all dead before the end of August, when the principal breeding season terminates; and that they are destroyed, together with all their worms or nymphs, by the working bees, probably by order of the queen, to save honey: yet it is equally certain, that the bees begin to breed early in the spring, sometimes in February, if the weather is mild; and that many broods are completed before these drones appear. But if drones of a smaller size are suffered to remain, which in a time of scarcity consume less honey than the others, these will answer the purpose of supplying the early broods, and the larger drones are produced against a time of greater plenty. Some observers affirm, that the smaller drones are all dead before the end of May, when the larger species appear and supersede their use. These circumstances accord with the suggestion of Abbé le Pluche in his *Spectacle de la Nature*, That a small number of drones are reserved to supply the necessities of the ensuing year; and that these drones are very little, if at all, larger than the common bees.

The WORKING BEES compose the greatest body of the state. Columella informs us, that the ancients distinguished several kinds of them. He joins in opinion with Virgil, who approves of those which are small, oblong, smooth, bright, and shining, of a gentle and mild disposition: "for," continues he, "by how much the larger and rounder the bee is, by so much the worse it is: but if it be fierce and cruel, it is the worst of all. The angry disposition of bees of a better character is easily softened by the frequent intercourse of those who take care of them, for they grow more tame when they are often handled." The experience of ages has now established the sort of bees which have been found to answer best the purposes of keeping them. 8 The working bees.

The working bees have the care of the hive, collect the wax and honey, fabricate and work up the wax, build the cells, feed the young, keep the hive clean, drive from thence strangers, and employ themselves in all other concerns relating to the hive.

The working bee has two stomachs; one which contains the honey, and a second in which is contained the crude

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Bee.

crude wax. The working bees have no parts analogous to the ovaria of the queen, or that resemble the male organs of the drones. Hence they have generally been supposed to be neutral or of neither sex. But a different doctrine has lately been established; which there will be occasion to notice in the sequel.

The sting is very necessary for a working bee, both as an offensive and as a defensive weapon: for their honey and wax excite the envy of many greedy and lazy insects; and they have also to defend themselves against enemies who are fonder of eating them than their honey. There is likewise a time when the drones must be sacrificed and exterminated for the good of the society; and as they are larger and stronger than the working bees, these last would have a very unequal match, were it not for this poisonous sting.

9 Of their battles.

There happen also among bees, either of the same or of different hives, most deadly feuds, in which their stings are their chief weapons. In these contests, great skill may be discerned in their manner of pointing the sting between the scaly rings which cover their bodies, or to some other easily vulnerable part. The bee which first gains the advantage remains the conqueror; though the victory costs the victor his life, if he has left his sting in the body of the enemy; for, with the sting, so much of his body is torn out, that death inevitably follows. Bees have very severe conflicts when whole hives engage in a pitched battle, and many are slain on both sides. Their fighting and plundering one another ought chiefly to be imputed, as Mr Thorley observes, either to their perfect abhorrence of sloth and idleness, or to their insatiable thirst for honey; for when, in spring or autumn, the weather is fair, but no honey can be collected from plants, and is to be found only in the hives of other bees, they will venture their lives to get it there.

Dr Warder assigns another cause of their fighting; which is, the necessity that the bees are reduced to when their own hive has been plundered, at a season when it is too late for them to repair the loss by any industry in the fields.

Sometimes one of the queens is killed in battle. In this case, the bees of both hives unite as soon as her death is generally known among them. All then become one people; the vanquished go off with the robbers, richly laden with their own spoils, and return every day with their new associates to pillage their old habitation. This causes a throng, unusual for the season, at the door of the hive they are plundering; and if the owner lifts it up at night, when all are gone home, he will find it empty of inhabitants; though there perhaps will remain in it some honey, which he takes as his property.

When two swarms take flight at the same time, they sometimes quarrel, and great numbers are destroyed on both sides, till one of the queens is slain. This ends the contest, and the bees of both sides unite under the surviving sovereign.

10 Their labours.

When the bees begin to work in their hives, they divide themselves into four companies; one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of their cells; a third is employed in making the inside smooth from the corners and angles; and the fourth company brings food for the rest, or relieves those who return with their respective burdens. But they are not kept constant to one employment; they often change the tasks assigned them; those that have been at work being permitted to go abroad, and those that have been in the fields already take their places. They seem even to have signs, by which they understand each other; for when any of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the other's mouth, which is at that time opened to receive it. Their diligence and labour are so great, that in a day's time, they are able to make cells which lie upon each other numerous enough to contain 3000 bees.

11 Of the combs.

In the plan and formation of these cells they discover a most wonderful sagacity. In constructing habitations within a limited compass, an architect would have three objects in view: first, to use the smallest quantity that can be of materials; next, to give to the edifice the greatest capacity in a determined space; and thirdly, to employ the spot in such a manner that none of it may be lost. On examination it would be found that the bees have obtained all these advantages in the hexagonal form of their cells: for, first, there is an economy of wax, as the circumference of one cell makes part of the circumferences of those contiguous to it; secondly, the economy of the spot, as these cells which join to one another leave no void between them; and thirdly, the greatest capacity or space; as, of all the figures which can be contiguous, that with six sides gives the largest area. This thriftiness prompts them to make the partitions of their cells thin; yet they are constructed so as that the solidity may compensate for the scantiness of materials. The parts most liable to injury are the entrance of the cells. These the bees take care to strengthen, by adding quite round the circumference of the apertures a fillet of wax, by which means this mouth is three or four times thicker than the sides: and they are strengthened at the bottom by the angle formed by the bottom of three cells falling in the middle of an opposite cell. The combs lie parallel to each other; and there is left between every one of them a space which serves as a street, broad enough for two bees to pass by each other. There are holes which go quite through the combs, and serve as lanes for the bees to pass from one comb to another, without being obliged to go a great way about. When they begin their combs, they form at the top of the hive a root or stay to the whole edifice, which is to hang from it. Though they generally lay the foundations of the combs so that there shall be no more between them than what is sufficient for two bees to pass, yet they sometimes place those beginnings of two combs too far asunder; and, in this case, in order to fill up part of the void space arising from that bad disposition, they carry their combs on obliquely, to make them gradually approach each other. This void space is sometimes so considerable, that the bees build in it an intermediate comb, which they terminate as soon as the original combs have only their due distances. As the combs would be apt, when full, to overcome by their weight all the security which the bees can give them against falling, they who prepare hives set in them, crosswise, sticks, which serve as props to the combs, and save the bees a great deal of labour. It is not

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Bee.

not easy to discover the particular manner of their working; for, notwithstanding the many contrivances used for this purpose, there are such numbers in continual motion, and succeed one another with such rapidity, that nothing but confusion appears to the sight. Some of them, however, have been observed carrying pieces of wax in their talons, and running to the places where they are at work upon the combs. These they fasten to the work by means of the same talons. Each bee is employed but a very short time in this way: but there is so great a number of them that go on in a constant succession, that the comb increases very perceptibly. Besides these, there are others that run about beating the work with their wings and the hinder part of their body, probably with a view to make it more firm and solid.

Whilst part of the bees are occupied in forming the cells, others are employed in perfecting and polishing those that are new modelled. This operation is performed by their talons, taking off every thing that is rough and uneven. These polishers are not so desultory in their operations as those that make the cells; they work long and diligently, never intermitting their labour, excepting to carry out of the cell the particles of wax which they take off in polishing. These particles are not allowed to be lost; others are ready to receive them from the polishers, and to employ them in some other part of the work.

12 Of their building-materials and provisions. 1. *Wax.*

The balls which we see attached to the legs of bees returning to the hives are not wax, but a powder collected from the stamina of flowers, not yet brought to the state of wax. The substance of these balls, heated in any vessel, does not melt as wax would do, but becomes dry, and hardens: it may even be reduced to a coal. If thrown into water, it will sink; whereas wax swims. To reduce this crude substance into wax, it must first be digested in the body of the bee.

Every bee, when it leaves the hive to collect this precious store, enters into the cup of the flower, particularly such as seem charged with the greatest quantity of this yellow farina. As the animal's body is covered over with hair, it rolls itself within the flower, and quickly becomes quite covered with the dust, which it soon after brushes off with its two hind legs, and kneads into two little balls. In the thighs of the hind legs there are two cavities, edged with hair; and into these, as into a basket, the animal sticks its pellets. Thus employed, the bee flits from flower to flower, increasing its store, and adding to its stock of wax, until the ball upon each thigh becomes as big as a grain of pepper; by this time having got a sufficient load, it returns, making the best of its way to the hive.

After the bees have brought home this crude substance, they eat it by degrees; or at other times, three or four bees come and ease the loaded bee, by eating each of them a share, the loaded bee giving them a hint so to do. Hunger is not the motive of their thus eating the balls of waxy matter, especially when a swarm is first hived; but it is their desire to provide a speedy supply of real wax for making the combs. At other times, when there is no immediate want of wax, the bees lay this matter up in repositories, to keep it in store.

When this waxy matter is swallowed, it is, by the digestive powers of the bee, converted into real wax, which the bees again disgorge as they work it up into combs; for it is only while thus soft and pliant from the stomach that they can fabricate it properly. That the wax thus employed is taken from their stomachs, appears from their making a considerable quantity of comb soon after they are hived, and even on any tree or shrub where they have rested but a short while before their being hived, though no balls were visible on their legs, excepting those of a few which may be just returned from the field. This is farther confirmed by what happened in a swarm newly hived: for two days together from the time of their quitting their former home, it rained constantly, insomuch that not one bee was able to stir out during that time; yet at the end of the two days they had made a comb 15 or 16 inches long, and thick in proportion.

The crude wax, when brought home by the bees, is often of as different colours as are the flowers from which it is collected: but the new combs are always of a white colour, which is afterwards changed only by the impurities arising from the steam, &c. of the bees.

Bees collect crude wax also for food; for if this was not the case, there would be no want of wax after the combs are made: but they are observed, even in old hives, to return in great numbers loaded with such matter, which is deposited in particular cells, and is known by the name of *bee-bread*. We may guess that they consume a great deal of this substance in food by the quantity collected; which, by computation, may in some hives amount to an hundred weight in a season, whilst the real wax in such a hive does not perhaps exceed two pounds.

13 2. The *propolis.*

It is well known that the habitation of bees ought to be very close; and what their hives want from the negligence or unskilfulness of man, these animals, supply by their own industry: so that it is their principal care, when first hived, to stop up all the cranies. For this purpose they make use of a resinous gum, which is more tenacious than wax, and differs greatly from it. This the ancients called *propolis*. It will grow considerably hard in the hive, though it will in some measure soften by heat; and is often found different in consistence, colour, and smell. It has generally an agreeable aromatic odour when it is warmed; and by some it is considered as a most grateful perfume. When the bees begin to work with it, it is soft; but it acquires a firmer consistence every day, till at length it assumes a brown colour, and becomes much harder than wax. The bees carry it on their hinder legs; and some think it is met with on the birch, the willow, and poplar. However it is procured, it is certain that they plaster the inside of their hives with this composition.

14 3. The *honey.*

Honey is originally a juice digested in plants, which sweats through their pores, and chiefly in their flowers, or is contained in reservoirs in which nature stores it. The bees sometimes penetrate into these stores, and at other times find the liquor exuded. This they collect in their stomachs; so that, when loaded with it, they seem, to an inattentive eye, to come home without any booty at all.

Besides the liquor already mentioned, which is obtained from the flowers of plants, another substance, called *honey-dew* *, has been discovered, of which the bees

* See the article *Honey-dew.*

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Bee.

bees are equally fond. Of this substance there are two kinds, both deriving their origin from vegetables, though in very different ways.

The first kind, the only one known to husbandmen, and which passes for a dew that falls on trees, is no other than a mild sweet juice, which, having circulated through the vessels of vegetables, is separated in proper reservoirs in the flowers, or on the leaves, where it is properly called the *honey-dew:* sometimes it is deposited in the pith, as in the sugar-cane; and, at other times, in the juice of pulpy summer fruit when ripe. Such is the origin of the manna which is collected on the ash and maple of Calabria and Briançon, where it flows in great plenty from the leaves and trunks of these trees, and thickens into the form in which it is usually seen.

The second kind of honey-dew, which is the chief resource of bees, after the spring-flowers and dew by transpiration on the leaves are past, owes its origin to a small mean insect *, the excrement thrown out by which makes a part of the most delicate honey we ever taste.

* See the articles *Aphis* and *Honey-dew.*

From whatever source the bees have collected their honey, the instant they return home, they seek cells in which they may disgorge and deposite their loads. They have two sorts of stores: one which consists of honey laid up for the winter; and the other of honey intended for accidental use in case of bad weather, and for such bees as do not go abroad in search of it. Their method of securing each of these is different. They have in each cell a thicker substance, which is placed over the honey, to prevent its running out of the cell; and that substance is raised gradually as the cell is filled, till the bees, finding that the cell cannot contain any more, close it with a covering of wax, not to be opened till times of want, or during the winter.

15
Of the manner in which they breed.

It has been already observed, that the cells are intended for other purposes besides being places of store for honey. One of their chief uses is, their being nurseries for the young. The cells for those which are to be working bees are commonly half an inch deep; those for drones, three quarters of an inch; and those which are intended for keeping of honey only, still deeper. This accounts for the inequalities observed in the surface of combs.

The queen-bee is generally concealed in the most secret part of the hive, and is never visible but when she lays her eggs in such combs as are exposed to sight. When she does appear, she is always attended by ten or a dozen of the common sort, who form a kind of retinue, and follow her wherever she goes with a sedate and grave tread. Before she lays her eggs, she examines the cells where she designs to lay them; and if she finds that they contain neither honey, wax, nor any embryo, she introduces the posterior part of her body into the cell, and fixes to the bottom of it a small white egg, which is composed of a thin white membrane, full of a whitish liquor. In this manner she goes on, till she fills as many cells as she has eggs to lay, which are generally many thousands. Sometimes more than one egg has been deposited in the same cell; when this is the case, the working bees remove the supernumerary eggs, and leave only one in each cell. On the first or second day after the egg is lodged in the cell, the drone bee injects a small quantity of whitish liquid, which, in about a day, is absorbed by the egg. On the third or fourth day is produced a worm or maggot; which, when it is grown so as to touch the opposite angle, coils itself up in the shape of a semicircle, and floats in a proper liquid, whereby it is nourished and enlarged in its dimensions. This liquor is of a whitish colour, of the thickness of cream, and of an insipid taste like flour and water. Naturalists are not agreed as to the origin and qualities of this liquid. Some have supposed, that it consists of some generative matter, injected by the working bees into each cell, in order to give fecundity to the eggs: but the most probable opinion is, that it is the same with what some writers have called the *bee-bread;* and that it is a mixture of water with the juices of plants and flowers collected merely for the nutrition of the young, whilst they are in their weak and helpless state. Whatever be the nature of this aliment, it is certain that the common working bees are very industrious in supplying the worms with a sufficient quantity of it. The worm is fed by the working bees for about eight days, till one end touches the other in the form of a ring; and when it begins to feel itself uneasy in its first posture, it ceases to eat, and begins to unroll itself, thrusting that end forward towards the mouth of the cell which is to be the head. The attendant bees, observing these symptoms of approaching transformation, desist from their labours in carrying proper food, and employ themselves in fastening up the top of the cell with a lid of wax, formed in concentric circles, and by their natural heat in cherishing the brood, and hastening the birth. In this concealed state the worm extends itself at full length, and prepares a web of a sort of silk in the manner of the silk worm. This web forms a complete lining for the cell, and affords a convenient receptacle for the transformation of the worm into a nymph or chrysalis. Some naturalists suppose, that as each cell is destined to the successive breeding of several worms, the whole web, which is composed of many crusts or doubles, is in reality a collection of as many webs as there have been worms. M. Maraldi apprehends, that this lining is formed of the skin of the worm thrown off at its entrance into the nymph state: but it is urged, that if the cells are opened when newly covered by the bees, the worm within will be found in its own form, and detected in the act of spinning its web; and by means of glasses it will be found composed of fine threads regularly woven together, like those of other spinning animals. In the space of 18 or 20 days the whole process of transformation is finished, and the bee endeavours to discharge itself from confinement by forcing an aperture with its teeth through the covering of the cell. The passage is gradually dilated; so that one horn first appears, then the head, and afterwards the whole body. This is usually the work of three hours, and sometimes of half a day. The bee, after it has disengaged itself, stands on the surface of the comb, till it has acquired its natural complexion, and full maturity and strength, so as to become fit for labour. The rest of the bees gather round it in this state, congratulate its birth, and offer it honey out of their own mouths. The exuviæ and scattered pieces of wax which are left in the cell are removed by the working bees; and the matrix is no sooner cleansed and fit for new fecundation, but the queen deposites another egg in it; insomuch that, M.

Maraldi

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Maraldi says, he has seen five bees produced in the same cell in the space of three months. The young bees are easily distinguished from the others by their colour; they are gray, instead of the yellowish brown of the common bees. The reason of this is, that their body is black, and the hairs that grow upon it are white, from the mixture of which seen together results a gray; but this colour forms itself into a brownish yellow by degrees, the rings of the body becoming more brown and the hairs more yellow.

The eggs from which drones are to proceed, are, as already observed, laid in larger cells than those of the working bees. The coverings of these cells, when the drones are in the nymph state, are convex or swelling outward, whilst the cells of the working bees are flat. This, with the privilege of leading idle effeminate lives, and not working for the public stock, is what distinguishes the drones.

The bees depart from their usual style of building when they are to raise cells for bringing up such maggots as are destined to become queens. These are of a longish oblong form, having one end bigger than the other, with their exterior surface full of little cavities. Wax, which is employed with so geometrical a thriftiness in the raising of hexagonal cells, is expended with profusion in the cell which is to be the cradle of a royal maggot. They sometimes fix it in the middle, and at other times on one side of a comb. Several common cells are sacrificed to serve as a basis and support to it. It is placed almost perpendicular to the common cells, the largest end being uppermost. The lower end is open till the season for closing it comes, or till the maggot is ready for transformation. It would be difficult to conceive how a tender maggot can remain in a cell turned bottom upmost, if we did not find it buried in a substance scarcely fluid, and if it were not in itself, at first, small and light enough to be suspended in this clammy paste. As it grows it fills all the upper and larger part of the cell. As soon as the young queen comes out of her cell, that cell is destroyed, and its place is supplied by common cells; but as the foundation of the royal castle is left, this part of the comb is found thicker than any other. There are several such cells prepared; for if there was only one reared in each hive, the swarms might often want a conductress. Many accidents may also destroy the little maggot before it becomes a bee. It is therefore necessary that a number of such cells should be provided; and accordingly there are observed several young queens in the beginning of the summer, more than one of which often takes flight when a swarm departs.

A young queen is in a condition to lead a swarm from a hive in which she was born in four or five days after she has appeared in it with wings. The bees of a swarm are in a great hurry when they know that their queen is ready to lay. In this case, they give to their new cells but part of the depth they are to have, and defer the finishing of them till they have traced the number of cells requisite for the present time. The cells first made are intended only for working bees; these being the most necessary.

16
Of their swarming.

When the hive is become too much crowded by the addition of the young brood, a part of the bees think of finding themselves a more commodious habitation, and with that view single out the most forward of the young queens. A new swarm is therefore constantly composed of one queen at least, and of several thousand working bees, as well as of some hundreds of drones. The working bees are some old, some young.

Scarce has the colony arrived at its new habitation, when the working bees labour with the utmost diligence to procure materials for food and building. Their principal aim is not only to have cells in which they may deposite their honey: a stronger motive seems to animate them. They seem to know that their queen is in haste to lay her eggs. Their industry is such that in 24 hours they will have made combs 20 inches long, and wide in proportion. They make more wax during the first fortnight, if the season is favourable, than they do during all the rest of the year. Other bees are at the same time busy in stopping all the holes and crevices they find in their new hive, in order to guard against the entrance of insects which covet their honey, their wax, or themselves; and also to exclude the cold air, for it is indispensably necessary that they be lodged warm.

When the bees first settle in swarming, indeed when they at any time rest themselves, there is something very particular in their method of taking their repose. It is done by collecting themselves in a heap, and hanging to each other by their feet. They sometimes extend these heaps to a considerable length. It would seem probable to us, that the bees from which the others hang must have a considerable weight suspended to them. All that can be said is, that the bees must find this to be a situation agreeable to themselves. They may perhaps have a method of distending themselves with air, thereby to lessen their specific gravity; in the same manner as fishes do in order to alter their gravity compared with water.

When a swarm divides into two or more bands, which settle separately, this division is a sure sign that there are two or more queens among them. One of these clusters is generally larger than the other. The bees of the smaller cluster or clusters, detach themselves by little and little, till at last the whole, together with the queen or queens, unite with the largest cluster.

As soon as the bees are settled, the supernumerary queen or queens must be sacrificed to the peace and tranquillity of the hive. This execution generally raises a considerable commotion in the hive; and several other bees, as well as the queen or queens, lose their lives. Their bodies may be observed on the ground, near the hive. The queen that is chosen is of a more reddish colour than those which are destroyed; so that fruitfulness seems to be a great motive of preference in bees; for the nearer they are to the time of laying their eggs, the bigger, larger, and more shining are their bodies. The method of hiving these swarms will be explained hereafter.

17
Other instincts.

Besides the capital instincts above mentioned, bees are possessed of others, some of which are equally necessary for their preservation and happiness.—They anxiously provide against the entrance of insects into the hive, by gluing up with wax the smallest holes in the skep. Some stand as centinels at the mouth of the hive, to prevent insects of any kind from getting in. But if a snail, or other large insect should get in, notwithstanding all resistance, they sting it to death; and even cover it over with a coat of propolis, to prevent

vent the bad smell or maggots which might proceed from the putrefaction of such a large animal. Bees seem to be warned of the appearance of bad weather by some particular feeling. It sometimes happens, even when they are very assiduous and busy, that they on a sudden cease from their work; not a single one stirs out; and those that are abroad hurry home in such prodigious crowds, that the doors of their habitations are too small to admit them. On this occasion look up to the sky, and you will soon discover some of those black clouds which denote impending rain. Whether they see the clouds gathering for it, as some imagine, or whether (as is much more probable) they feel some other effects of it upon their bodies, is not yet determined; but it is alleged, that no bee is ever caught even in what we call a sudden shower, unless it have been at a very great distance from the hive, or have been before injured by some accident, or be sickly and unable to fly so fast as the rest. Cold is a great enemy to them. To defend themselves against its effects during a hard winter, they crowd together in the middle of the hive, and buzz about, and thereby excite a warmth which is often perceptible by laying the hand upon the glass windows of the hive. They seem to understand one another by the motions of their wings: when the queen wants to quit the hive, she gives a little buzz; and all the others immediately follow her example, and retire along with her.

18
Age of bees.

As to the age of bees, the large drones live but a little while, being destroyed without mercy by the working bees, probably to save honey, as already noticed. But of the other sort, lately discovered, no larger than the working bees, and not easily to be distinguished from them, the age has not yet been ascertained. Writers are not agreed as to the age of the working bees. Some maintain that they are annual, and others suppose that they live many years. Many of them, it is well known, die annually of hard labour; and though they may be preserved by succession in hives or colonies for several years, the most accurate observers are of opinion that their age is but a year, or at the longest no more than two summers.

19
Opinions concerning the sex and fecundation of bees.

Concerning the sex and fecundation of bees, various experiments have been made of late years, by which new light has been thrown upon the subject, and several difficulties which embarrassed the process of generation among these curious insects seem to have been removed.

Swammerdam, and after him Maraldi, discovered in the structure of the drones some resemblance to the male organs of generation, as has already been described, and from thence concluded that they were the males: but neither of those accurate and industrious observers could detect them in the act of copulation. Swammerdam, therefore, entertained a notion, that the female or queen-bee was fecundated without copulation; that it was sufficient for her to be near the males; and that her eggs were impregnated by a kind of vivifying aura, exhaled from the body of the males, and absorbed by the female. However, M. Reaumur, thought that he had discovered the actual copulation of the drones with the female-bee, and he has very minutely described the process of it. A very ingenious naturalist * of the present day, without taking any notice of recent discoveries, seems to have given into the same idea. "The office of the males or drones (says he) is to render the queen pregnant. One single female should in the midst of seven or eight hundred males, one would think, be incessantly assailed. But nature has provided against that inconvenience, by making them of a constitution extremely frigid. The female chooses out one that pleases her; she is obliged to make the first advances, and excite him to love by her caresses. But this favour proves fatal to him: scarce has he ceased from amorous dalliance, but he is seen to perish. The pleasure of these observations may be taken, by putting a female with several males into a bottle."

* Barbut, Genera of Insects, p. 286.

Others again, as M. Shirach and M. Hattorf, reject the drones as bearing no share at all in the business of propagation, and assert the queen-bee to be self-prolific. But for what purpose then should wise nature have furnished the drones with that large quantity of seminal liquor? to what use so large an apparatus of fecundating organs so well described by Reaumur and Maraldi? The fact is, that the above gentlemen have founded their opinion upon observations that hives are peopled at a time of the year when (as they suppose) there are no drones in being. But we have already noticed, that nature has provided drones of different sizes for the purpose of impregnation, adapted to different times, occasions, and circumstances: And the mistake of Messrs Shirach and Hattorf seems to have proceeded from their missing the large-sized drones, and not being acquainted with or not adverting to the other sort, so hardly distinguishable from the working bees.

Lastly, many of the ancients as well as moderns have supposed that the eggs of the female bee are not impregnated with the male sperm, while in the body of the creature, but that they are deposited unimpregnated in the cells; and that the male afterwards ejects the male sperm on them as they lie in the cells, in the same manner as the generation of fishes is supposed to be performed by the males impregnating the spawn after it is cast out by the females. M. Maraldi † long since conjectured that this might be the case; and he was confirmed in his opinion, by observing a liquid whitish substance surrounding each egg at the bottom of the cell a little while after it had been laid, and that a great number of eggs, which are not encompassed by this liquor, remained barren in the cell.

† Hist. Acad. Sc. 1712, p. 331.

This method of impregnation has been lately established beyond all contradiction by the observations of Mr Debraw of Cambridge ‡. Having put some bees into glass-hives with a large number of drones, he observed on the first or second day (always before the third) from the time in which the eggs were placed in the cells, which the queen generally lays on the fourth or fifth day after they are put into the hive, that a great number of bees fastened themselves to one another, and formed a kind of curtain from the top to the bottom of the hive, probably in order to conceal the process of generation. 20

Mr Debraw's experiments and discoveries.

Mr Debraw, however, could soon perceive several bees, whose size he was not able to distinguish, inserting the posterior part of their bodies each into a cell, and sinking into it; after a little while they retired, and he could see with the naked eye a small quantity of whitish liquor left in the angle of the base of each cell containing an egg; this liquor

‡ Phil. Trans. vol. lxvii. part i. art. ;

liquor was less liquid than honey, and had no sweet taste.

In order to prove farther that the eggs are fecundated by the males, and that their presence is necessary at the time of breeding, Mr Debraw made the following experiments. They consist in leaving in a hive the queen, with only the common or working bees, without any drones, to see whether the eggs she laid would be prolific. To this end, he took a swarm, and shook all the bees into a tub of water, leaving them there till they were quite senseless: by which means he could distinguish the drones without any danger of being stung: Leaving these out, therefore, he restored the queen and working-bees to their former state, by spreading them on a brown paper in the sun; after this he replaced them in a glass-hive, where they soon began to work as usual. The queen laid eggs, which, to his great surprise, were impregnated; for he imagined he had separated all the drones or males, and therefore omitted watching them; at the end of twenty days he found several of his eggs had, in the usual course of changes, produced bees, while some had withered away, and others were covered with honey. Hence he inferred, that some of the males had escaped his notice, and impregnated part of the eggs. To convince himself of this, he took away all the brood comb that was in the hive, in order to oblige the bees to provide a fresh quantity, being determined to watch narrowly their motions after new eggs should be laid in the cells. On the second day after the eggs were placed in the cells, he perceived the same operation that was mentioned before; namely, that of the bees hanging down in the form of a curtain, while others thrust the posterior part of their body into the cells. He then introduced his hand into the hive, and broke off a piece of the comb, in which there were two of these insects: he found in neither of them any sting (a circumstance peculiar to the drones); upon dissection, with the assistance of a microscope, he discovered the four cylindrical bodies which contain the glutinous liquor, of a whitish colour, as observed by Maraldi in the large drones. He was therefore now under a necessity of repeating his experiments, in destroying the males, and even those which might be suspected to be such.

He once more immersed the same bees in water; and when they appeared in a senseless state, he gently pressed every one, in order to distinguish those armed with stings from those which had none, and which of course he supposed to be males: of those last he found fifty-seven, and replaced the same in a glass-hive, where they immediately applied again to the work of making cells; and on the fourth or fifth day, very early in the morning, he had the pleasure to see the queen-bee deposite her eggs in those cells; he continued watching most part of the ensuing days, but could discover nothing of what he had seen before.

The eggs after the fourth day, instead of changing in the manner of caterpillars, were found in the same state they were the first day, except that some were covered with honey. A singular event happened the next day about noon: all the bees left their own hive, and attempted to get into a neighbouring hive, probably in search of males; but the queen was found dead, having been killed in the engagement.

To be further satisfied, Mr Debraw took the brood-comb, which had not been impregnated, and divided it into two parts: one he placed under a glass bell, N° 1. with honey-comb for the bees food, taking care to leave a queen, but no drones, among the bees confined in it: the other piece of brood-comb he placed under another glass bell, N° 2. with a few drones, a queen, and a proportionable number of common bees. The result was, that in the glass, N° 1. there was no impregnation, the eggs remained in the same state they were in when put into the glass; and on giving the bees their liberty on the seventh day, they all flew away, as was found to be the case in the former experiment; whereas in the glass, N° 2. the very day after the bees had been put into it, the eggs were impregnated by the drones, the bees did not leave their hive on receiving their liberty, the eggs at the usual time underwent the necessary transformations, and a numerous young colony was produced.

Naturalists have observed, that the queen bees are produced in a manner peculiar to themselves, and different from the drones and working bees. Some have supposed, that the eggs laid by the queen in a hive, and destined for the production of queen bees, are of a peculiar kind; but though this is not the case, as M. Shirach has lately discovered, yet there are particular cells appropriated for this purpose. These cells are generally near the edges, and at the bottom of the combs, and sometimes on the sides of a honey-comb: they are of an oblong circular form, and very strong; and are more or less numerous in different hives as occasion seems to require. It has also been supposed, that the matter with which they are nourished is of a different kind and quality from that employed for the nourishment of the other bees; that which has been collected out of the royal cells being of a gummy glutinous nature, of a deep transparent red, and dissolving in the fire rather than crumbling to powder.

It has been generally supposed, that the queen bee is the only female contained in the hive; and that the working bees are neutral, or of neither sex. But M. Shirach * has lately established a different doctrine, which has been also confirmed by the later observations of Mr Debraw †. According to M. Shirach, all the working or common bees are females in disguise; and the queen-bee lays only two kinds of eggs, viz. those which are to produce the drones, and those from which the working bees are to proceed: and from any one or more of these, one or more queens may be produced; so that every worm of the latter or common kind, which has been hatched about three days, is capable, under certain circumstances, of becoming the queen or mother of a hive. In proof of this doctrine, new and singular as it may seem, he alleges a number of satisfactory and decisive experiments, which have been since verified by those of Mr Debraw. In the early months of the spring, and in any preceding month, even so late as November, he cut off from an old hive a piece of that part of the comb which contains the eggs of the working bees; taking care, however, that it contained likewise worms which had been hatched about three days. He fixed this in an empty hive, or box, together with a portion of honey-comb, &c. or, in other words, with a sufficiency of food and building materials, or wax, for the use of the intended colony.

* *Hist. Nat. de la Reine des Abeilles, &c.*

† *Phil. Trans.* vol. lxvii. part i.

21
M. Schirach's discoveries.

Bee.

lony. He then put into, and confined within the same box, a sufficient number of common working bees, taken from the same or any other hive. As soon as the members of this small community found themselves deprived of their liberty, and without a queen, a dreadful uproar ensued, which continued generally, with some short intervals of silence, for the space of about twenty-four hours; during which time it is to be supposed they were alternately meditating and holding council on the future support of the new republic. On the final cessation of this tumult, the general and almost constant result was, that they betook themselves to work; first proceeding to the construction of a royal cell, and then taking the proper measures for hatching and feeding the brood enclosed within them. Sometimes even on the second day the foundations of one or more royal cells were to be perceived; the view of which furnished certain indications that they had elected one of the enclosed worms to the sovereignty.

The operation has been hitherto conducted in the house. This new colony may now be safely trusted in the garden, if the weather be warm and have the liberty allowed them of passing out of the box; of which they instantly avail themselves, and are seen in a short time almost totally to desert their new habitation. In about two hours, however, they begin to re-enter it. We should not neglect to observe, that if they should be placed near the old hive, from which they were taken, they will very often attempt to enter it, but are as constantly repulsed by their former companions and brethren. It is prudent, therefore, to place them at a distance from the mother state, in order to avoid the inconveniences of a civil war. The final result of the experiment is, that the colony of working bees thus shut up, with a morsel of common brood, not only hatch it, but are found, at the end of eighteen or twenty days, to have produced from thence one or two queens; which have apparently proceeded from worms of the common sort, pitched upon by them for that purpose; and which, under other circumstances, that is, if they had remained in the old hive, there is reason to suppose would have been changed into common working bees. In the present instance, the common worm appears to be converted by them into a queen-bee, merely because the hive was in want of one. Hence we may justly infer, that the kingdom of the bees is not, if the expression may be used, a *jure divino* or hereditary monarchy, but an elective kingdom; in which the choice of their future ruler is made by the body of the people, while she is yet in the cradle, or in embryo; and who are determined by motives of preference which will perhaps for ever elude the penetration of the most sagacious naturalists.

The conclusions drawn by M. Shirach, from experiments of the preceding kind, often repeated by himself and others with the same success, are, that all the common or working bees were originally of the female sex; but that when they have undergone their last metamorphosis, they are condemned to a state of perpetual virginity, and the organs of generation are obliterated; merely because they have not been lodged, fed, and brought up in a particular manner, while they were in the worm state. He supposes that the worm, designed by the community to be a queen, or mother, owes its metamorphosis into a queen, partly to the extraordinary size of its cell, and its peculiar position in it; but principally to a certain appropriate nourishment found there, and carefully administered to it by the working bees while it was in the worm state; by which, and possibly other means unknown, the developement and extension of the germ of the female organs, previously existing in the embryo, is effected; and those differences in its form and size are produced, which afterwards so remarkably distinguish it from the common working bees.

Bee.

This discovery is capable of being applied towards forming artificial swarms, or new colonies of bees, by which means their number might be increased, and their produce in honey and wax proportionably augmented.

Explanation of Plate LXXXIX. Fig. 1. is the queen bee. 2. Is the drone. 3. Is the working bee. 4. Represents the bees hanging to each other by the feet, which is the method of taking their repose. 5. The proboscis or trunk, which is one of the principal organs of the bees, wherewith they gather the honey and take their nourishment. 6. One of the hind legs of a working bee, loaded with wax. 7. A comb, in which the working bees are bred. The cells are the smallest of any. Two of them have the young bees enclosed. A royal cell is suspended on one side. 8. A comb in which the drones are bred, being larger than the former; the young drones being included in several of them; with two royal cells suspended on the side. 9. A similar comb, in which the royal cell is fixed in the middle of the comb; and several common cells are sacrificed to serve as a basis and support to it. In general, the royal cells are suspended on the side of a comb, as in fig. 7. and 8. To the side of fig. 9. two royal cells are begun, when they resemble pretty much the cup in which an acorn lies. The other royal cells have the young queens included in them. Fig. 10. exhibits the sting and all its parts. The sting is composed of a sheath or case, and two shanks, united to each other, and terminating in a sharp point, so as to look like a single part. *b*, The poisonous bag. *c*, The tube that serves to convey the poison from its bag to the thickest part of the sting's sheath. *d d*, The two shanks of the sting, mutually converging to each other. *e e*, The sheath of the sting. *f f*, The thickest end of the sheath, where the tube opens into it, by which it receives the insect's poison. *g*, The extreme point of the sting, formed by the two shanks of that organ, that are in this place closely united. *h h*, The beards with which the shanks of the sting are armed at their extremities. *i*, The tube that serves to secrete the poison, which it discharges into the poison-bag. *k k*, The two blind extremities of the said tube. *l l l l*, Two pair of cartilages, of different forms, which are for the most part of a deep black, and articulated among themselves, and with the shanks of the sting. *m m*, Two other cartilages less conspicuous than the former, with one pair of which they are articulated. These two cartilages *m m*, are almost entirely of a membranaceous substance. *n n n n n n n n*, Eight places in which the foregoing cartilages are articulated among themselves, and with the shanks of the sting *d d*. *o o o o*, Four muscles serving to move the sting different ways, by the assistance of the same cartilages. *p p*, Two muscles which draw the shanks of the sting into its sheath.

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sheath. *q q*, Two appendages of the sting which are moved along with it, and seem to answer no other purpose but that of ornament.—Fig. 11. The ovary.—Fig. 12. Six eggs drawn after nature, and placed on their ends: These eggs are oblong, very slender, but somewhat thicker on their upper parts.—Fig. 13. An egg viewed with a microscope: it resembles the skin of a fish, divested of its scales, but still retaining the marks of their insertion.—Fig. 14. Worms of bees, of different sizes, drawn after nature. *a*, A worm newly hatched. *bcde*, Four worms that have received more nourishment, and are more grown. *fg*, Two worms still bigger than the former, having had more time to make use of the nourishment provided for them. They are here represented as they lie doubled in their cells. *h*, A worm placed on its belly so as to show on its back a black line, inclining to a light blue or gray. This line denotes the stomach, which appears in this place through the transparent parts that lie over it. *i*, A worm lying on its back, and beginning to draw in the hinder part of its body, and move its head.—Fig. 15. A full-grown worm, viewed with a microscope. *a a*, Its 14 annular incisions or divisions. *h*, The head and eyes, &c. *ccc*, Ten breathing-holes.—Fig. 16. The worm forming its web. *a a*, The sides of the cell that contain it. *b*, The bottom of the cell. *c*, The entrance or door of the cell. The worm is here represented as making its web in the properest manner to shut up this entrance.—Fig. 17. Worm taken out of the web in which it had enclosed itself, and just ready to cast its skin.—Fig. 18. A cell containing the worm changed into a nymph, and perfectly lined with the said worm's web. Likewise the said web entire, with the nymph contained in it, as they appear on opening the cell. *a a*, The sides of the cell, lined with the worm's web. *b*, The mouth of the cell, perfectly closed by the web. *c*, The bottom of the cell. *d*, The web entire, as it appears on opening the cell, which it greatly resembles in form. *e*, The upper part of the web, of a convex form. This part shows its filaments pretty distinctly. *f*, The enclosed nymph appearing through the transparent sides of the web. *g*, The bottom of the web, answering to that of the wax cell.—Fig. 19. Worm changed to a nymph, of its natural size and form, yet so as to exhibit its limbs, which are folded up in a most wonderful manner.—Fig. 20. The nymph of the bee viewed with the microscope, displaying in a distinct manner all the parts of the enclosed insect, and the beautiful manner in which they are laid up. *a*, The head, bloated with humours. *b b*, The eyes, projecting considerably. *c c*, The horns, or antennæ. *d*, The lip. *e e*, The teeth, or jaw-bones. *ff*, The first pair of joints belonging to the proboscis. *h*, The proboscis itself. *i i*, The first pair of legs. *k k*, Two transparent stiff little parts, lying against the lowest joints of the first pair of legs. These little parts are not to be found, as they remain in the skin it sheds on quitting the nymph state. *l l*, The second pair of legs. *m m*, The wings. *n n*, The blade-bones. *o o*, The last pair of legs. *p p*, The abdominal rings. *q*, (*g*) The hinder part of the body. The sting projects a little in this place. *r*, Two little parts accompanying the sting. *s*, The anus.—Fig. 21. *a*, A cell full of bees bread, placed in layers. *b*, Little grains, of which the said substance, viewed with the microscope, appears to consist.

II. *Of the* Management *of* Bees, *and most approved Inventions for saving their Lives while we take their Honey and Wax.*

1. *Of the Apiary, and Hives.* Columella directs that the apiary face the south, and be situated in a place neither too hot nor too much exposed to the cold: that it be in a valley, in order that the loaded bees may with the greater ease descend to their homes; that it be near the mansion house, on account of the conveniency of watching them; but so situated as not to be exposed to noisome smells, or to the din of men or cattle: that it be surrounded with a wall, which however should not rise above three feet high: that, if possible, a running stream be near them; or, if that cannot be, that water be brought near them in troughs, with pebbles or small stones in the water, for the bees to rest on while they drink; or that the water be confined within gently declining banks, in order that the bees may have safe access to it; they not being able to produce either combs, honey, or food for their maggots, without water; that the neighbourhood of rivers or basons of water with high banks be avoided, because winds may whirl the bees into them, and they cannot easily get on shore from thence to dry themselves; and that the garden in which the apiary stands be well furnished with such plants as afford the bees plenty of good pasture. The trees in this garden should be of the dwarf kind, and their heads bushy, in order that the swarms which settle on them may be the more easily hived. 22 Of the apiary.

The proprietor should be particularly attentive that the bees have also in their neighbourhood such plants as yield them plenty of food. Columella enumerates many of these fitted to a warm climate: among them he mentions thyme, the oak, the pine, the sweet-smelling cedar, and all fruit-trees. Experience has taught us, that furze, broom, mustard, clover, heath, &c. are excellent for this purpose. Pliny recommends broom, in particular, as a plant exceedingly grateful and very profitable to bees.

With regard to hives, those made of straw are generally preferred, on several accounts; they are not liable to be over-heated by the rays of the sun; they keep out cold better than wood or any other materials; and the cheapness renders the purchase of them easy. As the ingenious Mr Wildman's hives are reckoned to be of a preferable construction to any other, we shall give an account of them in his own words. 23 Of hives.

"My hives (says he) are seven inches in height and ten in width. The sides are upright, so that the top and bottom are of the same diameter. A hive holds nearly a peck. In the upper row of straw there is a hoop of about half an inch in breadth; to which are nailed five bars of deal, full a quarter of an inch in thickness, and an inch and quarter wide, and half an inch asunder from one another; a narrow short bar is nailed at each side, half an inch distant from the bars next them, in order to fill up the remaining parts of the circle; so that there are in all seven bars of deal, to which the bees fix their combs. The space of half an inch between the bars allows a sufficient and easy passage

passage for the bees from one comb to another. In order to give great steadiness to the combs, so that, upon moving the hive, the combs may not fall off, or incline out of their direction, a stick should be run through the middle of the hive, in a direction directly across the bars or at right angles with them. When the hives are made, a piece of wood should be worked into the lower row of straw, long enough to allow a door for the bees, of four inches in length, and half an inch in height.

"The proprietor of the bees should provide himself with several flat covers of straw, worked of the same thickness as the hives, and a foot in diameter, that so it may be of the same width as the outside of the hives. Before the cover is applied to the hive, a piece of clean paper, of the size of the top of the hive, should be laid over it; and a coat of cow-dung, which is the least apt to crack of any cement easily to be obtained, should be laid all round the circumference of the hive. Let the cover be laid upon this, and made fast to the hive with a packing-needle and pack-thread, so that neither cold nor vermin may enter.

"Each hive should stand single on a piece of deal, or other wood, somewhat larger than the bottom of the hive: That part of the stand which is at the mouth of the hive should project some inches, for the bees to rest on when they return from the field. This stand should be supported upon a single post, two and a half feet high; to which it should be screwed very securely, that high winds, or other accidents, may not blow down both stand and hive. A quantity of soot mixed with barley chaff should be strewed on the ground round the post; which will effectually prevent ants, slugs, and other vermin, from rising up to the hive. The soot and chaff should from time to time be renewed as it is blown or washed away; though, as it is sheltered by the stand, it remains a considerable time, especially if care be taken that no weeds rise through it. Weeds, indeed, should not be permitted to rise near the hive; for they may give shelter to vermin which may be hurtful to the bees.

"The stands for bees should be four yards asunder; or if the apiary will not admit of so much, as far asunder as may be, that the bees of one hive may not interfere with those of another hive, as is sometimes the case when the hives are near one another or on the same stand; for the bees, mistaking their own hives, light sometimes at the wrong door, and a fray ensues, in which one or more may lose their lives.

24
Of the proper season for purchasing hives of bees.

"The person who intends to erect an apiary should purchase a proper number of hives at the latter part of the year, when they are cheapest. The hives should be full of combs, and well stored with bees. The purchaser should examine the combs, in order to know the age of the hives. The combs of that season are white, those of the former year are of a darkish yellow; and where the combs are black, the hive should be rejected, because old hives are most liable to vermin and other accidents.

"If the number of hives wanted were not purchased in the autumn, it will be necessary to remedy this neglect after the severity of the cold is past in the spring. At this season, bees which are in good condition will get into the fields early in the morning, return loaded, enter boldly, and do not come out of the hive in bad weather; for when they do, this indicates they are in great want of provisions. They are alert on the least disturbance, and by the loudness of their humming we judge of their strength. They preserve their hives free from all filth, and are ready to defend it against every enemy that approaches.

"The summer is an improper time for buying bees, because the heat of the weather softens the wax, and thereby renders the combs liable to break, if they are not very well secured. The honey, too, being then thinner than at other times, is more apt to run out of the cells; which is attended with a double disadvantage, namely, the loss of the honey, and the daubing of the bees, whereby many of them may be destroyed. A first and strong swarm may indeed be purchased; and, if leave can be obtained, permitted to stand in the same garden till the autumn; but if leave is not obtained, it may be carried away in the night after it has been hived.

"I suppose, that, in the stocks purchased, the bees are in hives of the old construction. The only direction here necessary is, that the first swarm from these stocks should be put into one of my hives; and that another of my hives should in a few days be put under the old stock, in order to prevent its swarming again."

25
Of hiving the swarm.

2. *Of Hiving*. Bees, as has been already observed, never swarm till the hive be too much crowded by the young brood. They first begin to swarm in May, or in the end of April, but earlier or later according to the warmth of the season. They seldom swarm before ten in the morning, and seldom later than three in the afternoon. We may know when they are about to swarm, by clusters of them hanging on the outside of the hive, and by the drones appearing abroad more than usual: But the most certain sign is, when the bees refrain from flying into the fields, though the season be inviting. Just before they take flight, there is an uncommon silence in the hive; after this, as soon as one takes flight, they all follow. Before the subsequent swarmings, there is a great noise in the hive, which is supposed to be occasioned by a contest whether the young or the old queen should go out. When the bees of a swarm fly too high, they are made to descend lower, by throwing handfuls of sand or dust among them, which they probably mistake for rain. For the same purpose, it is usual to beat on a kettle or frying-pan: This practice may have taken its rise from observing that thunder or any great noise prompts such bees as are in the fields to return home.

As soon as the swarm is settled, the bees which compose it should be got into a hive with all convenient speed, to prevent their taking wing again. If they settle on a small branch of a tree, easy to come at, it may be cut off and laid upon a cloth; the hive being ready immediately to put over them. If the branch cannot be conveniently cut, the bees may be swept from off it into a hive. Lodge but the queen into the hive, and the rest will soon follow. If the bees must be considerably disturbed in order to get them into the hive, the most advisable way is to let them remain in the place where they have pitched till the evening, when there is less danger of their taking wing. If it be observed that they still hover about the place they first alighted upon, the branches there may be rubbed with rue,

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Bee. rue, or alder-leaves, or any other thing distasteful to them, to prevent their returning to it.

The hive employed on this occasion should be cleaned with the utmost care, and its inside be rubbed very hard with a coarse cloth, to get off the loose straws, or other impurities, which might cost them a great deal of time and labour to gnaw away. It may then be rubbed with fragrant herbs or flowers, the smell of which is agreeable to the bees; or with honey.

The hive should not be immediately set on the stool where it is to remain; but should be kept near the place at which the bees settled, till the evening, lest some stragglers should be lost. It should be shaded either with boughs or with a cloth, that the too great heat of the sun may not annoy the bees.

We sometimes see a swarm of bees, after having left their hive, and even alighted upon a tree, return to their first abode. This never happens but when the young queen did not come forth with them, for want of strength, or perhaps courage to trust her wings for the first time; or possibly from a consciousness of her not being impregnated.

26 Of uniting swarms. When a swarm is too few in number for a hive, another may be added. The usual method of thus uniting swarms is very easy. Spread a cloth at night upon the ground close to the hive in which the two casts or swarms are to be united; lay a stick across this cloth; then fetch the hive with the new swarm, set it over the stick, give a smart stroke on the top of the hive, and all the bees will drop down upon the cloth in a cluster. This done, throw aside the empty hive, take the other from off the stool, and set this last over the bees, who will soon ascend into it, mix with those already there, and become one and the same family. Others, instead of striking the bees down upon the cloth, place with its bottom upmost the hive in which the united swarms are to live, and strike the bees of the other hive down into it. The former of these hives is then restored to its natural situation, and the bees of both hives soon unite. If some bees still adhere to the other hive, they may be brushed off on the cloth, and they will soon join their brethren. Or one may take the following method, which gives less disturbance to the bees. Set with its mouth upmost the hive into which the young swarm has been put, and set upon it the other hive. The bees in the lower hive, finding themselves in an inverted situation, will soon ascend into the upper.

Though all writers acknowledge, that one of the queens is constantly slain on these occasions, and generally a considerable number of the working bees; yet none of them, Columella excepted, has proposed the easy remedy of killing the queen of the latter cast or swarm before the union is made; a means by which the lives of the working bees may be preserved. This may be done either by intoxicating them and then picking her out, or by searching her out when the bees are beaten down upon the cloth; for this being done in the night, to prevent the battle which might otherwise ensue, there will be no great difficulty in finding her.

A large swarm may weigh eight pounds, and so gradually less to one pound: consequently a very good one may weigh five or six pounds. All such as weigh less than four pounds should be strengthened by uniting to each of them a less numerous swarm. The size of the hive should be proportioned to the number of the bees; and, as a general rule, it should be rather under than over sized, because bees require to be kept warmer than a large hive will admit of.

In the *Letters from an American Farmer*, we have the following entertaining account of the swarming of bees, their flight into the woods, and the method of discovering them there. A little experience renders it easy to predict the time of their swarming: but the "difficult point is, when on the wing, to know whether they want to go to the woods or not. If they have previously pitched in some hollow trees, it is not the allurements of salt and water, of fennel, hickory leaves, &c. nor the finest box, that can induce them to stay. They will prefer those rude, rough, habitations, to the best polished mahogany hive. When that is the case with mine, I seldom thwart their inclinations. It is in freedom that they work. Were I to confine them, they would dwindle away and quit their labour. In such excursions we only part for a while. I am generally sure to find them again the following fall. This elopement of theirs only adds to my recreations. I know how to deceive even their superlative instinct. Nor do I fear losing them, though 18 miles from my house, and lodged in the most lofty trees in the most impervious of our forests. After I have done sowing, by way of recreation I prepare for a week's jaunt in the woods, not to hunt either the deer or the bears, as my neighbours do, but to catch the more harmless bees. I cannot boast that this chase is so noble or so famous among men: but I find it less fatiguing, and full as profitable; and the last consideration is the only one that moves me. I take with me my dog, as a companion, for he is useless as to this game; my gun, for no one ought to enter the woods without one; my blanket, some provisions, some wax, vermilion, honey, and a small pocket-compass. With these implements I proceed to such woods as are at a considerable distance from any settlements. I carefully examine whether they abound with large trees; if so, I make a small fire, on some flat stones, in a convenient place. On the fire I put some wax: close by this fire, on another stone, I drop honey in distinct drops, which I surround with small quantities of vermilion, laid on the stone; and then I retire carefully to watch whether any bees appear. If there are any in that neighbourhood, I rest assured that the smell of the burnt wax will unavoidably attract them. They will soon find out the honey, for they are fond of preying on that which is not their own; and in their approach, they will necessarily tinge themselves with some particles of vermilion, which will adhere long to their bodies. I next fix my compass, to find out their course; which they keep invariably straight, when they are returning home loaded. By the assistance of my watch, I observe how long those are in returning which are marked with vermilion. Thus possessed of the course, and, in some measure, of the distance, which I can easily guess at, I follow the first, and seldom fail of coming to the tree where those republicans are lodged. I then mark it; and thus, with patience, I have found out sometimes 11 swarms in a season; and it is inconceivable what a quantity of honey these trees will sometimes afford. It entirely depends on the size of the

Bee. 27 Bee-hunting in America.

Bee.

hollow, as the bees never rest or swarm till it is replenished; for, like men, it is only the want of room that induces them to quit the maternal hive. Next I proceed to some of the nearest settlements, where I procure proper assistance to cut down the trees, get all my prey secured, and then return home with my prize. The first bees I ever procured were thus found in the woods by mere accident; for, at that time, I had no kind of skill in this method of tracing them. The body of the tree being perfectly sound, they had lodged themselves in the hollow of one of its principal limbs, which I carefully sawed off, and with a good deal of labour and industry, brought it home, where I fixed it up in the same position in which I found it growing. This was in April. I had five swarms that year, and they have been ever since very prosperous. This business generally takes up a week of my time every fall, and to me it is a week of solitary ease and relaxation."

28 Shifting the bees in search of pasture.

3. *Of shifting the Abode of Bees.* Great improvements may certainly be made in the essential article of providing plenty of pasture for bees, whenever this subject shall be more carefully attended to than it has hitherto been. A rich corn country is well known to be a barren desert to them during the most considerable part of the year; and therefore the practice of other nations, in shifting the places of abode of their bees, well deserves our imitation.

Lib. ix. c. 14.

Columella informs us, that, as few places are so happily situated as to afford the bees proper pasture both in the beginning of the season and also in the autumn, it was the advice of Celsus, that after the vernal pastures are consumed, the bees should be transported to places abounding with autumnal flowers; as was practised by conveying the bees from Achaia to Attica, from Eubœa and the Cyclad islands to Scyrus; and also in Sicily, where they were brought to Hybla from other parts of the island.

Lib. xxi. c. 12.

We find by Pliny, that this was likewise the practice of Italy in his time. "As soon," says he, "as the spring-food for bees has failed in the valleys near our towns, the hives of bees are put into boats, and carried up against the stream of the river, in the night, in search of better pasture. The bees go out in the morning in quest of provisions, and return regularly to their hives in the boats, with the stores they have collected. This method is continued, till the sinking of the boats to a certain depth in the water shows that the hives are sufficiently full; and they are then carried back to their former homes, where their honey is taken out of them." And this is still the practice of the Italians who live near the banks of the Po, (the river which Pliny instanced particularly in the above-quoted passage).

Vol. ii. p. 24.

M. Maillet relates, in his curious Description of Egypt, that, "spite of the ignorance and rusticity which have got possession of that country, there yet remain in it several footsteps of the industry and skill of the ancient Egyptians. One of their most admirable contrivances is, their sending their bees annually into distant countries, in order to procure them sustenance there, at a time when they could not find any at home; and their afterwards bringing them back, like shepherds who should travel with their flock, and make them feed as they go. It was observed by the ancient inhabitants of Lower Egypt, that all plants blossomed, and the fruits of the earth ripened, above six weeks earlier in Upper Egypt than with them. They applied this remark to their bees; and the means then made use of by them, to enable these usefully industrious insects to reap advantage from the more forward state of nature there, were exactly the same as are now practised, for the like purpose, in that country. About the end of October, all such inhabitants of Lower Egypt as have hives of bees, embark them on the Nile, and convey them up that river quite into Upper Egypt; observing to time it so that they arrive there just when the inundation is withdrawn, the lands have been sown, and the flowers begin to bud. The hives thus sent are marked and numbered by their respective owners, and placed pyramidically in boats prepared for the purpose. After they have remained some days at their farthest station, and are supposed to have gathered all the wax and honey they could find in the fields within two or three leagues around; their conductors convey them in the same boats two or three leagues lower down, and there leave the laborious insects so long time as is necessary for them to collect all the riches of this spot. Thus, the nearer they come to the place of their more permanent abode, they find the productions of the earth, and the plants which afford them food, forward in proportion. In fine, about the beginning of February, after having travelled through the whole length of Egypt, gathering all the rich produce of the delightful banks of the Nile, they arrive at the mouth of that river, towards the ocean; from whence they set out, and from whence they are now returned to their several homes: for care is taken to keep an exact register of every district from whence the hives were sent in the beginning of the season, of their numbers, of the names of the persons who sent them, and likewise of the mark or number of the boat in which they were placed."

In many parts of France, floating bee-houses are very common. They have on board one barge threescore or a hundred bee-hives, well defended from the inclemency of an accidental storm. With these the owners suffer themselves to float gently down the river, the bees continually choosing their flowery pasture along the banks of the stream; and thus a single floating bee-house yields the proprietor a considerable income.

They have also a method of transporting their bees by land, well worth our imitation in many parts of this kingdom. Their first care is, to examine those hives, some of whose honey-combs might be broken or separated by the jolting of the vehicle; they are made fast one to the other, and against the sides of the hive, by means of small sticks, which may be disposed differently as occasion will point out. This being done, every hive is set upon a packing-cloth, or something like it, the threads of which are very wide; the sides of this cloth are then turned up and laid on the outside of each hive, in which state they are tied together with a piece of small pack-thread wound several times round the hive. As many hives as a cart built for that purpose will hold, are afterwards placed in this vehicle. The hives are set two and two, the whole length of the cart. Over these are placed others; which make, as it were, a second story or bed of hives. Those which

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which are stored with combs should always be turned topsy-turvy. It is for the sake of their combs, and to fix them the better, that they are disposed in this manner; for such as have but a small quantity of combs in them, are placed in their natural situation. Care is taken in this stowage not to let one hive stop up another, it being essentially necessary for the bees to have air; and it is for this reason they are wrapped up in a coarse cloth, the threads of which were wove very wide, in order that the air may have a free passage, and lessen the heat which these insects raise in their hives, especially when they move about very tumultuously, as often happens in these carts. Those used for this purpose in Yevre, hold from 30 to 48 hives. As soon as all are thus stowed, the caravan sets out. If the season is sultry, they travel only in the night; but a proper advantage is made of cool days. These caravans do not go fast. The horses must not be permitted even to trot: they are led slowly, and through the smoothest roads. When there are not combs in the hives sufficient to support the bees during their journey, the owner takes the earliest opportunity of resting them wherever they can collect wax. The hives are taken out of the cart, then set upon the ground, and after removing the cloth from over them, the bees go forth in search of food. The first field they come to serves them as an inn. In the evening, as soon as they are all returned, the hives are shut up; and being placed again in the cart, they proceed on their journey. When the caravan is arrived at the journey's end, the hives are distributed in the gardens, or in the fields adjacent to the houses of different peasants, who, for a very small reward, undertake to look after them. Thus it is that, in such spots as do not abound in flowers at all seasons, means are found to supply the bees with food during the whole year.

These instances of the great advantages which attend shifting of bees in search of pasture, afford an excellent lesson to many places in this kingdom: they direct particularly the inhabitants of the rich vales, where the harvest for bees ends early, to remove their stocks to places which abound in heath, this plant continuing in bloom during a considerable part of autumn, and yielding great plenty of food to bees. Those in the neighbourhood of hills and mountains will save the bees a great deal of labour, by taking also the advantage of shifting their places of abode.

29 Management of bees in winter.

4. *Of feeding and defending Bees in Winter.* Providence has ordained, that insects which feed on leaves, flowers, and green succulent plants, are in an insensible and torpid state from the time that the winter's cold has deprived them of the means of subsistence. Thus the bees during the winter are in so lethargic a state, that little food supports them: but as the weather is very changeable, and every warm and sunny day revives them, and prompts them to return to exercise, food becomes necessary on these occasions.

Many hives of bees, which are thought to die of cold in the winter, in truth die of famine; when a rainy summer has hindered the bees from laying in a sufficient store of provisions. The hives should therefore be carefully examined in the autumn, and should then weigh at least 18 pounds.

Columella describes an annual distemper which seizes bees in the spring, when the spurge blossoms, and the elm discloses its seeds; for that, being allured by the first flowers, they feed so greedily upon them, that they surfeit themselves, and die of a looseness, if they are not speedily relieved.

The authors of the *Maison Rustique* impute this purging to the bees feeding on pure honey, which does not form a food sufficiently substantial for them, unless they have bee-bread to eat at the same time; and advise giving them a honey-comb taken from another hive, the cells of which are filled with crude wax or bee-bread.

There is still, however, a want of experiments to ascertain both the time and the manner in which bees should be fed. The common practice is to feed them in the autumn, giving them as much honey as will bring the whole weight of the hive to near 20 pounds. To this end, the honey is diluted with water, and then put into an empty comb, split reeds, or, as Columella directs, upon clean wool, which the bees will suck perfectly dry. But the dilution with water makes the honey apt to be candied, and honey in that state is prejudicial to bees.

The following directions given in the *Maison Rustique* seem to be very judicious. Replenish the weak hives in September with such a portion of combs full of honey taken from other hives as shall be judged to be a sufficient supply for them. In order to do this, turn up the weak hive, after taking the precaution of defending yourself with the smoke of rags, cut out the empty combs, and put the full ones in their place; where secure them with pieces of wood run across, in such manner that they may not fall down when the hive is returned to its place. The bees will soon fix them more effectually. If this method be thought too troublesome, set under the hive a plate of liquid honey, unmixed with water, with straws laid across it, and over these a paper pierced full of holes, through which the bees will suck the honey without daubing themselves. This should be done in cloudy or rainy weather, when the bees stir least abroad; and the hive should be covered, to protect the bees from robbers, who might be allured to it by the smell of the honey. Tom. i. p. 435.

Another circumstance which may render it very necessary to feed the bees is, when several days of bad weather ensue immediately after they have swarmed; for then, being destitute of every supply beyond what they carried with them, they may be in great danger of starving. In this case, honey should be given them in proportion to the duration of the bad weather.

The degree of cold which bees can endure has not been ascertained. We find that they live in the cold parts of Russia, and often in hollow trees, without any care being taken of them. Their hives are frequently made of the bark of trees, which does not afford them much protection from cold. Mr White, therefore, judiciously observes, that bees which stand on the north side of a building whose height intercepts the sun's beams all the winter, will waste less of their provisions (almost by half) than others which stand in the sun: for coming seldom forth, they eat little; and yet in the spring are as forward to work and swarm as those which had twice as much honey in the autumn before. The owner should, however, examine their state in the winter; and if he finds, that, instead of being clustered between

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Bee.

between the combs, they fall down in numbers on the stool or bottom of the hive, the hive should be carried to a warmer place, where they will soon recover. He must be cautious in returning them again to the cold, lest the honey be candied.

Where the winters are extremely severe, the authors of the *Maison Rustique* advise to lay on the bottom of an old cask the depth of half a foot of very dry earth, powdered and pressed down hard, and to set on this the stool with the hive; then, to preserve a communication with the air, which is absolutely necessary, to cut a hole in the cask, opposite to the mouth of the hive, and place a piece of reed, or of alder, made hollow, from the mouth of the hive to the hole in the cask; and after this to cover the hive with more of the same dry earth. If there be any room to fear that the bees will not have a sufficiency of food, a plate with honey, covered as before directed, may be put under the hive. If the number of hives be great, boxes may be made of deals nailed together, deep enough to contain the hives when covered with dry earth. The bees will thus remain all the winter free from any danger from cold, hunger, or enemies.

30
Methods of taking the honey and the wax. Common method in this country.

5. *Of taking the Honey and Wax.* In this country it is usual, in seizing the stores of these little animals, to rob them also of their lives. The common method is, That when those which are doomed for slaughter have been marked out (which is generally done in September), a hole is dug near the hive, and a stick, at the end of which is a rag that has been dipped in melted brimstone, being stuck in that hole, the rag is set on fire, the hive is immediately set over it, and the earth is instantly thrown up all round, so that none of the smoke can escape. In a quarter of an hour, all the bees are seemingly dead; and they will soon after be irrecoverably so, by being buried in the earth that is returned back into the hole. By this last means it is that they are absolutely killed; for it has been found by experiment, that all the bees which have been affected only by the fume of the brimstone, recover again, except such as have been singed or hurt by the flame. Hence it is evident, that fume of brimstone might be used for intoxicating the bees, with some few precautions. The heaviest and the lightest hives are alike treated in this manner: the former, because they yield the most profit, with an immediate return; and the latter, because they would not be able to survive the winter. Those hives which weigh from 15 to 20 pounds are thought to be the fittest for keeping.

More humane and judicious methods were practised by the ancients *; and the following simple method is at this day practised in Greece, degenerate as it is.

* Vide *Columella*, lib. ix. c. 15. and *Varro de Re Rustica*, lib. iii. c. 16.

31
Greek method of sharing the honey with the bees. See *Wheeler's Journey into Greece*, p. 411.

"Mount Hymethus is celebrated for the best honey in all Greece. This mountain was not less famous in times past for bees and admirable honey; the ancients believing that bees were first bred here, and that all other bees were but colonies from this mountain; which if so, we assured ourselves that it must be from this part of the mountain that the colonies were sent; both because the honey here made is the best, and that here they never destroy the bees. It is of a good consistence, of a fair gold-colour, and the same quantity sweetens more water than the like quantity of any other doth. I no sooner knew that they never destroy or impair the stock of bees in taking away their honey, but I was inquisitive to understand their method of ordering the bees; which being an art so worthy the knowledge of the curious, I shall not think it beside the purpose, to relate what I saw, and was informed of to that effect by such as had skill in that place.

"The hives they keep their bees in are made of willows or osiers, fashioned like our common dust-baskets, wide at top and narrow at the bottom, and plastered with clay or loam within and without. They are set as in fig. 1. with the wide end uppermost. The tops are covered with broad flat sticks, which are also plastered over with clay; and, to secure them from the weather, they cover them with a tuft of straw, as we do. Along each of these sticks, the bees fasten their combs; so that a comb may be taken out whole, without the least bruising, and with the greatest ease imaginable. To increase them in spring-time, that is in March or April, until the beginning of May, they divide them; first separating the sticks on which the combs and bees are fastened, from one another, with a knife: so, taking out the first comb and bees together on each side, they put them into another basket, in the same order as they were taken out, until they have equally divided them. After this, when they are both again accommodated with sticks and plastered, they set the new basket in the place of the old one, and the old one in some new place. And all this they do in the middle of the day, at such time as the greatest part of the bees are abroad; who at their coming home, without much difficulty, by this means divide themselves equally. This device hinders them from swarming and flying away. In August, they take out their honey. This they do in the day-time also, while they are abroad; the bees being thereby, say they, disturbed least: at which time they take out the combs laden with honey, as before; that is, beginning at each outside, and so taking away, until they have left only such a quantity of combs, in the middle, as they judge will be sufficient to maintain the bees in winter; sweeping those bees that are on the combs into the basket again, and then covering it with new sticks and plaster."

Plate XC.

The Greek method above related was introduced into France in 1754, as we are informed by M. de Reaumur and Du Hamel, in the memoirs of the Royal Academy for that year, p. 331.

Attempts have been made in our own country to attain the desirable end of getting the honey and wax without destroying the bees; the most approved of which we shall now relate as concisely as possible.

32
Mr Thorley's observations, &c.

Mr Thorley, in his *Inquiry into the Nature, Order, and Government of Bees*, thinks colonies preferable to hives, for the following reasons: *First*, The more certain preservation of very many thousands of these useful creatures. *Secondly*, Their greater strength (which consists in numbers), and consequently their greater safety from robbers. *Thirdly*, Their greater wealth, arising from the united labours of the greater number. He tells us, that he has in some summers taken two boxes filled with honey from one colony; and yet sufficient store has been left for their maintenance during the winter; each box weighing 40 pounds. Add to these advantages, the pleasure of viewing them, with the greatest safety, at all seasons, even in their busiest time of gathering, and their requiring a much less attendance

tendance in swarming time. The bees thus managed are also more effectually secured from wet and cold, from mice and other vermin.

His boxes are made of deal, which, being spongy, sucks up the breath of the bees sooner than a more solid wood would do. Yellow dram-deal thoroughly seasoned is the best.

An octagon, being nearer to a sphere, is better than a square form; for as the bees, in winter, lie in a round body near the centre of the hive, a due heat is then conveyed to all the out-parts, and the honey is kept from candying.

The dimensions which Mr Thorley, after many years experience, recommends for the boxes, are 10 inches depth, and 12 or 14 inches breadth in the inside. He has tried boxes containing a bushel or more, but found them not to answer the design like those of a lesser size. The larger are much longer in filling; so that it is later ere you come to reap the fruits of the labour of the bees: nor is the honey there so good and fine, the effluvia even of their own bodies tainting it.

The best and purest honey is that which is gathered in the first five or six weeks: and in boxes of less dimensions you may take, in a month or little more, provided the season be favourable, a box full of the finest honey.

The top of the box should be made of an entire board a full inch thick after it has been planed; and it should project on all sides at least an inch beyond the dimensions of the box. In the middle of this top there must be a hole five inches square, for a communication between the boxes; and this hole should be covered with a sliding shutter, of deal or elm, running easily in a groove over the back window. The eight pannels, nine inches deep, and three quarters of an inch thick when planed, are to be let into the top so far as to keep them in their proper places; to be secured at the corners with plates of brass, and to be cramped with wires at the bottom to keep them firm; for the heat in summer will try their strength. There should be a glass window behind, fixed in a frame, with a thin deal-cover, two small brass hinges, and a button to fasten it. This window will be sufficient for inspecting the progress of the bees. Two brass handles, one on each side, are necessary to lift up the box: these should be fixed in with two thin plates of iron, near three inches long, so as to turn up and down, and put three inches below the top-board, which is nailed close down with sprigs to the other parts of the box.

Those who choose a frame within, to which the bees may fasten their combs, need only use a couple of deal sticks of an inch square, placed across the box, and supported by two pins of brass; one an inch and a half below the top, and the other two inches below it; by which means the combs will quickly find a rest. One thing more, which perfects the work, is, a passage, four or five inches long, and less than half an inch deep, for the bees to go in and out at the bottom of the box.

33 Management of bees in colonies, and method of taking their honey and wax.

1. In keeping bees in colonies, a house is necessary, or at least a shed; without which the weather, especially the heat of the sun, would soon rend the boxes to pieces.

Your house may be made of any boards you please, but deal is the best. Of whatever sort the materials are, the house must be painted, to secure it from the weather.

The length of this house, we will suppose for six colonies, should be full 12 feet and a half, and each colony should stand a foot distance from the other. It should be three feet and a half high, to admit four boxes one upon another; but if only three boxes are employed, two feet eight inches will be sufficient. Its breadth in the inside should be two feet. The four corner-posts should be made of oak, and well fixed in the ground, that no stormy winds may overturn it; and all the rails should be of oak, supported by several uprights of the same, before and behind, that they may not yield or sink under 6, 7, or 8 cwt. or upwards. The floor of the house (about two feet from the ground) should be strong and smooth, that the lowest box may stand close to it.

This floor may be made with boards or planks of deal the full length of the bee-house; or, which is preferable, with a board or plank to each colony, of two feet four inches long, and fixed down to the rails; and that part which appears at the front of the house may be cut into a semicircle, as a proper alighting place for the bees. Plane it to a slope, that the wet may fall off. When this floor to a single colony wants to be repaired, it may easily be removed, and another be placed in its room, without disturbing the other colonies, or touching any other part of the floor.

Upon this floor, at equal distances, all your colonies must be placed against a door or passage cut in the front of the house.

Only observe farther, to prevent any false step, that as the top-board of the box (being a full inch broader than the other part) will not permit the two mouths to come together, you must cut a third in a piece of deal of a sufficient breadth, and place it between the other two, so close that not a bee may get that way into the house. And fixing the said piece of deal down to the floor with two lath-nails, you will find afterwards to be of service, when you have occasion either to raise a colony, or take a box of honey, and may prove a means of preventing a great deal of trouble and mischief.

The house being in this forwardness, you may cover it to your own mind, with boards, fine slates, or tiles. But contrive their position so as to carry off the wet, and keep out the cold, rain, snow, or whatever might any way hurt and prejudice them.

The back-doors may be made of half-inch deal, two of them to shut close in a rabbet, cut in an upright pillar, which may be so contrived as to take in and out, by a mortise in the bottom rail, and a notch in the inside of the upper rail, and fastened with a strong hasp. Place these pillars in the spaces between the colonies.

Concluding your house made after this model, without front-doors, a weather-board will be very necessary to carry the water off from the places where the bees settle and rest.

Good painting will be a great preservative. Forget not to paint the mouths of your colonies with different colours, as red, white, blue, yellow, &c. in form of a half-moon, or square, that the bees may the better know their own home. Such diversity will be a direction to them.

Thus your bees are kept warm in the coldest winter; and

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and in the hottest summer greatly refreshed by the cool air, the back doors being set open without any air-holes made in the boxes.

Dr Warden observes, that in June, July, and August, when the colonies come to be very full, and the weather proves very hot, the appearance of a shower drives the bees home in such crowds, that pressing to get in, they stop the passage so close, that those within are almost suffocated for want of air; which makes these last so uneasy, that they are like mad things. In this extremity, he has lifted the whole colony up a little on one side; and by thus giving them air, has soon quieted them. He has known them, he says, come pouring out, on such an occasion, in numbers sufficient to have filled at once two or three quarts; as if they had been going to swarm. To prevent this inconvenience, he advises cutting a hole two inches square in about the middle of one of the hinder pannels of each box. Over this hole, nail, in the inside of the box, a piece of tin-plate punched full of holes so small that a bee cannot creep through them; and have over it, on the outside, a very thin slider, made to run in grooves; so that, when it is thrust home, all may be close and warm; and when it is opened, in very hot weather, the air may pass through the hole, and prevent the suffocating heat. Or holes may be bored in the pannels themselves, on such an emergency, in a colony already settled.

Such a thorough passage for the air may be convenient in extreme heat, which is sometimes so great as to make the honey run out of the combs. The Memoirs of the truly laudable Berne Society, for the year 1764, give us a particular instance of this, when they say, that, in 1761, many in Switzerland were obliged to smother their bees, when they saw the honey and wax trickling down; not knowing any other remedy for the losses they daily sustained. Some shaded these hives from the sun, or covered them with cloths wet several times a-day, and watered the ground all around.

The best time to plant the colonies is either in spring with new stocks full of bees, or in summer with swarms. If swarms are used, procure, if possible, two of the same day: hive them either in two boxes or in a hive and a box: at night, place them in the bee-house, one over the other; and with a knife and a little lime and hair stop close the mouth of the hive or upper box, so that not a bee may be able to go in or out but at the front door. This done, you will in a week or ten days with pleasure see the combs appear in the boxes; but if it be a hive, nothing can be seen till the bees have wrought down into the box. Never plant a colony with a single swarm, as Mr Thorley says he has sometimes done, but with little success.

When the second box, or the box under the hive, appears full of bees and combs, it is time to raise your colony. This should be done in the dusk of the evening, and in the following manner:

Place your empty box, with the sliding shutter drawn back, behind the house, near the colony that is to be raised, and at nearly the height of the floor: then lifting up the colony with what expedition you can, let the empty box be put in the place where it is to stand, and the colony upon it; and shut up the mouth of the then upper box with lime and hair, as before directed.

When, by the help of the windows in the back of the boxes, you find the middle box full of combs, and a quantity of honey sealed up in it, the lowest box half full of combs, and few bees in the uppermost box, proceed thus:

About five o'clock in the afternoon, drive close with a mallet the sliding shutter under the hive or box that is to be taken from the colony. If the combs are new, the shutter may be forced home without a mallet; but be sure it be close, that no bees may ascend into the hive or box to be removed. After this shut close the doors of your house, and leave the bees thus cut off from the rest of their companions for the space of half an hour or more. In this space of time, having lost their queen, they will fill themselves with honey, and be impatient to be set at liberty.

If, in this interval, you examine the box or boxes beneath, and observe all to be quiet in them, you may be confident that the queen is there, and in safety. Hereupon raise the back part of the hive or box so far, by a piece of wood slipped under it, as to give the prisoners room to come out, and they will return to their fellows: then lifting the box from off the colony, and turning its bottom upmost, cover it with a cloth all night; and the next morning, when this cloth is removed, the bees that have remained in it will return to the colony. Thus you have a hive or box of honey, and all your bees safe.

If the bees do not all come out in this manner, Dr Warder's method may be followed, especially if it be with a hive. It is to place the hive with the small end downward in a pail, peck, or flower-pot, so as to make it stand firm: then to take an empty hive, and set it upon the former, and to draw a cloth tight round the joining of the two hives, so that none of the bees may be able to get out: after this, to strike the full hive so smartly as to disturb the bees that are in it, but with such pauses between the strokes as to allow them time to ascend into the empty hive, which must be held fast while this is doing, lest it fall off by the shaking of the other. When you perceive, by the noise of the bees in the upper hive, that they are got into this last, carry it to a cloth spread for this purpose before the colony, with one end fastened to the landing-place, and knock them out upon it: they will soon crawl up the cloth, and join their fellows, who will gladly receive them.

Mr Thorley next gives an account of his narcotic, and of the manner of using it.

The method which he has pursued with great success for many years, and which he recommends to the public as the most effectual for preserving bees in common hives, is incorporation, or uniting two stocks into one, by the help of a peculiar fume or opiate, which will put them entirely in your power for a time to divide and dispose of at pleasure. But as that dominion over them will be of short duration, you must be expeditious in this business.

The queen is immediately to be searched for, and killed. Hives which have swarmed twice, and are consequently reduced in their numbers, are the fittest to be joined together, as this will greatly strengthen and improve them. If a hive which you would take is both

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Bee.

both rich in honey and full of bees, it is but dividing the bees into two parts, and putting them into two boxes instead of one. Examine whether the stock to which you intend to join the bees of another have honey enough in it to maintain the bees of both: it should weigh full 20 pounds.

The narcotic, or stupifying fume, is made with the *fungus maximus* or *pulverulentus*, the large mushroom, commonly known by the name of *bunt*, *puckfist*, or *frogcheese*. It is as big as a man's head, or bigger; when ripe, it is of a brown colour, turns to powder, and is exceeding light. Put one of these pucks into a large paper, press it therein to two-thirds or near half the bulk of its former size, and tie it up very close; then put it into an oven some time after the household bread has been drawn, and let it remain there all night; when it is dry enough to hold fire, it is fit for use. The manner of using it is thus:

Cut off a piece of the puck, as large as a hen's egg, and fix it in the end of a small stick slit for that purpose, and sharpened at the other end; which place so that the pluck may hang near the middle of an empty hive. This hive must be set with the mouth upward, in a pail or bucket, which should hold it steady, near the stock you intend to take. This done, set fire to the puck, and immediately place the stock of bees over it, tying a cloth round the hives, that no smoke may come forth. In a minute's time, or little more, you will hear the bees fall like drops of hail into the empty hive. You may then beat the top of the full hive gently with your hand, to get out as many of them as you can: after this, loosing the cloth, lift the hive off to a table, knock it several times against the table, several more bees will tumble out, and perhaps the queen among them. She often is one of the last that falls. If she is not there, search for her among the main body in the empty hive, spreading them for this purpose on a table.

You must proceed in the same manner with the other hive, with the bees of which these are to be united. One of the queens being secured, you must put the bees of both hives together, mingle them thoroughly, and drop them among the combs of the hive which they are intended to inhabit. When they are all in, cover it with a packing or other coarse cloth which will admit air, and let them remain shut up all that night and the next day. You will soon be sensible that they are awakened from this sleep.

The second night after their union, in the dusk of the evening, gently remove the cloth from off the mouth of the hive (taking care of yourself), and the bees will immediately sally forth with a great noise; but being too late, they will soon return: then inserting two pieces of tobacco-pipes to let in air, keep them confined for three or four days, after which the door may be left open.

The best time for uniting bees is, after their young brood are all out, and before they begin to lodge in the empty cells. As to the hour of the day, he advises young practitioners to do it early in the afternoon, in order that having the longer light they may the more easily find out the queen. He never knew such combined stocks conquered by robbers. They will either swarm in the next summer, or yield a hive full of honey.

Mr N. Thornley, son of the above-mentioned clergyman, has added to the edition which he has given of his father's book, a postscript, purporting, that persons who choose to keep bees in glass-hives may, after uncovering the hole at the top of a flat-topped straw-hive, or box, place the glass over it so close that no bee can go in or out but at the bottom of the hive or box. The glass-hive must be covered with an empty hive or with a cloth, that too much light may not prevent the bees from working. As soon as they have filled the straw-hive or box, they will begin to work up into the glass-hive. He tells us, that he himself has had one of these glass-hives filled by the bees in 30 days in a fine season; and that it contained 38 pounds of fine honey. When the glass is completely filled, slide a tin-plate between it and the hive or box, so as to cover the passage, and in half an hour the glass may be taken off with safety. What few bees remain in it, will readily go to their companions. He has added a glass window to his straw-hives, in order to see what progress bees make; which is of some importance, especially if one hive is to be taken away whilst the season still continues favourable for their collecting honey; for when the combs are filled with honey, the cells are sealed up, and the bees forsake them, and reside mostly in the hive in which their works are chiefly carried on. Observing also that the bees were apt to extend their combs through the passage of communication in the upper hive, whether glass or other, which rendered it necessary to divide the comb when the upper hive was taken away, he now puts in that passage a wire screen or netting, the meshes of which are large enough for a loaded bee to go easily through them. This prevents the joining of the combs from one box to the other, and consequently obviates the necessity of cutting them, and of spilling some of the honey, which running down among a crowd of bees, used before to incommode them much, it being difficult for them to clear their wings of it. Fig. 2. is a drawing of one of his colonies.

Bee. 34 Glass-hives.

Plate XC.

35 Of bees in boxes, and method of taking their honey and wax.

2. The reverend Mr White informs us, that his fondness for these little animals soon put him upon endeavouring if possible to save them from *fire* and *brimstone*; that he thought he had reason to be content to share their labours for the present, and great reason to rejoice if he could at any time preserve their lives, to work for him another year; and that the main drift of his observations and experiments has hitherto been, to discover an easy and cheap method, suited to the abilities of the common people, of taking away so much honey as can be spared, without destroying or starving the bees; and by the same means to encourage seasonable swarms.

In his directions how to make the bee-boxes of his inventing, he tells us, speaking of the manner of constructing a single one, that it may be made of deal or any other well-seasoned boards which are not apt to warp or split. The boards should be near an inch thick; the figure of the box square, and its height and breadth nine inches and five-eighths, every way, measuring within. With these dimensions it will contain near a peck and a half. The front part must have a door cut in the middle of the bottom edge, three inches wide, and near half an inch in height, which will give free liberty to the bees to pass through, yet not be large enough for their enemy the mouse to enter. In the back

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back part you must cut a hole with a rabbet in it, in which you are to fix a pane of the clearest and best crown-glass, about five inches in length, and three in breadth, and fasten it with putty; let the top of the glass be placed as high as the roof, withinside, that you may see the upper part of the combs, where the bees with their riches are mostly placed. You will by this means be better able to judge of their state and strength, than if your glass was fixed in the middle. The glass must be covered with a thin piece of board, by way of shutter, which may be made to hang by a string, or turn upon a nail, or slide sidewise between two mouldings. Such as are desirous of seeing more of the bees works, may make the glass as large as the box will admit without weakening it too much; or they may add a pane of glass on the top, which must likewise be covered with a shutter, fastened down with pegs, to prevent accidents.

The side of the box which is to be joined to another box of the same form and dimensions, as it will not be exposed to the internal air, may be made of a piece of slit deal not half an inch thick. This he calls the *side of communication*, because it is not to be wholly enclosed: a space is to be left at the bottom the whole breadth of the box, and a little more than an inch in height; and a hole or passage is to be made at top, three inches long, and more than half an inch wide. Through these the bees are to have a communication from one box to the other. The lower communication being on the floor, our labourers, with their burdens, may readily and easily ascend into either of the boxes. The upper communication is only intended as a passage between the boxes, resembling the little holes or narrow passes, which may be observed in the combs formed by our sagacious architects, to save time and shorten the way when they have occasion to pass from one comb to another; just as in populous cities, there are narrow lanes and alleys passing transversely from one large street to another.

In the next place you are to provide a loose board, half an inch thick, and large enough to cover the side where you have made the communications. You are likewise to have in readiness several little iron staples, an inch and half long, with the two points or end bended down more than half an inch. The use of these will be seen presently.

You have now only to fix two sticks crossing the box from side to side, and crossing each other, to be a stay to the combs; one about three inches from the bottom, the other the same distance from the top; and when you have painted the whole, to make it more durable, your box is finished.

The judicious bee-master will here observe, that the form of the box now described is as plain as possible for it to be. It is little more than five square pieces of board nailed together; so that a poor cottager who has but ingenuity enough to saw a board into the given dimensions, and to drive a nail, may make his own boxes well enough, without the help or expence of a carpenter.

No directions are necessary for making the other box, which must be of the same form and dimensions. The two boxes differ from each other only in this, that the side of communication of the one must be on your right hand; of the other on your left. Fig. 3. represents two of these boxes, with their openings of communication, ready to join to each other.

Mr White's manner of hiving a swarm into one or both of these boxes is thus:

You are to take the loose board, and fasten it to one of the boxes, so as to stop the communications. This may be done by three of the staples before mentioned; one on the top of the box near the front; the two others on the back, near the top and near the bottom. Let one end of the staple be thrust into a gimlet-hole made in the box, so that the other end may go as tight as can be over the loose board, to keep it from slipping when it is handled. The next morning after the bees have been hived in this box, the other box should be added, and the loose board should be taken away. This will prevent a great deal of labour to the bees, and some to the proprietor.

Be careful to fasten the shutter so close to the glass that no light may enter through it; for the bees seem to look upon such a light as a hole or breach in their house, and on that account may not so well like their new habitation. But the principal thing to be observed at this time is, to cover the box as soon as the bees are hived with a linen cloth thrown closely over it, or with green boughs to protect it from the piercing heat of the sun. Boxes will admit the heat much sooner than straw-hives; and if the bees find their house too hot for them, they will be wise enough to leave it. If the swarm be larger than usual, instead of fastening the loose board to one box, you may join two boxes together with three staples, leaving the communication open from one to the other, and then hive your bees into both. In all other respects, they are to be hived in boxes after the same manner as in common hives.

The door of the second box should be carefully stopped up, and be kept constantly closed, in order that the bees may not have an entrance but through the first box.

When the boxes are set in the places where they are to remain, they must be screened from the summer's sun, because the wood will otherwise be heated to a greater degree than either the bees or their works can bear; and they should likewise be screened from the winter's sun, because the warmth of this will draw the bees from that lethargic state which is natural to them, as well as many other insects, in the winter season. For this purpose, and also to shelter the boxes from rain, our ingenious clergyman has contrived the following frame.

Fig. 4. represents the front of a frame for twelve colonies: *a*, *a*, are two cells of oak lying flat on the ground more than four feet long. In these cells are fixed four oaken posts, about the thickness of such as are used for drying linen. The two posts *b*, *b*, in the front, are about six feet two inches above the cells: the other two, standing backward, five feet eight inches. You are next to nail some boards of slit deal horizontally from one of the fore-posts to the other, to screen the bees from the sun. Let these boards be seven feet seven inches in length, and nailed to the inside of the posts; and be well seasoned that they may not shrink or gape in the joints. *c*, *c*, Are two splints of deal, to keep the boards even, and strengthen them.

Fig. 5. represents the back of the frame. *d*, *d*, *d*, *d*, Are four strong boards of the same length with the frame on which you are to place the boxes. Let the upper

upper side of them be very smooth and even, that the boxes may stand true upon them: or it may be still more advisable, to place under every pair of boxes a smooth thin board, as long as the boxes, and about a quarter of an inch wider. The bees will soon fasten the boxes to this board in such a manner that you may move or weigh the boxes and board together, without breaking the wax or resin, which for many reasons ought to be avoided. These floors must be supported by pieces of wood or bearers, which are nailed from post to post at each end. They are likewise to be well nailed to the frame, to keep them from sinking with the weight of the boxes. *f* Represents the roof, which projects backward about seven or eight inches beyond the boxes, to shelter them from rain. You have now only to cut niches or holes in the frame, over against each mouth or entrance into the boxes, at *h*, *h*, *h*, in fig. 4. Let these niches be near four inches long; and under each you must nail a small piece of wood for the bees to alight upon. The morning or evening sun will shine upon one or both ends of the frame, let its aspect be what it will: but you may prevent its overheating the boxes, by a loose board set up between the posts, and kept in by two or three pegs.

The same gentleman, with great humanity, observes, that no true lover of bees ever lighted the fatal match without much concern: and that it is evidently more to our advantage to spare the lives of our bees, and be content with part of their stores, than to kill and take possession of the whole.

About the latter end of August, says he, by a little inspection through your glasses, you may easily discover which of your colonies you may lay under contribution. Such as have filled a box and a half with their works, will pretty readily yield you the half box. But you are not to depend upon the quantity of combs, without examining how they are stored with honey. The bees should, according to him, have eight or nine pounds left them, by way of wages for their summer's work.

The most proper time for this business is the middle of the day; and as you stand behind the frame, you will need no armour, except a pair of gloves. The operation itself is very simple and easily performed, thus: Open the mouth of the box you intend to take; then with a thin knife cut through the resin with which the bees have joined the boxes to each other, till you find that you have separated them; and after this, thrust a sheet of tin gently in between the boxes. The communication being hereby stopped, the bees in the fullest box, where it is most likely the queen is, will be a little disturbed at the operation; but those in the other box where we suppose the queen is not, will run to and fro in the utmost hurry and confusion, and send forth a mournful cry, easily distinguished from their other notes. They will issue out at the newly opened door; not in a body as when they swarm, nor with such calm and cheerful activity as when they go forth to their labours; but by one or two at a time, with a wild flutter and visible rage and disorder. This, however, is soon over: for as soon as they get abroad and spy their fellows, they fly to them instantly and join them at the mouth of the other box. By this means, in an hour or two, for they go out slowly, you will have a box of pure honey, without leaving a bee in it to molest you; and likewise without dead bees, which, when you burn them, are often mixed with your honey, and both waste and damage it.

Mr White acknowledges, that he has sometimes found this method fail, when the mouth of the box to be taken away has not been constantly and carefully closed: the bees will in this case get acquainted with it as an entrance; and when you open the mouth in order to their leaving this box, many of them will be apt to return, and the communication being stopped, will in a short time carry away all the honey from this to the other box; so much do they abhor a separation. When this happens, he has recourse to the following expedient, which he thinks infallible. He takes a piece of deal, a little larger than will cover the mouth of the box, and cuts in it a square niche somewhat more than half an inch wide. In this niche he hangs a little trapdoor, made of a thin piece of tin, turning upon a pin, with another pin crossing the niche a little lower, so as to prevent the hanging door from opening both ways. This being placed close to the mouth, the bees which want to get out will easily thrust open the door outwards, but cannot open it the other way to get it again; so must, and will readily, make to the other box, leaving this in about the space of two hours, with all its store, justly due to the tender-hearted bee-master as a ransom for their lives.

What led Mr White to prefer collateral boxes to those before in use, was, to use his own words, his "compassion for the poor bees, who, after traversing the fields, return home weary and heavy laden, and must perhaps deposit their burden up two pair of stairs, or in the garret. The lower room, it is likely, is not yet furnished with stairs: for, as is well known, our little architects lay the foundation of their structures at the top and build downward. In this case, the weary little labourer is to drag her load up the sides of the walls: and when she has done this, she will travel many times backward and forward, as I have frequently seen, along the roof, before she finds the door or passage into the second story; and here again she is perplexed with a like puzzling labyrinth, before she gets into the third. What a waste is here of that precious time which our bees value so much, and which they employ so well! and what an expence of strength and spirits, on which their support and sustenance depend! In the collateral boxes, the rooms are all on the ground floor; and because I know my bees are wise enough to value convenience more than state, I have made them of such a moderate, though decent, height, that the bees have much less way to climb to the top of them than they have to the crown of a common hive."

36 Of the management of bees in Mr Wildman's hives.

Mr Wildman's hives have been already described (N° 23, 24.). A good swarm will soon fill one of these hives, and therefore another hive may be put under it the next morning. The larger space allowed the bees will excite their industry in filling them with combs. The queen will lay some eggs in the upper hive; but so soon as the lower hive is filled with combs, she will lay most of them in it. In little more than three weeks, all the eggs laid in the upper hive will be turned into bees; and if the season is favourable, their cells will be soon filled with honey.

As soon as they want room, a third hive should be placed

Bee.

placed under the two former; and in a few days after the end of three weeks from the time the swarm was put into the hive, the top hive may be taken away at noon of a fair day; and if any bees remain in it, carry it to a little distance from the stand, and turning its bottom up, and striking it on the sides, the bees will be alarmed, take wing, and join their companions in the second and third hives. If it is found that the bees are very unwilling to quit it, it is probable that the queen remains among them. In this case, the bees must be treated in the manner that shall be directed when we describe Mr Wildman's method of taking the honey and the wax. The upper hive now taken away should be put in a cool place, in which no vermin, mice, &c. can come at the combs, or other damage can happen to them, and be thus preserved in reserve.

When the hives seem to be again crowded, and the upper hive is well stored or filled with honey, a fourth hive should be placed under the third, and the upper hive be taken off the next fair day at noon, and treated as already directed. As the honey made during the summer is the best, and as it is needless to keep many full hives in store, the honey may be taken out of the combs of this second hive for use.

If the season is very favourable, the bees may still fill a third hive. In this case, a fifth hive must be put under the fourth, and the third taken away as before. The bees will then fill the fourth for their winter store.

As the honey of the first hive is better than the hony collected so late as that in the third, the honey may be taken out of the combs of the first, and the third may be preserved with the same care as directed for that.

In the month of September, the top hive should be examined; if full, it will be a sufficient provision for the winter; but if light, that is, not containing 20 pounds of honey, the more the better, then, in the month of October, the fifth hive should be taken away, and the hive kept in reserve should be put upon the remaining one, to supply the bees with abundant provisions for the winter. Nor need the owner grudge them this ample store; for they are faithful stewards, and will be proportionally richer and more forward in the spring and summer, when he will reap an abundant profit. The fifth hive which was taken away should be carefully preserved during the winter, that it may be restored to the same stock of bees, when an additional hive is wanted next summer; or the first swarm that comes off may be put into it. The combs in it, if kept free from filth and vermin, will save much labour, and they will at once go to the collecting of honey.

It is almost needless to observe, that when the hives are changed, a cover, as already directed (see N° 23.) should be put upon every upper hive; and that when a lower hive becomes an upper hive, the door of it should be shut up, that so their only passage out shall be by the lower hive; for otherwise the queen would be apt to lay eggs in both indiscriminately. The whole of the above detail of the management of one hive may be extended to any number; it may be proper to keep a register to each set; because, in restoring hives to the bees, they may be better pleased at receiving their own labours than that of other stocks.

If in the autumn the owner has some weak hives, which have neither provision nor number sufficient for the winter, it is advisable to join the bees to richer hives: for the greater number of bees will be a mutual advantage to one another during the winter, and accelerate their labours much in the spring. For this purpose, carry a poor and a richer hive into a room a little before night: then force the bees out of both hives into two separate empty hives, in a manner that shall be hereafter directed: shake upon a cloth the bees out of the hive which contains the fewest; search for the queen; and as soon as you have secured her with a sufficient retinue, bring the other hive which contains the greater number, and place it on the cloth on which the other bees are, with a support under one side, and with a spoon shovel the bees under it. They will soon ascend; and, while under this impression of fear, will unite peaceably with the other bees; whereas, had they been added to the bees of the richer hive, while in possession of their castle, many of the new-comers must have paid with their lives for their intrusion.

It appears from the account of the management of bees in Mr Wildman's hives, that there is very little art wanting to cause the bees to quit the hives which are taken away, unless a queen happens by chance to be among them. In that case, the same means may be used as are necessary when we would rob one of the common hives of part of their wealth. The method is as follows:

37 His method of taking the honey and wax.

Remove the hive from which you would take the wax and honey into a room, into which admit but little light, that it may at first appear to the bees as if it was late in the evening. Gently invert the hive, placing it between the frames of a chair or other steady support, and cover it with an empty hive, keeping that side of the empty hive raised a little, which is next the window, to give the bees sufficient light to get up into it. While you hold the empty hive, steadily supported on the edge of the full hive, between your side and your left arm, keep striking with the other hand all round the full hive from top to bottom, in the manner of beating a drum, so that the bees may be frightened by the continued noise from all quarters; and they will in consequence mount out of the full hive into the empty one. Repeat the strokes rather quick than strong round the hive, till all the bees are got out of it, which in general will be in about five minutes. It is to be observed, that the fuller the hive is of bees, the sooner they will have left it. As soon as a number of them have got into the empty hive, it should be raised a little from the full one, that the bees may not continue to run from the one to the other, but rather keep ascending upon one another.

So soon as all the bees are out of the full hive, the hive in which the bees are must be placed on the stand from which the other hive was taken, in order to receive the absent bees as they return from the fields.

If this is done early in the season, the operator should examine the royal cells, that any of them that have young in them may be saved, as well as the combs which have young bees in them, which should on no account be touched, though by sparing them a good deal of honey be left behind. Then take out the other combs with a long, broad, and pliable knife, such as the apothecaries make use of. The combs should be cut from the sides and crown as clean as possible, to save the future labour of the bees, who must lick up the

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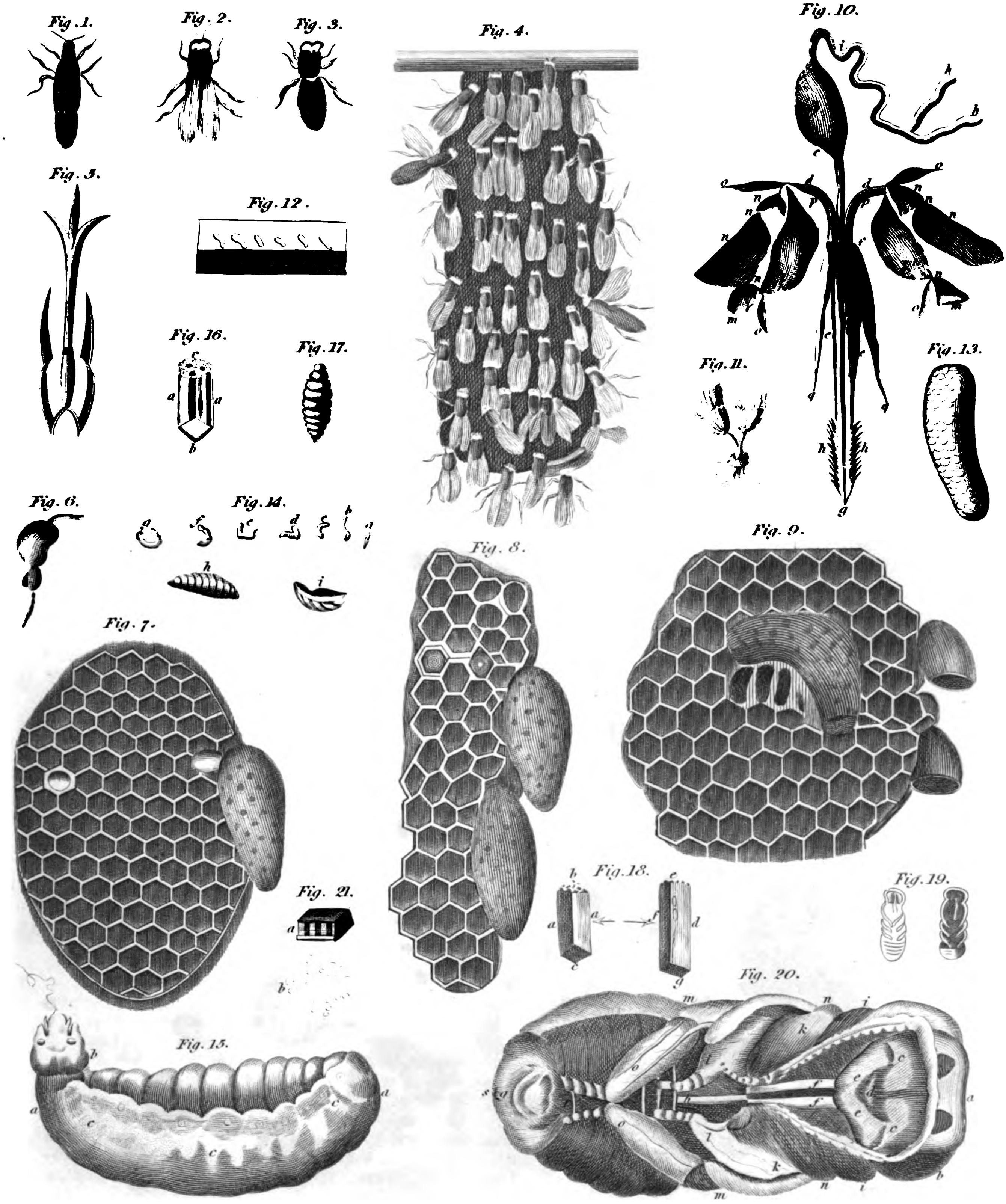

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Fig. 1.

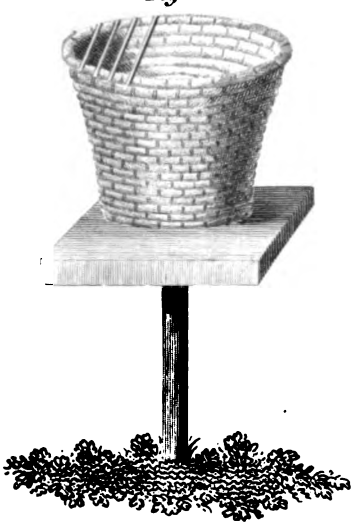


Fig. 2.

Fig. 3.

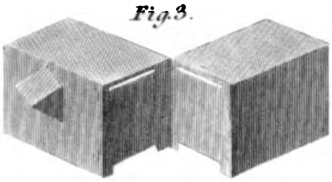


Fig. 4.

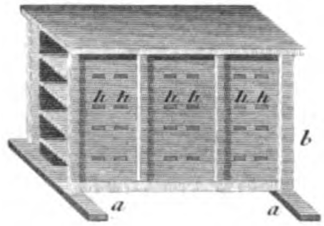
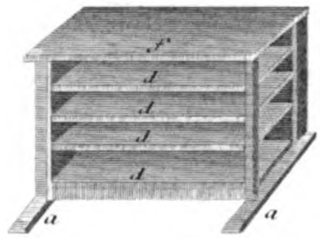


Fig. 5.



BIRD CATCHING.

Fig. 6.

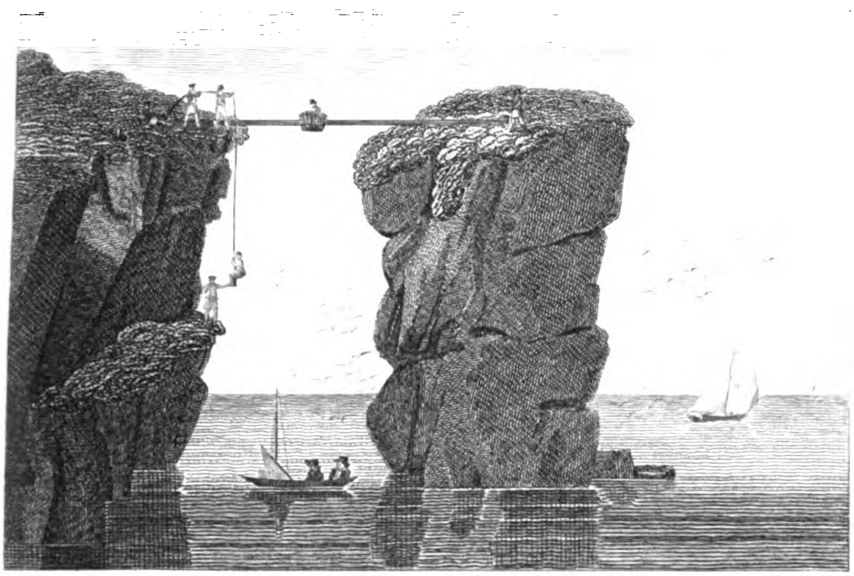
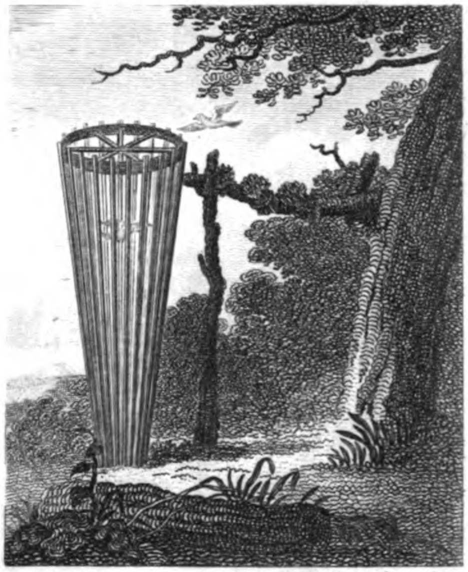


Fig. 7.



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the honey spilt, and remove every remain of wax, and then the sides of the hive should be scraped with a table spoon to clear away what was left by the knife. During the whole of this operation, the hive should be placed inclined to the side from which the combs are taken, that the honey which is spilt may not daub the remaining combs. If some combs were unavoidably taken away, in which there are young bees, the parts of the combs in which they are should be returned into the hive, and secured by sticks in the best manner possible. Place the hive then for some time upright, that any remaining honey may drain out. If the combs are built in a direction opposite to the entrance, or at right angles with it, the combs which are the farthest from the entrance are to be preferred; because there they are best stored with honey, and have the fewest young bees in them.

Having thus finished taking the wax and honey, the next business is to return the bees to their old hive; and for this purpose place a table covered with a clean cloth near the stand, and giving the hive in which the bees are a sudden shake, at the same time striking it pretty forcibly, the bees will be shaken on the cloth. Put their own hive over them immediately, raised a little on one side, that the bees may the more easily enter; and when all are entered, place it on the stand as before. If the hive in which the bees are be turned bottom uppermost, and their own hive be placed over it, the bees will ascend into it, especially if the lower hive is struck on the sides to alarm them.

As the chief object of the bees during the spring and beginning of the summer is the propagation of their kind, honey during that time is not collected in such quantity as it is afterwards: and on this account it is scarcely worth while to rob a hive before the latter end of June; nor is it safe to do it after the middle of July, lest rainy weather may prevent their restoring the combs they have lost, and laying in a stock of honey sufficient for the winter, unless there is a chance of carrying them to a rich pasture. See the article BEE in the SUPPLEMENT.

BEE is also used figuratively to denote sweetness, industry, &c. Thus Xenophon is called the *Attic Bee*, on account of the great sweetness of his style. Antonius got the denomination *Melissa* or *Bee*, on account of his collection of common places.—Leo Allatius gave the appellation *apes urbanæ* to the illustrious men at Rome, from the year 1630 to the year 1632.

BEE's-Bread. See BEE, N° 12. par. *ult*.

BEE-Eater. See MEROPS, ORNITHOLOGY *Index*.

BEE-Flower. See OPHRYS, BOTANY *Index*.

BEE-Glue, called by the ancients *propolis*, is a soft, unctuous, glutinous matter, employed by bees to cement the combs to the hives, and to close up the cells. See BEE, N° 13.

BEE-Hives. See BEE, N° 19, 34, 36.

BEECH-TREE. See FAGUS, BOTANY *Index*.

BEECH-Mast, the fruit of the beech-tree, said to be good for fattening hogs, deer, &c.—It has sometimes, even to men, proved an useful substitute for bread. Chios is said to have endured a memorable siege by means of it.

BEECH-Oil, an oil drawn by expression from the mast of the beech-tree, after it has been shelled and pounded. This oil is very common in Picardy, and used there and in other parts of France instead of butter; but most of those who take a great deal of it complain of pains and a heaviness in the stomach.

BEEF, the flesh of black-cattle prepared for food. According to Dr Cullen*, beef, though of a more firm texture and less soluble than mutton, is equally alkalescent, perspirable, and nutritious: and if in the southern countries it is not esteemed so, it is on account of its imperfection there.

* *Lect. on Mat. Med.*

BEELE, a kind of pick-axe, used by the miners for separating the ores from the rocks in which they lie; this instrument is called a *tubber* by the miners of Cornwall.

BEER, is a spirituous liquor made from any farinaceous grain, but generally from barley. It is, properly speaking, the wine of barley. The meals of any of these grains being extracted by a sufficient quantity of water, and remaining at rest in a degree of heat requisite for the spirituous fermentation, naturally undergo this fermentation, and are changed into a vinous liquor. But as all these matters render the water mucilaginous, fermentation proceeds slowly and imperfectly in such liquors. On the other side, if the quantity of farinaceous matter be so diminished that its extract or decoction may have a convenient degree of fluidity, this liquor will be impregnated with so small a quantity of fermentable matter, that the beer or wine of the grain will be too weak, and have too little taste.

These inconveniences are remedied by preliminary operations which the grain is made to undergo.—These preparations consist in steeping it in cold water, that it may soak and swell to a certain degree; and in laying it in a heap with a suitable degree of heat, by means of which, and of the imbibed moisture, a germination begins, which is to be stopped by a quick drying, as soon as the bud shows itself. To accelerate this drying, and render it more complete, the grain is slightly roasted, by making it pass down an inclined canal sufficiently heated. This germination, and this slight roasting, changes considerably the nature of the mucilaginous fermentable matter of the grain. The germination attenuates much, and in some measure totally destroys, the viscosity of the mucilage; and it does this, when not carried too far, without depriving the grain of any of its disposition to ferment. On the contrary, it changes the grain into a saccharine substance, as may be perceived by mashing grains beginning to germinate. The slight roasting contributes also to attenuate the mucilaginous fermentable matter of the grain. When the grain is thus prepared, it is fit to be ground, and to impregnate water with much of its substance without forming a glue or viscous mass. The grain thus prepared is called *malt*. This malt is then to be ground; and all its substance, which is fermentable and soluble in water, is to be extricated by means of hot water. This extract or infusion is sufficiently evaporated by boiling, in caldrons; and some plant of an agreeable bitterness, such as hops, is at that time added, to heighten the taste of the beer, and to render it capable of being longer preserved. Lastly, this liquor is put into casks, and allowed to ferment; nature performs the rest of the work, and is only to be assisted by the other most favourable circumstances for the spirituous fermentation. See FERMENTATION.

Foreigners

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Foreigners have framed divers conjectures to account for the excellency of the British beer, and its superiority to that of other countries, even of Bremen, Mons, and Rostoch. It has been pretended our brewers throw dead dogs flayed into their wort, and boil them till the flesh is all consumed. Others, more equitable, attribute the excellency of our beer to the quality of our malt and water, and the skill of our brewers in preparing it.

Sour beer may be restored divers ways; as by salt made of the ashes of barley-straw, put into the vessel and stirred; or by three or four handfuls of beech-ashes thrown into the vessel, and stirred; or, where the liquor is not very sour, by a little put in a bag, without stirring; chalk calcined, oyster-shells, egg-shells, burnt sea-shells, crabs eyes, alkalized coral, &c. do the same, as they imbibe the acidity, and unite with it into a sweetness.—Beer, it is said, may bé kept from turning sour in summer, by hanging in the vessel a bag containing a new-laid egg, pricked full of little pin-holes, some laurel-berries, and a few barley-grains; or by a new-laid egg and walnut-tree leaves. Glauber commends his sal mirabile and fixed nitre, put in a linen bag, and hung on the top of the cask so as to reach the liquor, not only for recovering sour beer, but preserving and strengthening it.

Laurel-berries, the skin being peeled off, will keep beer from *deadness;* and beer already dead may be restored by impregnating it with fixed air.

Beer *tasting of the cask* may be freed from it by putting a handful of wheat in a bag, and hanging it in the vessel.

BEEROTH, a village of Judea, situated at the foot of Mount Gabaon, seven miles from Ælia or Jerusalem, on the road to Nicopolis (Jerome).

BEERSHEBA (Moses), a city to the south of the tribe of Judah, adjoining to Idumea (Josephus). See Bersabe.

BEESTINGS, or Breastings, a term used by country-people for the first milk taken from a cow after calving.—The beestings are of a thick consistence, and yellow colour, seeming impregnated with sulphur. Dr Morgan imagines them peculiarly fitted and intended by nature to cleanse the young animal from the recrements gathered in its stomach and intestines during its long habitation *in utero.* The like quality and virtue he supposes in women's first milk after delivery; and hence infers the necessity of the mother's suckling her own child, rather than committing it to a nurse whose first milk is gone.

BEET. See Beta, Botany *Index.*

BEETLE. See Scarabæus, Entomology *Index.*

Beetle also denotes a wooden instrument for driving piles, &c. It is likewise called a *stamper*, and by paviors a *rammer.*

BEEVES, a general name for oxen. See Bos, Mammalia *Index.*

BEFORT, a small town of France in the department of Upper Rhine. It was ceded to France by the treaty of Westphalia in 1648. It contains nearly 5000 inhabitants, and is important on account of the great road by this place from Franche Compte. The fortifications were greatly augmented by Louis XIV. It is seated at the foot of a mountain. E. Long. 6. 2. N. Lat. 47. 38.

BEG, or Bey, in the Turkish affairs. See Bey.

Beg is more particularly applied to the lord of a banner, called also in the same language *sangiak-beg.* A beg has the command of a certain number of the spahis, or horse, maintained by the province under the denomination of *timariots.* All the begs of a province obey one governor-general, called *begler-beg*, or *beyler-beg*, q. d. lord of lords or of the beys of the province.

Begs, or Beghs, of Egypt, denote twelve generals, who had the command of the militia or standing forces of the kingdom; and were to secure the country from the insults of Arabs, as well as to protect the pilgrims in their annual expeditions to Mecca. They were formerly very rich and powerful; but the Turkish Pasha Ali, who has raised himself to independence in Egypt since the expulsion of the French, has annihilated the power of this class of officers.

BEGA, Cornelius, painter of landscape, cattle, and conversations, was born at Haerlem in 1620, and was the disciple of Adrian Ostade. Falling into a dissipated way of life, he was disinherited by his father: for which reason he cast off his father's name, which was Begeyn, and assumed that of Bega: his early pictures being marked with the former, and his latter works with the other. He had a fine pencil, and a delicate manner of handling his colours, so as to give them a look of neatness and transparence; and his performances are so much esteemed in the Low Countries, as to be placed among the works of the best artists. He caught the plague from a woman with whom he was deeply enamoured; and he showed so much sincerity of affection, that notwithstanding the expostulations of all his friends and physicians, he would attend her to the last moments of her life, and died a few days after, aged 44.

BEGGAR, a person who begs. See a general view of the condition and number of such persons in Britain, in the article Beggar in the Supplement.

BEGHARDS. See Beguards.

BEGLERBEG, a governor of one of the principal governments of the Turkish empire, and next in dignity to the grand vizier. To every beglerbeg the grand signior gives three ensigns or staves, trimmed with a horsetail; to distinguish them from the bashaws, who have but two; and from simple begs, or sangiac begs, who have but one.

The province or government of beglerbeg is called *beglerbeglik*, or *beglierbeglik.* There are two sorts; the first called *basilo beglerbeglik*, which have a certain rent assigned out of the cities, countries, and signiories allotted to the principality: the second called *saliane beglerbeglik*, for maintenance of which is annexed a salary or rent, collected by the grand signior's officers with the treasure of the empire. The beglerbegs of the first sort are in number 22, viz. those of Anatolia, Caramania, Diarbekir, Damascus, Aleppo, Tripoli, Trebizond, Buda, Timiswar, &c. The beglerbegs of the second sort are in number six, viz. those of Cairo, Babylon, &c. Five of the beglerbegs have the title of *viziers*, viz. those of Anatolia, Babylon, Cairo, Romania, and Buda.

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The beglerbegs appear with great state, and a large retinue, especially in the camp, being obliged to bring a soldier for every 5000 aspers of rent which they enjoy. Those of Romania brought 10,000 effective men into the field.

The beglerbegs are become almost independent, and have under their jurisdiction several sangiacs or particular governments, and begs, agas, and other officers who obey them.

BEGUARDS, or Beghards, religious of the third order of St Francis in Flanders. They were established at Antwerp in the year 1228, and took St Begghe for their patroness, whence they had their name. From their first institution they employed themselves in making linen cloth, each supporting himself by his own labour, and united only by the bonds of charity, without having any particular rule. But, when Pope Nicholas IV. had confirmed that of the third order of St Francis in 1289, they embraced it the year following. They were greatly favoured by the dukes of Brabant, particularly John II. and John III. who exempted them from all contributions and taxes. In the year 1425, they began to live in common, and made solemn vows in 1467, after having taken the habit of the Terciaries (or religious of the third order of St Francis) of Liege. At last, in 1472, they became subject to the general of the congregation of Zepperen in the diocese of Liege, to which they were united by Pope Sixtus IV. As the convent of Antwerp is since become very considerable, the name of *Beguards* has been given to all the other religious of the same congregation. But, in 1650, Pope Innocent X. having suppressed the general of the congregation of Zepperen, all the convents of the third order of St Francis, in the dioceses of Liege, Malines, and Antwerp, were submitted to the visitation, jurisdiction, and correction, of the general of Italy, and erected into a province, under the title of *the province of Flanders*. This province has at present 10 or 12 convents, the principal of which are those of Antwerp, Brussels, Maestricht, and Louvain.

BEGUINES, a congregation of religious or nuns, founded either by St Begghe, founder likewise of the Beguards, or by Lambert le Begue; of whom the former died about the end of the seventh century, the latter about the end of the 12th. They were established first at Liege, and afterwards at Neville, in 1207; and from this last settlement sprang the great number of Beguinages, which are spread over all Flanders, and which have passed from Flanders into Germany. In the latter country, some of these religious fell into extravagant errors, persuading themselves that it was possible, in the present life, to arrive at the highest perfection, even to impeccability, and a clear view of God; in short, to so eminent a degree of contemplation, that there was no necessity, after this, either to observe the fasts of the church, or submit to the direction and laws of mortal men. The council of Vienna condemned these errors, and abolished the order of Beguines; permitting, nevertheless, those among them, who continued in the true faith, to live in chastity and penitence, either with or without vows. It is by favour of this latter clause, that there still subsist so many communities of Beguines in Flanders; who, since the council of Vienna, have conducted themselves with so much wisdom and piety, that Pope John XXII. by his decretal, which explains that of his predecessor made in the council of Vienna, took them under his protection; and Boniface VIII. in another, exempted them from the secular tribunal, and put them under the jurisdiction of the bishops.

There is scarcely a town in the Low Countries, in which there is not a society of Beguines; and, notwithstanding the change of religion at Amsterdam, there is a very flourishing one in that city. These societies consist of several houses placed together in one inclosure, with one or more churches, according to the number of Beguines. There is in every house a prioress, or mistress, without whose leave they dare not stir out. They make a sort of vow, which is conceived in the following terms: "I N. promise to be obedient and chaste as long as I continue in this Beguinage." They observe a three years noviciate before they take the habit. The rector of the parish is superior of the Beguinage; and he does nothing without the advice of eight Beguines. They were formerly habited in different manners; some in gray, others in blue; but at present they all wear black. When they go abroad, in Amsterdam, they put on a black veil. Formerly they had as many different statutes as there were societies. In the visitations of the year 1600 and 1601, by the archbishop Matthias Hovius, they were forbidden, under the penalty of a fine, to have lapdogs. The finest Beguinage in Flanders is that of Malines. That of Antwerp likewise is very spacious, and has two separate churches.

BEHEADING, a capital punishment, wherein the head is severed from the body by the stroke of an axe, sword, or other cutting instrument.

Beheading was a military punishment among the Romans, known by the name of *decollatio*. Among them the head was laid on a *cippus* or block, placed in a pit dug for the purpose; in the army, without the *vallum*; in the city, without the walls, at a place near the *porta decumana*. Preparatory to the stroke, the criminal was tied to a stake, and whipped with cords. In the early ages the blow was given with an axe; but in after-times with a sword, which was thought the more reputable manner of dying. The execution was but clumsily performed in the first times; but afterwards they grew more expert, and took the head off clean, with one circular stroke.

In England, beheading is the punishment of nobles, as it was formerly in France; being reputed not to derogate from nobility, as hanging does.

In Scotland they do not behead with an axe, as in England; nor with a sword, as in Holland; but with an edged instrument called the Maiden. With an instrument similar to this, were the bloody executions perpetrated in France during the late revolution. It was called *guillotine*, from the name of the supposed inventor, who was a physician.

BEHEMOTH, the hippopotamus or river-horse. See Hippopotamus, Mammalia *Index*.

BEHEN, in *Botany*. See Cucubalus, Botany *Index*.

BEHMEN. See Boehmen.

BEHN, Aphara, a celebrated authoress, descended from a good family in the city of Canterbury, was born some time in Charles I.'s reign, but in what year

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year is uncertain. Her father's name was *Johnson*, who through the interest of Lord Willoughby, to whom he was related, being appointed lieutenant-general of Surinam and 36 islands, undertook a journey to the West Indies, taking with him his whole family, among whom was our poetess, at that time very young. Mr Johnson died on the voyage; but his family reaching Surinam, settled there for some years. Here it was that she learned the history of, and acquired a personal intimacy with, the American prince Oroonoko, and his beloved Imoinda, whose adventures she hath so pathetically related in her celebrated novel of that name, and which Mr Southerne afterwards made such an admirable use of, in adopting it as the groundwork of one of the best tragedies in the English language.

On her return to London, she became the wife of one Mr Behn, a merchant, residing in that city, but of Dutch extraction. How long he lived after their marriage is not very apparent, probably not very long; for her wit and abilities having brought her into high estimation at court, King Charles II. fixed on her as a proper person to transact some affairs of importance abroad during the course of the Dutch war. To this purpose she went over to Antwerp, where, by her intrigues and gallantries, she so far crept into the secrets of state, as to answer the ends proposed by sending her over. Nay, in the latter end of 1666, by means of the influence she had over one Vander Albert, a Dutchman of eminence, whose heart was warmly attached to her, she wormed out of him the design formed by De Ruyter, in conjunction with the family of the De Wits, of sailing up the Thames and burning the English ships in their harbours, which they afterwards put in execution at Rochester. This she immediately communicated to the English court: but though the event proved her intelligence to be well grounded, yet it was at that time only laughed at; which, together probably with no great inclination shown to reward her for the pains she had been at, determined her to drop all further thoughts of political affairs, and during the remainder of her stay at Antwerp to give herself up entirely to the gaiety and gallantries of the place. Vander Albert continued his addresses, and after having made some unsuccessful attempts to obtain the possession of her person on easier terms than matrimony, at length consented to make her his wife; but while he was preparing at Amsterdam for a journey to England with that intent, a fever carried him off, and left her free from any amorous engagements. In her voyage back to England, she was very near being lost, the vessel she was in being driven on the coast by a storm; but happening to founder within sight of land, the passengers were, by the timely assistance of boats from the shore, all fortunately preserved.

From this period she devoted her life entirely to pleasure and the muses. Her works are extremely numerous, and all of them have a lively and amorous turn. It is no wonder then that her wit should have gained her the esteem of Mr Dryden, Southerne, and other men of genius, as her beauty, of which in her younger part of life she possessed a great share, did the love of those of gallantry. Nor does she appear to have been any stranger to the delicate sensations of that passion, as appears from some of her letters to a gentleman, with whom she corresponded under the name of Lycida, and who seems not to have returned her flame with equal ardour, or received it with that rapture her charms might well have been expected to command.

She published three volumes of Miscellany Poems; two volumes of Histories and Novels; translated Fontenelle's Plurality of Worlds, and annexed a Criticism on it; and her plays make four volumes. In the dramatic line, the turn of her genius was chiefly to comedy. As to the character her plays should maintain in the records of dramatic history, it will be difficult to determine, since their faults and perfections stand in strong opposition to each other. In all, even the most indifferent of her pieces, there are strong marks of genius and understanding. Her plots are full of business and ingenuity, and her dialogue sparkles with the dazzling lustre of genuine wit, which everywhere glitters among it. But then she has been accused, and that not without great justice, of interlarding her comedies with the most indecent scenes, and giving an indulgence to her wit in the most indelicate expressions. To this accusation she has herself made some reply in the Preface to the Lucky Chance; but the retorting the charge of prudery and preciseness on her accusers, is far from being a sufficient exculpation of herself. The best and perhaps the only true excuse that can be made for it is, that, as she wrote for a livelihood, she was obliged to comply with the corrupt taste of the times.

After a life intermingled with numerous disappointments, she departed from this world on the 16th of April 1689, and lies interred in the cloisters of Westminster Abbey.

BEJA, an ancient town of Portugal, in the province of Alentejo. It is seated in a very agreeable and fruitful plain, remarkable for excellent wine. There are three gates remaining, which are of Roman architecture, and a great many Roman antiquities are dug out of the earth. The town has a strong castle for its defence, and is situated in W. Long. 7. 20. N. Lat. 37. 58. It was taken from the Moors in 1162.

BEJAR, a town of Estremadura in Spain, famous for its baths. It is seated in a very agreeable valley surrounded with high mountains whose tops are always covered with snow. Here the dukes of Bejar have a handsome palace. In this neighbourhood are forests filled with game, and watered by fine springs; also a lake abounding with excellent fish, particularly trouts. They pretend that this lake makes such a noise before a storm, that it may be heard 15 miles off.

BEICHLINGEN, a town of Thuringia in Upper Saxony, in E. Long. 11. 50. N. Lat. 51. 20.

BEILA, a town of Italy, in Piedmont. E. Long. 7. 45. N. Lat. 45. 2.

BEILSTEIN, a town of the landgravate of Hesse in Germany, in E. Long. 8. 0. N. Lat. 50. 30.

BEINASCHI, GIOVANNI BATTISTA, called *Cavalier Beinaschi*, history painter, was a Piedmontese, and born in 1634. He studied in Rome, under the direction of Pietro del Po; and some authors affirm, that he was afterwards the disciple of Lanfranc. It was certain that he was peculiarly fond of the works of Lanfranc, and at last became so thoroughly acquainted with the style, manner, and touch, of that excellent

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excellent master, that many of the pictures of Beinaschi are at this day accounted the work of Lanfranc's own hand. He was an admirable designer; his lively invention furnished him with a surprising variety: his thought was noble; he was not only expeditious but correct; and as a public acknowledgment of his merit, the honour of knighthood was conferred upon him.

BEINHEIM, a fort of Alsace in France, seated on the river Sur, near its confluence with the Rhine, in E. Long. 8. 12. N. Lat. 45. 2.

BEIRA, a province of Portugal, bounded on the west by the ocean, on the south by the Portuguese Estremadura, on the south-east by the Spanish province of the same name, on the east by the province of Tra los Montos, and on the north by the river Douro. It extends in length about 34 leagues, and in breadth about 30 leagues, and is divided into six commarcas. Within this province lies Lamego, where the first assembly of the states was held; the chief episcopal city of Conimbra, or Coimbra, which is likewise an university; and Viseo, also a bishopric, and formerly the capital of a dukedom. The country is equally agreeable and fruitful, producing corn, wines, &c. in abundance, and the hills affording excellent pasture to cattle and sheep. The population in 1810 was 880,602, and the number of parishes 1227.

BEIRAM, or BAIRAM. See BAIRAM.

BEIRALSTON, a town in Devonshire, which sends two members to parliament.

BEIZA, or BEIZATH, in Hebrew antiquity, a word signifying an *egg;* as also a certain measure in use among the Jews. The beiza was likewise a gold coin, weighing 40 drachms, among the Persians, who gave out that Philip of Macedon owed their king Darius 1000 beizaths or golden eggs, for tribute-money; and that Alexander the Great refused to pay them, saying, that the bird which laid these eggs was flown into the other world.

BEKKER, BALTHASAR, one of the most famous Dutch divines, and author of the celebrated book, The World Bewitched, an ingenious piece against the vulgar notion of spirits. This raised a terrible clamour against him. He was deposed from the office of minister; but the magistrates of Amsterdam continued him his pension. He died in 1698.

BEL, MATTHIAS, was born in Hungary, and became a Lutheran minister at Presburg, and historiographer to the emperor Charles VI. He wrote, among other works, a History of Hungary, which was so much admired, that the emperor sent him letters of nobility; and notwithstanding his being a Lutheran, the Pope, in 1736, sent him his picture, and many large gold medals. He was a member of the Royal Society of London, and of the academies of Berlin and Petersburg; and died in 1749, at 66 years of age.

BEL, or *Belus*, the supreme god of the ancient Chaldeans or Babylonians. He was the founder of the Babylonian empire; and is supposed to be the Nimrod of Scripture, and the same as the Phœnician Baal. This god had a temple erected to him in the city of Babylon, on the very uppermost range of the famous tower of Babel, or Babylon, wherein were many statues of this deity; and one, among the rest, of massy gold, 40 feet high. The whole furniture of this magnificent temple was of the same metal, and valued at 800 talents of gold.—This temple, with its riches, was in being till the time of Xerxes, who, returning from his unfortunate expedition into Greece, demolished it, and carried off the immense wealth which it contained. It was the statue of this god which Nebuchadnezzar, being returned to Babylon after the end of the Jewish war, set up and dedicated in the plain of Dura; the story of which is related at large in the third chapter of Daniel.

BEL and the Dragon, the history of; an apocryphal and uncanonical book of Scripture. It was always rejected by the Jewish church, and is extant neither in the Hebrew nor the Chaldee language, nor is there any proof that it ever was so. St Jerome gives it no better title than the *Fable of Bell and the Dragon*. It is however permitted to be read, as well as the other apocryphal writings, for instruction and the improvement of manners.

BELAC, a small town of France, in the province of the Lyonnois, now the department of Upper Vienne, and district of La Marche. It contains about 3900 inhabitants. E. Long. 1. 3. N. Lat. 46. 8.

BELAY, on board a ship, signifies the same as fasten.—Thus they say, belay the sheet, or tack, that is, fasten it to the kevel, by winding it several times round a last, &c.

BELCASTRO, an episcopal city of Italy in the farther Calabria, and kingdom of Naples. It is seated on a mountain, in E. Long. 17. 15. N. Lat. 39. 6.

BELCHITE, a town of Spain, in the kingdom of Arragon, seated on the river Almonazir, in W. Long. 0. 30. N. Lat. 41. 19.

BELCHOE, a town of Ireland, in the province of Ulster, and county of Fermanagh, seated on Lough Nilly, in W. Long. 6. 6. N. Lat. 54. 2.

BELEM, a town of Estremadura in Portugal, about a mile from Lisbon. It is seated on the north side of the river Tajo, and is designed to defend the entrance to Lisbon; and here all the ships that sail up the river must bring to. In this place they inter the kings and queens of Portugal.

BELEMNITES, vulgarly called *thunder-bolts* or *thunder-stones*, are composed of several crusts of stone encircling each other, of a conical form, and various sizes; usually a little hollow, and somewhat transparent, formed of several striæ radiating from the axis to the surface of the stone; and when burnt or rubbed against one another, or scraped with a knife, yield an odour like rasped horn. Their size is various, from a quarter of an inch to eight inches; and their colour and shape differ. They are supposed to be originally either a part of some sea production; or a stone formed in the cavity of some worm-shell, which being of a tender and brittle nature, has perished, after giving its form to the stone. They are very frequently found in many parts of England; and the common people have a notion, that they are always to be met with after a storm. They are often enclosed in, or adhere to, other stones; and are most frequent amongst gravel, or in clay; they abound in Gloucestershire; and are found near Dedington in Oxfordshire, where they sometimes contain the silver marcasite.

BELERIUM, in *Ancient Geography*, a promontory of

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of the Dunmonii or Damnonii, the westmost Britons. Now called the *Land's End*, in Cornwall.

BELESIS, or NANYBRUS, is said to have been the founder of the ancient Babylonish empire, and in conjunction with Arbaces the Mede to have put an end to the kingdom of the Assyrians by the defeat and death of Sardanapulus. This first prince is represented as a crafty and mean-spirited knave; and at the same time, as nothing less than a hero. It is said, he was base enough to circumvent Arbaces his colleague and friend in the most shameful manner; by pretending a vow he had, in the midst of the war, made to his god Belus, That if success was the event of it, and the palace of Sardanapalus was consumed, as it was, he would be at the charge and trouble of removing the ashes that were left to Babylon; where he would heap them up into a mount near the temple of his god; there to stand as a monument to all who should navigate the Euphrates, of the subversion of the Assyrian empire. He, it seems, had been privately informed, by an eunuch, of the immense treasure which had been consumed in the conflagration at Nineveh; and knowing it to be a secret to Arbaces, his avarice suggested to him this artifice. Arbaces not only granted him his request; but appointed him king of Babylon, with an exemption from all tribute. Belesis, by this artifice, carried a prodigious treasure with him to Babylon; but when the secret was discovered, he was called to an account for it, and tried by the other chiefs who had been assistant in the war, and who, upon his confession of the crime, condemned him to lose his head. But Arbaces, a munificent and generous prince, freely forgave him, left him in possession of the treasure, and also in the independent government of Babylon, saying, The good he had done ought to serve as a veil to his crime; and thus he became at once a prince of great wealth and dominion.

In process of time, and under the successor of Arbaces, he became a man of dress, shew, and effeminacy, unworthy of the kingdom or province he held. Nanybrus, for so we must now call Belesis, understanding a certain robust Mede, called *Parsondas*, held him in the utmost contempt, and had solicited the emperor of the Medes to divest him of his dominions, and to confer them upon himself, offered a very great reward to the man who should take Parsondas and bring him to him. Parsondas hunting somewhere near Babylon with the king of the Medes, and straggling from the company, happened to fall in with some of the servants of the Babylonian Nanybrus, who had been tempted with the promised reward. They were purveyors to the king; and Parsondas being very thirsty, asked them for a draught of wine; which they not only granted, but prevailed upon him to take a meal with them. As he drank freely, suspecting no treachery, he was easily persuaded to pass that night in company with some beautiful women, brought on purpose to detain him. But, while he was in a profound sleep, the servants of Nanybrus rushing upon him, bound him, and carried him to their prince; who bitterly reproached him for endeavouring to estrange his master the king of the Medes from him, and by that means place himself in his room on the throne of Babylon. Parsondas did not deny the charge; but with great intrepidity owned, that he thought himself more worthy of a crown than such an indolent and effeminate prince as he was. Nanybrus, highly provoked at the liberty he took, swore by the gods Belus and Malis, or rather Mylitta, that Parsondas himself should in a short time become so effeminate as to reproach none with effeminacy. Accordingly, he ordered the eunuch who had the charge of his music-women, to shave, paint, and dress him after the manner of those women, to teach him the art, and in short to transform him by all possible means into a woman. His orders were obeyed; and the manly Parsondas soon excelled the fairest female in singing, playing, and the other arts of allurement.

In the mean time the king of the Medes, having in vain sought after his favourite servant, and in vain offered great rewards to such as should give him any information concerning him, concluded he had been destroyed by some wild beast in the chase. At length, after seven years, the Mede was informed of his state and condition by an eunuch, who, being cruelly scourged by Nanybrus's order, fled, at the instigation of Parsondas into Media; and there disclosed the whole to the king, who immediately despatched an officer to demand him. Nanybrus pretended to know nothing of any such person: upon which another officer was sent by the Mede, with a peremptory order to seize on Nanybrus if he persisted in the denial, to bind him with his girdle, and lead him to immediate execution. This order had the desired effect: the Babylonian owned what he had before denied; promising to comply, without further delay, with the king's demand; and in the mean time invited the officer to a banquet, at which 150 women, among whom was Parsondas, made their appearance, singing and playing upon various instruments. But, of all, Parsondas appeared by far the most charming; insomuch, that Nanybrus inquiring of the Mede which he liked best, immediately pointed at him. At this the Babylonian clapt his hands; and, falling into an immoderate fit of laughter, told him who the person was whom he thus preferred to all the rest; adding, that he could answer what he had done before the king of the Medes. The officer was no less surprised at such an astonishing change than his master was afterwards, when Parsondas appeared before him. The only favour Parsondas begged of the king, for all his past services, was, that he would avenge on the Babylonian the base and highly injurious treatment he had met with at his hands. The Mede marched accordingly at his instigation to Babylon; and, notwithstanding the remonstrances of Nanybrus, urging, that Parsondas had, without the least provocation, endeavoured to deprive him both of his life and kingdom, declared that in ten days time he would pass the sentence on him which he deserved, for presuming to act as judge in his own cause, instead of appealing to him. But Nanybrus having in the mean time gained with a large bribe Mitraphernes the Mede's favourite eunuch, the king was by him prevailed upon to sentence the Babylonian only to a fine; which made Parsondas curse the man who first found out gold, for the sake of which he was to live the sport and derision of an effeminate Babylonian.

BELESME, a town of Perche in France, in the department of Orne, in W. Long. 0. 16. N. Lat. 48. 23.

BELEZERO, a town of Russia, and capital of a province of the same name. It is situated on the south-east shore of the White sea, in E. Long. 36. 10. N. Lat. 61. 50.

BELFAST, a town of Ireland, in the county of Antrim. It is seated at the bottom of Carrickfergus bay, and is the chief town and port in this part of Ireland, as well for beauty, as for its wealth, trade, and shipping. The customhouse duties for the year 1816 amounted to 349,417l.; and the inhabitants, who are mostly Scots, and of the Presbyterian religion, amounted in the same year to 30,000. W. Long. 5. 54. N. Lat. 54. 38.

BELFRY, Belfredus, is used by military writers of the middle age for a sort of tower erected by besiegers to overlook and command the place besieged. Belfry originally denoted a high tower, whereon sentinels were placed to watch the avenues of a place, and prevent surprise from parties of the enemies, or to give notice of fires by ringing a bell. In the cities of Flanders, where there is no belfry on purpose, the tower of the chief church serves the same end. The word *belfry* is compounded of the Teutonic *bell*, and *freid*, "peace," because the bells were hung for preserving the peace.

Belfry is also used for that part of a steeple wherein the bells are hung. This is sometimes called by the middle-age writers *campanile*, *clocaria*, and *tristegum*.

Belfry is more particularly used for the timber-work which sustains the bells in a steeple, or that wooden structure to which the bells in church-steeples are fastened.

BELGÆ, in *Ancient Geography*, a people of Britain, to the west: Now Hampshire, Wiltshire, and Somersetshire, (Camden).

BELGICA, a town of the Ubii in Gallia Belgica, midway between the rivers Rhine and Roer: Now called *Balchusen* (Cluverius); a citadel of Juliers (Baudrand).

Belgica Gallia, one of Cæsar's three divisions of Gaul, contained between the ocean to the north, the rivers Seine and Marne to the west, the Rhine to the east, but on the south at different times within different limits. Augustus, instituting everywhere a new partition of provinces, added the Sequani and Helvetii, who till then made a part of Celtic Gaul, to the Belgic (Pliny, Ptolemy). The gentilitious name is *Belgæ*, called by Cæsar the bravest of the Gauls, because untainted by the importation of luxuries. The epithet is *Belgicus* (Virgil).

BELGARDEN, a town of Germany, in East Pomerania, in a circle of the same name, and subject to Prussia. E. Long. 16. 5. N. Lat. 54. 10.

BELGINUM, a town of the Treviri, in Gallia Belgica: Now called *Baldenau*, in the electorate of Triers.

BELGIUM, manifestly distinguished from Belgica, as a part from the whole (Cæsar); who makes Belgium the country of the Bellovaci; Hirtius adding the Atrebates. But as the Ambiani lay between the Bellovaci and Atrebates, we must also add these: and thus Belgium reached to the sea, because the Ambiani lay upon it: and these three people constituted the proper and genuine Belgæ (all the rest being adventitious, or foreigners); and these were the people of Beauvais, Amiens, and Artois.

BELGOROD, a town of Russia, and capital of a province of the same name. It is seated on the river Donnets, in E. Long. 18. 5. N. Lat. 51. 20.

Belgorod, a strong town of Bessarabia in European Russia, seated at the mouth of the river Niester, on the Black sea, 80 miles south-east of Bender. E. Long. 31. 0. N. Lat. 46. 10.

BELGRADE, a city of Turkey in Europe, and capital of Servia, seated at the confluence of the Save and the Danube, in E. Long. 20. 10. N. Lat. 44. 52. The Danube is very rapid near this city, and its waters look whitish. Belgrade is built on a hill, and was once large, strong, and populous. It was surrounded with a double wall, flanked with a great number of towers, and had a castle situated on a rising ground, and built with square stones. The suburbs are very extensive: and resorted to by Turkish, Jewish, Greek, Hungarian, and Sclavonian merchants. The streets where the greatest trade is carried on are covered with wood, to shelter the dealers from the sun and rain. The rivers render it very convenient for commerce; and as the Danube falls into the Black sea, the trade is easily extended to distant countries, which renders it the staple town in these parts; and as the Danube runs up to Vienna, they send goods from thence with a great deal of ease. The Armenians have a church here, and the Jews a synagogue; both these being employed as factors. The shops are but small: and the sellers sit on tables, disposing of their commodities out of a window, for the buyers never go on the inside. The richest merchandise is exposed to sale in two bezesteins or bazars, built crosswise. There are two exchanges, built with stone, and supported with pillars not unlike the Royal Exchange at London. It has been taken by the Turks and Imperialists alternately several times. The fine fortifications were demolished in 1739; and the place was finally ceded to the Turks in 1791. It was taken by the Servian insurgents in 1806.

BELGRADO, a town of Friuli, in the Venetian territories in Italy. It stands near the river Tejamento, in E. Long. 13. 5. N. Lat. 46. 0.

BELIA, in *Ancient Geography*, a town of hither Spain: Now *Belchite*, in the kingdom of Arragon. See Belchite.

BELIAL, בליאל, a Hebrew word which signifies a wicked worthless man, one who is resolved to endure no subjection. Thus the inhabitants of Gibeah, who abused the Levite's wife (Judges xix. 22.), have the name of Belial given them. Hophni and Phineas, the high priest Eli's sons, are likewise called sons of Belial (1 Sam. ii. 12.), upon account of the several crimes they had committed, and the unbecoming manner in which they behaved themselves in the temple of the Lord. Sometimes the name Belial is taken to denote the devil. Thus St Paul says (Cor. vi. 15.) "What concord hath Christ with Belial?" Whence it appears, that in his time the Jews, under the name of Belial, commonly understood the devil in the places where this term occurs in the Old Testament.

BELIDOR, Bernard Forest de, a Catalonian engineer in the service of France, and member of the academies of sciences at Paris and Berlin, and of the royal

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royal society at London; a celebrated mathematician, and author of a number of military tracts in which the science of mathematics is applied to military uses. Died in 1765, aged 70.

BELIEF, in its general and natural sense, denotes a persuasion, or a strong assent of the mind to the truth of any proposition. In which sense, belief has no relation to any particular kind of means or arguments, but may be produced by any means whatever. Thus we are said to believe our senses, to believe our reason, to believe a witness, &c. And hence, in rhetoric, all sorts of proofs, from whatever topics deduced, are called πιστις, because apt to beget belief or persuasion touching the matter in hand.

Belief, in its more restrained and technical sense, invented by the schoolmen, denotes that kind of assent which is grounded only on the authority or testimony of some person or persons, asserting or attesting the truth of any matter proposed.

In this sense, belief stands opposed to knowledge and science. We do not say we believe that snow is white, or that the whole is equal to its parts; but we see and know them to be so. That the three angles of a triangle are equal to two right angles, or that all motion is naturally rectilinear, are not said to be things credible, but scientifical; and the comprehension of such truths is not belief but science.

But when a thing propounded to us is neither apparent to our sense, nor evident to our understanding; neither certainly to be collected from any clear and necessary connection with the cause from which it proceeds, nor with the effects which it naturally produces; nor is taken up upon any real arguments, or relation thereof to other acknowledged truths; and yet, notwithstanding, appears as true, not by manifestation, but by an attestation of the truth, and moves us to assent, not of itself, but in virtue of a testimony given to it—this is said to be properly credible; and an assent to this is the proper notion of belief or faith.

BELIEVERS, an appellation given toward the close of the first century to those Christians who had been admitted into the church by baptism, and instructed in all the mysteries of religion. They had also access to all the parts of divine worship, and were authorized to vote in the ecclesiastical assemblies. They were thus called in contradistinction to the catechumens, who had not been baptized, and were debarred from these privileges.

BELIO, in *Ancient Geography*, a river of Lusitania, called otherwise *Limæus*, *Limeas*, *Limias*, and *Lethe*, or the *river of oblivion*: the boundary of the expedition of Decimus Brutus. The soldiers out of superstition refusing to cross, he snatched an ensign out of the hands of the bearer, and passed over, by which his army was encouraged to follow (Livy). He was the first Roman who ever proceeded so far, and ventured to cross. The reason of the appellation, according to Strabo is, that in a military expedition a sedition arising between the Celtici and Turduli, after crossing that river, in which the general was slain, they remained dispersed there; and from this circumstance it came to be called the *river of Lethe*, or *oblivion*. Now called *El Lima*, in Portugal, running westward into the Atlantic, to the south of the Minho.

BELISARIUS, general of the emperor Justinian's

army, who overthrew the Persians in the east, the Vandals in Africa, and the Goths in Italy. See Rome. But after all his great exploits, he was falsely accused of a conspiracy against the emperor. The real conspirators had been detected and seized, with daggers hidden under their garments. One of them died by his own hand, and the other was dragged from the sanctuary. Pressed by remorse, or tempted by the hopes of safety, he accused two officers of the household of Belisarius; and torture forced them to declare that they had acted according to the secret instructions of their patron. Posterity will not hastily believe, that a hero who in the vigour of life had disdained the fairest offers of ambition and revenge, should stoop to the murder of his prince, whom he could not long expect to survive. His followers were impatient to fly; but flight must have been supported by rebellion, and he had lived enough for nature and for glory. Belisarius appeared before the council with less fear than indignation: after 40 years service, the emperor had prejudged his guilt; and injustice was sanctified by the presence and authority of the patriarch. The life of Belisarius was graciously spared: but his fortunes were sequestered; and, from December to July, he was guarded as a prisoner in his own palace. At length his innocence was acknowledged; his freedom and honours were restored; and death, which might be hastened by resentment and grief, removed him from the world about eight months after his deliverance. That he was deprived of his eyes, and reduced by envy to beg his bread, "Give a penny to Belisarius the general!" is a fiction of later times; which has obtained credit, or rather favour, as a strange example of the vicissitudes of fortune.—The source of this idle fable may be derived from a miscellaneous work of the 12th century, the Chiliads of John Tzetzes, a monk. He relates the blindness and beggary of Belisarius in ten vulgar or political verses (Chiliad iii. N° 88. 339—348. in Corp. Poet. Græc. tom. ii. p. 311.).

Εκπωμα ξυλινον κρατων εβοα τῳ μιλιῳ
Βελισαριῳ οβολον δοτε τῳ στρατηλατῃ
Ον τυχη μεν εδοξασεν, αποτυφλοι δ' ὁ φθονος.

This moral or romantic tale was imported into Italy with the language and manuscripts of Greece; repeated before the end of the 15th century by Crinitus, Pontanus, and Volaterranus; attacked by Alciat for the honour of the law, and defended by Baronius (A. D. 561, N° 2, &c.) for the honour of the church. Yet Tzetzes himself had read in other chronicles, that Belisarius did not lose his sight, and that he recovered his fame and fortunes.—The statue in the Villa Borghese at Rome, in a sitting posture, with an open hand, which is vulgarly given to Belisarius, may be ascribed with more propriety to Augustus in the act of propitiating Nemesis (*Winckleman*, *Hist. de l'Art*. tom. iii. p. 266.). "Ex nocturno visu etiam stipem, quotannis, die certo, emendicabat à populo, cavam manum asses porrigentibus præbens." (*Seuton. in Aug.* c. 91.).

BELL, a well known machine, ranked by musicians among the musical instruments of percussion.

The constituent parts of a bell are the body or *barrel*, the *clapper* on the inside, and the ear or *cannon* by which it hangs to a large beam of wood. The matter of which it is usually made is a composition called *bell-metal*.

metal. The thickness of a bell's edge is usually $\frac{1}{15}$ of the diameter, and its height, 12 times its thickness. The bell-founders have a diapason, or bell-scale, wherewith they measure the size, thickness, weight, and tone, of their bells. For the method of casting bells, see FOUNDERY.

The sound of a bell is conjectured to consist in a vibratory motion of its parts, much like that of a musical chord. The stroke of the clapper must necessarily change the figure of the bell, and of a round make it oval: but the metal having a great degree of elasticity, that part will return back again which the stroke drove farthest off from the centre, and that even some small matter nearer the centre than before; so that the two parts which before were extremes of the longest diameter, do then become those of the shortest; and thus the external surface of the bell undergoes alternate changes of figure, and by that means gives that tremulous motion to the air in which the sound consists. M. Perrault maintains, that the sound of the same bell or chord is a compound of the sounds of the several parts thereof; so that where the parts are homogeneous, and the dimensions of the figure uniform, there is such a perfect mixture of all these sounds as constitutes one uniform, smooth, even sound; and the contrary circumstances produce harshness. This he proves from the bells differing in tone according to the part you strike; and yet strike it anywhere, there is a motion of all the parts. He therefore considers bells as a compound of an infinite number of rings, which according to their different dimensions have different tones, as chords of different lengths have; and when struck, the vibrations of the parts immediately struck determine the tone, being supported by a sufficient number of consonant tones in the other parts.

Bells are observed to be heard farther placed on plains than on hills; and still farther in valleys than on plains: the reason of which will not be difficult to assign, if it be considered that the higher the sonorous body is, the rarer is its medium: consequently, the less impulse it receives, and the less proper vehicle it is to convey it to a distance.

M. Reaumur, in the Memoirs of the Paris Academy, has the following observations relating to the shape most proper for bells, to give them the loudest and clearest sound. He observes, "that as pots and other vessels more immediately necessary to the service of life were doubtless made before bells, it probably happened that the observing these vessels to have a sound when struck, gave occasion to making bells, intended only for sound, in that form; but that it does not appear that this is the most eligible figure; for lead, a metal which is in its common state not at all sonorous, yet becomes greatly so on its being cast into a particular form, and that very different from the common shape of bells. In melting lead for the common occasions of casting in small quantities, it is usually done in an iron ladle: and as the whole is seldom poured out, the remainder which falls to the bottom of the ladle, cools into a mass of the shape of that bottom. This is consequently a segment of a sphere, thickest in the middle, and thinner towards the edges; nor is the ladle any necessary part of the operation, since if a mass of lead be cast in that form in a mould of earth or sand, in any of these cases it is found to be very sonorous. Now if this shape alone can give sound to a metal which in other forms is perfectly mute, how much more must it necessarily give it to other metals naturally sonorous in whatever form? It should seem, that bells would much better perform their office in this than in any other form: and that it must particularly be a thing of great advantage to the small bells of common house-clocks, which are required to have a shrill note, and yet are not allowed any great size." He adds, "that had our forefathers had opportunities of being acquainted with the sound of metals in this shape, we should probably have had all our bells at present of this form."

The use of bells is very ancient, as well as extensive. We find them among Jews, Greeks, Romans, Christians, and Heathens, variously applied; as on the necks of men, beasts, birds, horses, sheep: but chiefly hung in buildings, either religious, as in churches, temples, and monasteries; or civil, as in houses, markets, baths; or military, as in camps and frontier towns.

Among the Jews it was ordained, that the lower part of the blue tunic which the high priest wore when he performed religious ceremonies, should be adorned with pomegranates and gold bells, intermixed equally and at equal distances. As to the number of the bells worn by the high priest, the Scriptures are silent; and authors are not very well agreed: but the sacred historian has let us into the use and intent of them in these words (Exod. xxviii. 33—35.), "And it shall be upon Aaron to minister, and his sound shall be heard when he goeth into the holy place before the Lord, and when he cometh out, that he die not." The kings of Persia are said to have the hem of their robes adorned like the Jewish high-priests with pomegranates and gold bells. It was in the opinion of Calmet, with a design of giving notice that the high-priest was passing by, that he wore little bells on the hem of his robe; or rather it was as it were a kind of public notice that he was going to the sanctuary: for, as in the king of Persia's court, no one was suffered to enter the apartments without giving notice thereof by the sound of something; so the high-priest, out of respect to the divine presence residing in the holy of holies, did, by the sound of little bells fastened to the bottom of his robe, desire, as it were, permission to enter, that the sound of the bells might be heard, and he not be punished with death for an unmannerly intrusion. The figure of these bells is not known to us. The prophet Zachariah (xiv. 20.) speaks of bells hung to war horses. "In that day (says the prophet) there shall be upon the bells of horses, Holiness unto the Lord."

Among the Greeks, those who went the nightly rounds in camps or garrisons, carried with them a little bell, which they rung at each centry box to see that the soldiers on watch were awake. A codonophorous or bellman also walked in funeral processions, at a distance before the corpse, not only to keep off the crowd, but to advertise the *flamen dialis* to keep out of the way, for fear of being polluted by the sight, or by the funerary music. The priest of Proserpine at Athens, called *hierophantus*, rung a bell to call the people to sacrifice.

There were also bells in the houses of great men, to call

call up the servants in a morning. Zonaras assures us, that bells were hung with whips on the triumphal chariots of their victorious generals, to put them in mind that they were still liable to public justice.

Bells were put on the necks of criminals going to execution, that persons might be warned by the noise to get out of the way of so ill an omen as the sight of the hangman or the condemned criminal, who was devoted and just going to be sacrificed to the *dii manes*.

For bells on the necks of brutes, express mention is made of them in Phædrus,—*Celsa cervice eminens, Clarumque collo jactans tintinnabulum.* Taking these bells away was construed by the civil law, theft; and if the beast was lost by this means, the person who took away the bells was to make satisfaction.

As to the origin of *church-bells*, Mr Whittaker *; observes, That bells being used, among other purposes, by the Romans to signify the times of bathing, were naturally applied by the Christians of Italy to denote the hours of devotion, and summon the people to church. The first application of them to this purpose is, by Polydore Virgil and others, ascribed to Paulinus bishop of Nola, a city of Campania, about the year 400. Hence, it is said, the names *nolæ* and *campanæ* were given them; the one referring to the city, the other to the country. Though others say they took the latter of these names, not from their being invented in Campania, but because it was here the manner of hanging and balancing them, now in use, was first practised; at least they were hung on the model of a sort of balance invented or used in Campania; for in Latin writers we find *campana statera*, for a steelyard: and in the Greek *καμπανίζειν*, and *ponderare*, "to weigh." In Britain, bells were applied to church-purposes, before the conclusion of the seventh century, in the monastic societies of Northumbria, and as early as the sixth even in those of Caledonia. And they were therefore used from the first erection of parish-churches among us. Those of France and England appear to have been furnished with several bells. In the time of Clothair II. king of France, and in the year 610, the army of that king was frighted from the siege of the city of Sens, by ringing the bells of St Stephen's church. The second excerption of Egbert, about the year 750, which is adopted in a French capitulary of 801, commands every priest, at the proper hours, to sound the bells of his church, and then to go through the sacred offices to God. And the council of Enham, in 1011, requires all the mulcts for sins to be expended in the reparation of the church, clothing, and feeding the minister of God, and the purchase of church-vestments, church-books, and church-bells. These were sometimes composed of iron in France; and in England, as formerly at Rome, were frequently made of brass. And as early as the ninth century, there were many cast of a large size and deep note.

* History of Manchester.

Ingulphus mentions, that Turketulus, abbot of Croyland, who died about the year 870, gave a great bell to the church of that abbey, which he named *Guthlac*; and afterwards six others, viz. two which he called *Bartholomew* and *Bettelin*, two called *Turketul* and *Tatwin*, and two named *Pega* and *Bega*, all which rang together; the same author says, *Non erat tunc tanta consonantia campanarum in tota Anglia.* Not long after, Kinseus archbishop of York gave two great bells to the church of St John at Beverly, and at the same time provided that other churches in his diocese should be furnished with bells. Mention is made by St Aldhem, and William of Malmesbury, of bells given by St Dunstan to the churches in the west. The number of bells in every church gave occasion to the curious and singular piece of architecture in the campanile or bell-tower; an addition, which is more susceptible of the grander beauties of architecture than any other part of the edifice, and is generally therefore the principle or rudiments of it. It was the constant appendage to every parish-church of the Saxons, and is actually mentioned as such in the laws of Athelstan.

The Greek Christians are usually said to have been unacquainted with bells till the ninth century, when their construction was first taught them by a Venetian. Indeed, it is not true that the use of bells was entirely unknown in the ancient eastern churches, and that they called the people to church, as at present, with wooden mallets. Leo Allatius, in his dissertations on the Greek temples, proves the contrary from several ancient writers. It is his opinion, that bells first began to be disused among them after the taking of Constantinople by the Turks; who, it seems, prohibited them lest their sound should disturb the repose of souls, which, according to them, wander in the air. He adds that they still retain the use of bells in places remote from the intercourse of the Turks; particularly, very ancient ones in Mount Athos. F. Simon thinks the Turks prohibited the Christians the use of bells rather out of political than religious reasons; inasmuch as the ringing of bells might serve as a signal for the execution of revolts, &c.

In the ancient monasteries we find six kinds of bells enumerated by Durandus, viz. *Squilla*, rung in the refectory; *cymbalum*, in the cloister; *nola*, in the choir; *nolula* or *dupla*, in the clock; *campana*, in the steeple; and *signum* in the tower. Belethus has much the same; only that for *squilla*, he puts *tintinnabulum*, and places the *campana* in the tower, and *campanella* in the cloister. Others place the *tintinnabulum* or *tinniolum*, in the refectory or dormitory; and add another bell called *corrigiuncula*, rung at the time of giving discipline, to call the monks to be flogged. The *cymbalum* is sometimes also said to have been rung in the cloister, to call the monks to meat.

In the funeral monuments of Weever, are the following particulars relating to bells. "Bells had frequently these inscriptions on them:

"*Funera plango, Fulgura frango, Sabbata pango,*
"*Excito lentos, Dissipo ventos, Paco cruentos.*

"In the little sanctuary at Westminster, King Edward III. erected a clochier, and placed therein three bells for the use of St Stephen's chapel: about the biggest of them were cast in the metal these words:

"King Edward made mee thirtie thousand weight and three.
"Take me down and wey mee, and more you shall fynd mee.

"But these bells being to be taken down in the reign of King Henry VIII. one writes underneath with a coale:
"But

Bell.

"But Henry the eight
"Will bait me of my weight." *Ibid.* 492.

This last distich alludes to a fact mentioned by Stow in his survey of London, ward of Farringdon Within; to wit, that near to St Paul's school stood a clochier, in which were four bells called *Jesus's bells*, the greatest in all England, against which Sir Miles Partridge staked a hundred pounds, and won them of King Henry VIII. at a cast of dice. Nevertheless it appears that abroad there are bells of greater magnitude. In the steeple of the great church at Roan in Normandy is a bell with this inscription:

Je suis George d'Ambois,
Qui trente cinque mille pois.
Mais lui qui me pesera,
Trente six mille me trouvera.

I am George of Ambois,
Thirty-five thousand in pois:
But he that shall weigh me,
Thirty-six thousand shall find me. *Ibid.*

And it is a common tradition that the bells of King's college chapel, in the university of Cambridge, were taken by Henry V. from some church in France, after the battle of Agincourt. They were taken down some years ago, and sold to Phelps the bell-founder in Whitechapel, who melted them down.

The uses of bells were summed up in the following distich, as well as that first above-mentioned:

Laudo Deum verum, plebem voco, conjugo clerum,
Defunctos ploro, pestem fugo, festa decoro.

Matthew Paris observes, than anciently the use of bells was prohibited in time of mourning; though at present they make one of the principal ceremonies of mourning. Mabillon adds, that it was an ancient custom to ring the bells for persons about to expire, to advertise the people to pray for them; whence our passing bells. The passing bell, indeed, was anciently rung for two purposes: one, to bespeak the prayers of all good Christians for a soul just departing: the other, to drive away the evil spirits who stood at the bed's foot, and about the house, ready to seize their prey, or at least to molest and terrify the soul in its passage: but by the ringing of that bell (for Durandus informs us, evil spirits are much afraid of bells), they were kept aloof; and the soul, like a hunted hare, gained the start, or had what is by sportsmen called *law*. Hence, perhaps, exclusive of the additional labour, was occasioned the high price demanded for tolling the greatest bell of the church; for that being louder, the evil spirits must go farther off to be clear of its sound, by which the poor soul got so much more the start of them: besides, being heard farther off, it would likewise procure the dying man a greater number of prayers. This dislike of spirits to bells is mentioned in the Golden Legend, by W. de Worde. "It is said, the evil spirytes that ben in the regyon of thayre, doubte moche when they here the belles rongen: and this is the cause why the belles ben rongen when it thondreth, and whan grete tempeste and outrages of wether happen, to the ende that the feinds and wycked spirytes shold be abashed and flee, and cease of the movynge of tempeste." Lobineau observes, that the custom of ringing bells at the approach of thunder, is of some antiquity; but that the design was not so much to shake the air, and so dissipate the thunder, as to call the people to church to pray that the parish might be preserved from that terrible meteor.

In the times of Popery, bells were baptized and anointed *oleo chrismatis*: they were exorcised, and blessed by the bishop; from a belief, that, when these ceremonies were performed, they had power to drive the devil out of the air, to calm tempests, to extinguish fire, and to recreate even the dead. The ritual for these ceremonies is contained in the Roman pontifical; and it was usual in their baptism to give to bells the name of some saint. In Chauncy's History of Hertfordshire, page 383, is a relation of the baptism of a set of bells in Italy with great ceremony, a short time before the writing that book. The bells of the parish church of Winnington in Bedfordshire had their names cast about the verge of every one in particular, with these rhyming hexameters.

Nomina Campanis hæc indita sunt quoque nostris.
1. *Hoc signum Petri pulsatur nomine Christi.*
2. *Nomen Magdalene campana sonat melode.*
3. *Sit nomen Domini benedictum semper in eum.*
4. *Musa Raphaelis sonat auribus Immanuelis.*
5. *Sum Rosa pulsata mundique Maria vocata.*

Weev. Fun. 122.

By an old chartulary, once in the possession of Weever the antiquary, it appears that the bells of the priory of Little Dunmow in Essex were, anno 1501, new cast, and baptized by the following names:

Prima in honore Sancti Michaelis Archangeli.
Secunda in honore S. Johannis Evangelisti.
Tertia in honore S. Johannis Baptisti.
Quarta in honore Assumptionis beatæ Mariæ.
Quinta in honore sanctæ Trinitatis, et omnium sanctorum. Ib. 633.

The bells of Osney abbey near Oxford were very famous; their several names were Douce, Clement, Austin, Hautecter [potius Hautcleri], Gabriel, and John.

Nankin in China was anciently famous for the largeness of its bells; but their enormous weight brought down the tower, the whole building fell to ruin, and the bells have ever since lain on the ground. One of these bells is near 12 English feet high, the diameter seven and a half, and its circumference 23; its figure almost cylindric, except for a swelling in the middle; and the thickness of the metal about the edges seven inches. From the dimensions of this bell, its weight is computed at 50,000 pounds, which is more than double the weight of that of Erfort, said by Father Kircher to be the greatest bell in the world. These bells were cast by the first emperor of the preceding dynasty, about 300 years ago. They have each their name; the hanger (*tchoui*), the eater (*che*), the sleeper (*choui*), the will (*fi*). Father le Compte adds, that there are seven other bells in Pekin cast in the reign of Youlo, each of which weighs 120,000 pounds. But the sounds even of their biggest bells are very poor;

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Bell.

Hawkins's History of Music, vol. iv. p. 152.

poor; being struck with a wooden in lieu of an iron clapper.

The practice of ringing bells in change, or regular peals, is said to be peculiar to England: whence Britain has been termed the *ringing island*. The custom seems to have commenced in the time of the Saxons, and was common before the Conquest. The ringing of bells, though a recreation chiefly of the lower sort, is in itself not incurious. The tolling a bell is nothing more than the producing a sound by a stroke of the clapper against the side of the bell, the bell itself being in a pendant position and at rest. In ringing, the bell, by means of a wheel and a rope, is elevated to a perpendicular; in its motion to this situation the clapper strikes forcibly on one side, and in its return downwards on the other side of the bell, producing at each stroke a sound. There are in London several societies of ringers, particularly one known by the name of the *College Youths*: of this it is said Sir Matthew Hale, lord chief justice of the court of King's Bench, was, in his youthful days, a member; and in the life of this learned and upright judge, written by Bishop Burnet, some facts are mentioned which favour this relation. In England the practice of ringing is reduced to a science, and peals have been composed which bear the name of the inventors. Some of the most celebrated peals now known were composed about 50 years ago by one Patrick. This man was a maker of barometers: in his advertisements he styled himself *Torricellian Operator*, from Torricelli, who invented instruments of this kind. In the year 1684, one Abraham Rudhall, of the city of Gloucester, brought the art of bell-founding to great perfection. His descendants in succession have continued the business of casting bells; and by a list published by them it appears, that at Lady-day 1774 the family, in peals and odd bells, had cast to the amount of 3594. The peals of St Dunstan's in the East, and St Bride's, London, and St Martin's in the Fields, Westminster, are in the number.

The music of bells is altogether melody; but the pleasure arising from it consists in the variety of interchange, and the various succession and general predominance of the consonances in the sounds produced. Musical authors seem to have written but little upon this subject.

Electrical BELLS are used in a variety of entertaining experiments by electricians. The apparatus, which is originally of German invention, consists of three small bells suspended from a narrow plate of metal; the two outermost by chains, and that in the middle, from which a chain passes to the floor, by a silken string. Two small knobs of brass are also hung by silken strings, one on each side of the bell in the middle, which serve for clappers. When this apparatus is connected with an electrified conductor, the outermost bells suspended by the chains will be charged, attract the clappers, and be struck by them. The clappers becoming electrified likewise will be repelled by these bells, and attracted by the middle bell, and discharge themselves upon it by means of the chain extending to the floor. After this, they will be again attracted by the outermost bells; and thus, by striking the bells alternately, occasion a ringing, which may be continued at pleasure. Flashes of light will be seen in the dark between the bells and clappers; and if the electrification be strong, the discharge will be made without actual contact, and the ringing will cease. An apparatus of this kind, connected with one of those conductors that are erected for securing buildings from lightning, will serve to give notice of the approach and passage of an electrical cloud.

Bell | Bellai.

BELL-*Animal*. See ANIMALCULE, N° 24—28.

BELL-*Metal*. See CHEMISTRY *Index*.

BELL, in *Chemistry*, denotes a glass vessel placed over some matter in a state of exhalation, either to collect the vapour or gather the flowers. Chemical bells are a sort of receptacles chiefly used in preparing the oil or spirit of sulphur, for condensing fumes into a liquor.

Diving-Bell. See DIVING.

BELL-*Foundery*. See FOUNDERY.

BELL-*Flower*. See CAMPANULA, BOTANY *Index*.

BELL-*Rock Light-House*. See SUPPLEMENT.

BELL-*Weed*. See JACEA, BOTANY *Index*.

BELLA, STEFANA DE LA, a most eminent engraver, was born at Florence A. D. 1610. His father was a goldsmith; and he himself began to work at his father's business. But whilst he was learning to draw, in order to perfect himself in that profession, some of the prints of Callot fell by accident into his hands; with which he was so delighted, that he prevailed upon his father to permit him to apply himself to engraving; and he became the disciple of Canta Gallina, who was also the instructor of Callot. De la Bella at first imitated the manner of Callot. His abilities soon began to manifest themselves: and as by degrees he acquired a facility in the handling of the point, he quitted the style in which he only shone as an imitator, and adopted one entirely his own, which in freedom and spirit is said even to have surpassed that of his fellow disciple. He went to Paris A. D. 1642, where he formed an acquaintance with Israel Silvestre, then newly returned from Rome; and he was much employed by Henriette the uncle of Silvestre. Some time after, Cardinal Richelieu engaged him to go to Arras, and make drawings of the siege and taking of that town by the royal army; which drawings he engraved at his return. He also went to Holland, where, it is reported, he saw some of the prints of Rembrandt Gerretsz, and attempted to imitate them: but finding he did not succeed to his expectations, he dropped that design, and continued to pursue his own manner, as most suitable to his genius. After abiding some considerable time at Paris, his family affairs obliged him to return to Florence; where he obtained a pension from the Great Duke, and was appointed to instruct the prince Cosmo his son in the art of design. Being subject to violent pains in the head, his life was rendered very uncomfortable by this cruel disorder, which at last put an end to it A. D. 1664, when he was only 54 years of age. De la Bella drew very correctly, and with great taste. His works manifest much genius and vast fertility of invention. The fire and animation which appear in them compensate for their slightness; and we may reasonably expect to find them slight when we are told that he engraved 1400 plates.

BELLAC. See BELAC.

BELLADONA, the trivial name of a species of atropa. See ATROPA, BOTANY *Index*.

BELLAI, WILLIAM DU, lord of Langey, a French general,

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general, who signalized himself in the service of Francis I. He was also an able negociator, so that the emperor Charles V. used to say, "that Langey's pen had fought more against him than all the lances in France." He was sent to Piedmont in quality of viceroy, where he took several towns from the Imperialists. His address in penetrating into the enemy's designs was surprising. In this he spared no expence, and thereby had intelligence of the most secret counsels of the emperor and his generals. He was extremely active in influencing some of the universities of France to give their judgment agreeable to the desires of Henry VIII. king of England, when this prince wanted to divorce his queen, in order to marry Anne Bullen. It was then the interest of France to favour the king of England in this particular, it being an affront to the emperor, and a gratification to Henry, which might serve to form a strict alliance between him and Francis I. He was sent several times into Germany to the princes of the Protestant league, and was made a knight of the order of St Michael. He was also a man of learning, having given proofs of his abilities and genius as a writer. He composed several works; the most remarkable of which was, the History of his Own Times, in Latin; divided into ogdoades, that is, several parts, each consisting of eight books; most of which, however, have been lost. When Langey was in Piedmont in 1542 he had some remarkable intelligence which he was desirous himself to communicate to the king, and being very infirm, he ordered a litter for his conveyance; but after having passed the mountain of Tarara, betwixt Lyons and Roan, he found himself so extremely bad at St Saphorin that he was obliged to stop there, where he died the 9th of January, in the year 1543. He was buried in the church of Mans, and a noble monument was erected to his memory.

BELLARMIN, Robert, an Italian Jesuit, one of the best controversial writers of his time. In 1576 he read lectures at Rome on controversies; which he did with such applause, that Sixtus V. sending a legate into France in 1590, appointed him as a divine, in case any dispute in religion should happen to be discussed. He returned to Rome, and was raised successively to different offices, till at last, in 1599, he was honoured with a cardinal's hat; to accept of which dignity, it is said, they were obliged to force him by the threats of an anathema. It is certain, that no Jesuit ever did greater honour to his order than he; and that no author ever defended the cause of the Romish church in general, and that of the pope in particular, to more advantage. The Protestants have owned this sufficiently: for, during the space of 50 years, there was scarcely any considerable divine among them who did not fix upon this author for the subject of his books of controversy. Notwithstanding the zeal with which this Jesuit maintained the power of the pope over the temporality of kings, he displeased Sixtus V. in his work *De Romano Pontifice*, by not insisting that the power which Jesus Christ gave to his vicegerent was direct, but only indirect; and had the mortification to see it put into the index of the inquisition, though it was afterwards removed. He left, at his death, to the Virgin Mary one half of his soul, and to Jesus Christ the other.—Bellarmin is said to have been a man of great chastity and temperance, and remarkable for his patience. His stature was low, and his mien very indifferent; but the excellence of his genius might be discovered from the traces of his countenance. He expressed himself with great perspicuity; and the words which he first made use of to explain his thoughts were generally so proper, that there appeared no rasure in his writings.

BELLATRIX, in *Astronomy*, a ruddy glittering star of the second magnitude, in the left shoulder of Orion. It takes its name from *bellum*, as being anciently supposed to have a great influence in kindling wars, and forming warriors. Its longitude, according to Hevelius, for the year 1700, was 16° 47′ 20″; and its latitude southward 16° 52′ 11″.

BELLCLARE, a town of Ireland, in the province of Connaught, and county of Sligo. W. Long. 9. 5. N. Lat. 53. 56.

BELLE, a town of the French Netherlands, seated in E. Long. 2. 40. N. Lat. 50. 45.

BELLEAU, Remi, a French poet, born at Nogent le Rotrou, in the territory of Perche, and province of Orleanois. He lived in the family of Renatus of Lorrain, marquis of Elbeuf, general of the French galleys; and attended him in his expedition into Italy, in 1557. This prince highly esteemed Belleau for his courage; and having also a high opinion of his genius and abilities, entrusted him with the education of his son Charles of Lorrain. Belleau was one of the seven poets of his time who were denominated the *French Pleiades*. He wrote several pieces; and translated the odes of Anacreon into the French language, but in this he is thought not to have preserved all the natural beauties of the original. His pastoral pieces are in greatest esteem. His verses in that way (according to his eulogists) are expressed with such beauty and simplicity, that they seem to be a living picture of what they describe. He also wrote an excellent poem on the nature and difference of precious stones, which by some has been reputed his best performance. Belleau died at Paris, in the family of the duke d'Elbeuf, on the 6th of March, 1577. He was interred in the church Des Peres Augustines, near the Pont-neuf; several eulogiums were made to his memory.

BELLEFOREST, Francis de, a French author, born in the province of Guienne, in 1530. He was but seven years of age when he lost his father; and his mother was left in poor circumstances, but she contributed all in her power to his education. He was supported some years by the queen of Navarre, sister to Francis I. Some time after he went to study at Bourdeaux; thence he removed to Toulouse; and at last to Paris, where he got acquainted with several men of learning, and was honoured with the friendship of many persons of quality. He wrote, 1. A History of the Nine Charles's of France; 2. Annotations on the books of St Augustin; 3. An universal History of the World; 4. The Chronicles of Nicholas Gillet, augmented; 5. An universal Cosmography; 6. Annals, or a general History of France: and many other works. In short, he supported his family by writing books on whatever subject was proposed to him by the booksellers, according to the taste of the public. He died in 1583.

Bellegarde, Belleisle.

BELLEGARDE, a town of France, in the department of the Eastern Pyrenees, on the frontiers of Catalonia. It is an important place on account of its being a passage to the Pyrenean mountains. E. Long. 3. 0. N. Lat. 42. 20.

BELLEGARDE, a town of France, in the department of Saone and Loire, seated on the river Saone, 15 miles south-east of Chalons, in E. Long. 4. 0. N. Lat. 46. 57.

BELLEISLE, an island of France, on the coast of Brittany, 15 miles distant from it. This island is between 12 and 13 leagues in circumference. It is a mixture of craggy rocks and fertile soil; but the inhabitants are very poor, and the only trade carried on in it is the curing of pilchards. There are three harbours in the island, viz. Palais, Sahzon, and Goulford; every one of which labours under some capital defect, either in being exposed, shallow, or dangerous in the entrance. It contains only one little city called *Le Palais*, three country towns, 103 villages, and 5570 inhabitants. The island originally belonged to the earl of Cornouaille; but was afterwards yielded to the king, who in 1742 erected it into a duchy, in favour of Marshal Belleisle. The town of Palais takes its name from a castle which belonged to the duke de Belleisle, which stood in its neighbourhood; but was afterwards converted into a citadel fronting the sea, strongly fortified. Its fortifications are composed principally of hornworks; and it is provided with two dry ditches, the one next the counterscarp, and the other so contrived as to secure the interior fortifications. This citadel is divided from the largest part of the town by an inlet of the sea, over which there is a bridge of communication. From the other part of the town, and which is most inhabited, it is only divided by its own fortifications and a glacis. In this state was the island in 1761, when an expedition was undertaken against it by a British fleet under the command of Commodore Keppel, having on board a considerable land force commanded by General Hodgson. The fleet sailed from Spithead on the 29th of March, and arrived before Belleisle on the 7th of April. The next day it was agreed to attempt a landing on the south-east part of the island, in a sandy bay, near Lochmaria point. Here the enemy were in possession of a little fort; they had moreover entrenched themselves on a hill excessively steep, the foot of which was scarped away. The attempt was made in three places with great resolution; but the British were at last repulsed with the loss of 500 men. It was not before the 25th of April that the weather allowed a second attempt. This was made on a very strong place, where the enemy were rather less attentive, on account of the excessive steepness and difficulty of climbing up the rocks. Besides the principal attack, two feints were made at the same time to distract the enemy, while the men of war directed their fire with great success on the hills. These manœuvres gave Brigadier-general Lambert, with a handful of men, an opportunity of climbing up a very steep rock without molestation. This little body formed themselves in good order without delay, and were immediately attacked by 300 French. The British, however, sustained this attack until the whole corps of Brigadier Lambert, which had now likewise ascended, came to their assistance, with whose help they repulsed the enemy. The landing of all the forces being soon after made good, the French were driven into the town of Palais. Here the chevalier de St Croix who commanded them, a brave and experienced officer, resolved to hold out to the last extremity; and it was not till the 7th of June that he capitulated, and the garrison marched out with the honours of war. The island, however, was restored to the French by the treaty concluded in 1763.

Belleisle, Bellenden.

BELLEISLE, an island of North America, lying at the mouth of the strait between the country of the Esquimaux, or New Britain, and the north end of Newfoundland; whence the straits take also the name of *Belleisle*. W. Long. 58. 5. N. Lat. 51. 50.

BELLENDEN, or BALLANTINE, WILLIAM, a Scotch writer who flourished in the beginning of the 17th century, was professor of humanity or belles lettres at Edinburgh, and master of requests to James I. of England. But the former is supposed to have been only nominal, or early given up, and the latter also to have consisted in the name only, since he appears to have resided almost constantly at Paris, where by the favour of his sovereign, he was enabled to live in easy circumstances. There he published, in 1608, his *Cicero Princeps*, a singular work; in which he extracted from Cicero's writings detached passages, and comprised them into one regular body, containing the rules of monarchical government, with the line of conduct to be pursued, and the virtues proper to be encouraged, by the prince himself: and the treatise, when finished, he dedicated, from a principle of patriotism and gratitude, to the son of his master, Henry, then prince of Wales. Four years afterwards, namely, in 1612, he proceeded to publish another work of a similar nature, which he called *Cicero Consul, Senator Senatusque Romanus*, in which he treated, with much perspicuity, and a fund of solid information, on the nature of the consular office, and the constitution of the Roman senate. Finding these works received, as they deserved, with the unanimous approbation of the learned, he conceived the plan of a third work, *De Statu prisci Orbis*, which was to contain a history of the progress of government and philosophy, from the times before the flood to their various degrees of improvement under the Hebrews, Greeks, and Romans. He proceeded so far as to print a few copies of this work, in the year 1615, when it seems to have been suggested that his treatises, *De Statu Principis, De Statu Reipublicæ*, and *De Statu Orbis*, being on subjects so nearly resembling each other, there might be a propriety in uniting them into one work, by republishing the two former, and entitling the whole *Bellendenus De Statu.* With this view, he recalled the few copies of his last work that were abroad, and after a delay of some months, published the three treatises together, under their new title, in 1616. These pieces have been lately reprinted by an ingenious political editor, who has thought proper to inscribe them to Mr Burke, Lord North, and Mr Fox, whose respective portraits are prefixed to each dedication, and whose talents and virtues he celebrates and defends in a preface of 76 pages, containing a very free and bold discussion of our public men and measures in very classical language, and a strong and satirical representation, under borrowed names of antiquity, of the chiefs of the other party, or the present ministry. Bellenden wrote another work, published after his death,

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death, *De tribus Luminibus Romanorum*, whom he conceives to be Cicero, Seneca, and the elder Pliny. The editor gives an account of this work, from whence he took his idea of drawing his characters of the three luminaries of Great Britain. He marks the proficiency in Greek and Roman literature which once distinguished the Scotch, before the civil dissensions drove their brightest geniuses abroad, and celebrates the ardour for philosophy and literature so prevalent in North Britain at present. Dr Middleton has been charged with borrowing not only the matter, but the arrangement, of his "Life of Cicero," from Bellenden, without the least acknowledgment, and the editor confesses himself of this opinion. It is surprising how little is known of Bellenden or his writings: concerning his lineage, birth, private life, and death, no notices have been transmitted even by tradition.

BELLEROPHON, in fabulous history, the son of Glaucus king of Epirus, happening accidentally to kill his brother, fled to Prœtus king of Argos, who gave him a hospitable reception: but Sthenobea, his queen, falling in love with the beautiful stranger, and finding that nothing could induce him to injure his benefactor, she accused him to her husband of an attempt to violate her honour. Prœtus, however, not being willing to act contrary to the laws of hospitality, sent him to Iobates king of Lysia, and the father of Sthenobea, with letters desiring him to be put to death: whence the proverb *Bellerophontis literas afferet*, equivalent to *Literæ Uriæ*. That prince, at the receipt of these letters, was celebrating a festival of nine days, which prevented Bellerophon's destruction. Iobates, however, sent him in the mean time to subdue the Solymi, the Amazons, and Lysians, and thought to get rid of him by exposing him to the greatest dangers; but by his prudence and courage he came off victorious. Iobates next employed him to destroy the Chimæra; when Minerva or according to others, Neptune, in consideration of his innocence, furnished him with the horse Pegasus, by whose assistance he killed the Chimæra. Iobates, on his return, being convinced of his truth and integrity, and charmed with his heroic virtues, gave him his daughter Philonoë in marriage, and declared him his successor: which when Sthenobea heard, she killed herself. Bellerophon at length growing vain with his prosperity, resolved, by the assistance of Pegasus, to ascend the skies; when Jupiter checked his presumption, by striking him blind in his flight; on which he fell down to the earth, and wandered till his death in contempt and misery: but Pegasus mounting into heaven, Jupiter placed him among the constellations.

BELLES LETTRES. Whether we consult the voluminous dictionaries of the French language, or those treatises that profess to point out the method of studying and teaching the belles lettres, we find not, in the one or the other, either a clear definition, or a succinct explication of the words *belles lettres*, nor any summary of those sciences which are comprehended under that general and collective denomination. It appears to be a vague term, under which every one may include whatever he thinks proper. Sometimes we are told, that by the belles lettres is meant, the knowledge of the arts of poetry and oratory; sometimes that the true belles lettres are natural philosophy, geometry, and other essential parts of learning; and sometimes, that they comprehend the art of war, by land and sea: in short, they are made to include all that we know, and whatever we please; so that, in treating on the belles lettres, they talk of the use of the sacraments, &c.*. Some comprehend under the term, all those instructive and pleasing sciences which occupy the memory and the judgment, and do not make part either of the superior sciences, of the *polite arts* †, or of mechanic professions; hence they make history, chronology, geography, genealogy, blazonry, philology, &c. the belles lettres. In a word, it were an endless task to attempt to enumerate all the parts of literature which different learned men have comprehended under this title. Nor would it be of any use to the reader for us to pretend to fix the true import of the term. Whatever arts or sciences it may be supposed to include, they are severally explained in the course of this work.

* *Rollin on the Belles Lettres.*

† See Arts, *Polite*.

BELLE VILLE, a town of France, in the department of the Rhone, seated near the river Saone. E. Long. 4. 46. N. Lat. 45. 5.

BELLEVOIS, painter of sea-pieces, is known through all parts of Europe as a good painter, though no particulars have been handed down concerning his life. He died in 1684. His subjects are views of havens, sea-ports, shores, calms, and storms at sea; but in his calms he shows his peculiar excellence. Pictures of this master are often in public sales; and some of them, which seem of his best style, are sold for a tolerable price.

BELLEY, or Bellay, a town of France, and capital of Bujey, in the department of Ain, containing 3800 inhabitants in 1816. It is seated near the river Rhone. E. Long. 5. 50. N. Lat. 45. 43.

BELLINGHAM, a town of Northumberland in England. W. Long. 2. 10. N. Lat. 55. 10.

BELLINI, Gentil, a Venetian painter, born in the year 1421. He was employed by the republic of Venice; and to him and his brother the Venetians are indebted for the noble works which are to be seen in the council-hall. We are told that Mahomet II. emperor of the Turks, having seen some of his performances, was so struck with them, that he wrote to the republic, entreating them to send him. The painter accordingly went to Constantinople, where he did many excellent pieces. Among the rest, he painted the decollation of St John the Baptist, whom the Turks revere as a great prophet. Mahomet admired the proportion and shadowing of the work; but he remarked one defect in regard to the skin of the neck, from which the head was separated; and in order to prove the truth of his observation, he sent for a slave and ordered his head to be struck off. The sight so shocked the painter, that he could not be easy till he had obtained his dismission; which the grand signior granted, and made him a present of a gold chain. The republic settled a pension upon him at his return, and made him a knight of St Mark. He died in 1501, in the 80th year of his age.

John Bellini, his brother, painted with more art and sweetness. He died in 1512, aged 90.

Bellini, *Laurence*, an eminent physician, born at Florence in the year 1643. After having finished his studies in polite literature, he went to Pisa, where he was assisted by the generosity of the grand duke Ferdinand

dinand II. and studied under two of the most learned men of that age, Oliva and Borelli. Oliva instructed him in natural philosophy, and Borelli taught him mathematics. At 20 years of age, he was chosen professor of philosophy at Pisa, but did not long continue in this office; for he had acquired such a reputation for his skill in anatomy, that the grand duke procured him a professorship in that science. This prince was often present at his lectures, and was highly satisfied with his abilities and performances. Bellini, after having held his professorship almost 30 years, accepted of an invitation to Florence, when he was about 50 years of age. Here he practised physic with great success, and was advanced to be first physician to the grand duke Cosmo III. He wrote the following books in Latin: 1. An Anatomical discourse on the Structure and Use of the Kidneys. 2. A Speech by way of thanks to the serene duke of Tuscany. 3. Some Anatomical Observations, and a proposition in Mechanics. 4. Of the Urine and Pulse, of Blood-letting, Fevers, and diseases of the Head and Breasts. 5. Several Tracts concerning Urine, the motion of the Heart, and Bile, &c. He died January 8. 1703, being 60 years of age. His works were read and explained publicly during his life, by the famous Scotch physician Dr Pitcairn, professor of physic in Leyden.

BELLINZONA, a town of Italy, in the Milanese, and one of the bailiwicks which the Swiss possess in that country. It is seated on the river Tesino, five miles above the place where it falls into the Lago Maggiore, and is fortified with two strong castles formerly joined together by a wall flanked with towers; but the Swiss have demolished a part of the fortifications. E. Long. 9. 0. N. Lat. 46. 8.

BELLIS, the DAISY. See BOTANY *Index*.

BELLIS Major. See CHRYSANTHEMUM, BOTANY *Index*.

BELLON, a distemper common in countries where they smelt lead-ore. It is attended with languor, intolerable pains and sensations of gripings in the belly, and generally costiveness.—Beasts, poultry, &c. as well as men, are subject to this disorder: hence a certain space round the smelting-houses is called *bellon-ground*, because it is dangerous for an animal to feed upon it.

BELLONA, in *Pagan Mythology*, the goddess of war, is generally reckoned the sister of Mars, and some represent her as both his sister and wife. She is said to have been the inventress of the needle; and from that instrument is supposed to have taken her name Βελονη, signifying a *needle*. This goddess was of a cruel and savage disposition, delighting in bloodshed and slaughter; and was not only the attendant of Mars, but took a pleasure in sharing his dangers. She is commonly represented in an attitude expressive of fury and distraction, her hair composed of snakes clotted with gore, and her garments stained with blood: she is generally depictured driving the chariot of Mars, with a bloody whip in her hand; but sometimes she is drawn holding a lighted torch or brand, and at others a trumpet. Bellona had a temple at Rome, near the Circus Flaminius, before which stood the column of war, from whence the consul threw his lance when he declared war. She was also worshipped at Comana, in Cappadocia; and Camden observes, that in the time of the emperor Severus, there was a temple of Bellona in the city of York.

BELLONARII, in antiquity, priests of Bellona, the goddess of wars and battles. The bellonarii cut and mangled their bodies with knives and daggers in a cruel manner, to pacify the deity. In this they are singular, that they offered their own blood, not that of other creatures, in sacrifice. In the fury and enthusiasm wherewith they were seized on these occasions, they ran about raging, uttering prophecies, and foretelling blood and slaughter, devastations of cities, revolutions of states, and the like: whence Martial calls them *turba entheata Bellonæ*. In after-times, they seem to have abated much of their zeal and transport, and to have turned the whole into a kind of farce, contenting themselves with making signs and appearances of cutting and wounds. Lampridius tells us, the emperor Commodus, out of a spirit of cruelty, turned the farce again into a tragedy, obliging them to cut and mangle their bodies really.

BELLONIA (so named from the famous Petrus Bellonius, who left many valuable tracts on natural history, &c.), a genus of the monogynia order, belonging to the pentandria class of plants. Of this genus there is only one species known, viz. the aspera, with a rough balm leaf. This is very common in the warm islands of America.

BELLORI, JOHN PETER, of Rome; a celebrated antiquary and connoisseur in the polite arts; author of the lives of the modern painters, architects, and sculptors, and of other works on antiquities and medals. He died in 1696.

BELLOVACI, in *Ancient Geography*, a people of Gallia Belgica, reckoned the bravest of the Belgæ: now *Beauvasis*, in the Isle of France.

BELLOWS, a machine so contrived as to exspire and inspire the air by turns, by enlarging and contracting its capacity. This machine is used in chambers and kitchens, in forges, furnaces, and founderies, to blow up the fire: it serves also for organs and other pneumatic instruments, to give them a proper degree of air. All these are of various constructions, according to their different purposes; but in general they are composed of two flat boards, sometimes of an oval, sometimes of a triangular figure: Two or more hoops, bent according to the figure of the boards, are placed between them; a piece of leather, broad in the middle, and narrow at both ends, is nailed on the edges of the boards, which it thus unites together; as also on the hoops which separate the boards, that the leather may the easier open and fold again: a tube of iron, brass, or copper, is fastened to the undermost board, and there is a valve within, that covers the holes in the under board to keep in the air.

Anacharsis the Scythian is recorded as the inventor of bellows. The action of bellows bears a near affinity to that of the lungs; and what we call blowing in the former, affords a good illustration of what is called *respiring* in the latter. Animal life itself may on some occasions be subsisted by blowing into the lungs with a pair of bellows. Dr Hooke's experiment to this effect is famous: having laid the thorax of a dog bare, by cutting away the ribs and diaphragm, pericardium, &c. and having cut off the aspera arteria below the epiglottis, and bound it on the nose of a bellows, he

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he found, that as he blewed, the dog recovered, and as he ceased, fell convulsive; and thus was the animal kept alternately alive and dead above the space of an hour. There are bellows made wholly of wood, without any leather about them; one of which is preserved in the repository of the Royal Society; and Dr Plot describes another in the copper-works at Ellaston in Staffordshire. Ant. della Fruta contrived a substitute for bellows, to spare the expence thereof in the fusion of metals. This is called by Kircher *camera æolia*, and in England commonly the *water-bellows;* where water falling through a funnel into a close vessel, sends from it so much air continually as blows the fire. See the article FURNACE, where different blowing machines of this kind are described.

Smiths and founders bellows, whether single or double, are wrought by means of a rocker, with a string or chain fastened thereto, which the workman pulls. The bellows pipe is fitted into that of the tewel. One of the boards is fixed, so as not to play at all. By drawing down the handle of the rocker, the moveable board rises, and by means of a weight on the top of the upper board, sinks again. The bellows of forges and furnaces of mines usually receive their motion from the wheels of a water-mill. Others, as the bellows of enamellers, are wrought by means of one or more steps or treddles under the workman's feet. Lastly, the bellows of organs are wrought by a man called the *blower;* and in small organs by the foot of the player. Butchers have also a kind of blast or bellows of a peculiar make, by which they bloat or blow up their meat when killed, in order to piecing or parting it the better.

*Bone-*BELLOWS, φυσήτηρες οστεοι, occur in Herodotus for those applied by the Scythians to the genitals of mares, in order to distend the uterus, and by this compression make them yield a greater quantity of milk.

Hessian BELLOWS are a contrivance for driving air into a mine for the respiration of the miners. This M. Papin improved, changing its cylindrical form into a spiral one; and with this, working it only with his foot, he could make wind to raise a two pound weight.

Hydrostatic BELLOWS. See HYDROSTATICS.

BELLUNESE, a territory of Italy, formerly belonging to the Venetians, but now to the Austrians. It lies between Friuli, Codorino, Feltrino, the bishopric of Trent and Tirol. It has good iron mines, but the only considerable place is Belluno.

BELLUNO, a town of Italy, in the Austrian territories, and capital of the Bellunese. It is a bishop's see; and is situated among the Alps, on the river Piave, between the towns Cadora and Trevigni, in E. Long. 12. 15. N. Lat. 46. 9.

BELLY, in *Anatomy*, the same with what is more usually called *abdomen*. See ANATOMY *Index*.

BELMONTE, a town of Italy, in the hither Calabria, and kingdom of Naples. It is situated on the coast of the Tuscan sea. E. Long. 16. 50. N. Lat. 30. 20.

BELOMANCY; BELOMANTIA, a kind of divination by means of arrows, practised in the east, but chiefly among the Arabians. The word is of Greek origin; compounded of βελος, *arrow*, and μαντεια, *divination.*

Belomancy has been performed in different manners. One was to mark a parcel of arrows, and put 11 or more of them into a bag: these were afterwards drawn out; and according as they were marked or not, they judged of future events.

Another way was to have three arrows, upon one of which was wrote, "God orders it me;" upon another, "God forbids it me;" and upon the third nothing at all. These were put into a quiver, out of which they drew one of the three at random; if it happened to be that with the first inscription, the thing they consulted about was to be done: if it chanced to be that with the second inscription, it was let alone: but if it proved that without inscription, they drew over again.

Belomancy is an ancient practice, and probably that which Ezekiel mentions, chap. xxi. 21. At least St Jerome understands it so, and observes that the practice was frequent among the Assyrians and Babylonians. Something like it is also mentioned in Hosea, chap. iv. only that staves are there mentioned instead of arrows, which is rather rhabdomancy than belomancy. Grotius, as well as Jerome, confounds the two together, and shows that it prevailed much among the Magi, Chaldeans, and Scythians; whence it passed to the Sclavonians, and thence to the Germans, whom Tacitus observes to make use of it.

BELON, PETER, of Le Mans, the capital of Le Maine, a province of France, flourished about the middle of the 16th century. He published several books in Latin. He wrote, in French, of birds, beasts, fishes, serpents, and the neglected culture of plants; and a book of travels, or observations of many singularities and memorable things found in Greece, Asia, Judæa, Egypt, and other foreign countries. He was murdered near Paris by one of his enemies, in 1564.

BELONE. See ESOX, ICHTHYOLOGY *Index*.

BELOOCHISTAN, a country of Asia, situated on the north-west of Hindostan. See SUPPLEMENT.

BELSHAZZAR, the last king of Babylon, generally supposed to be the son of Evil-merodach, and grandson to the great Nebuchadnezzar.—During the time that Babylon was besieged by Cyrus, Belshazzar made an entertainment for a thousand of his most eminent courtiers (Dan. v. 1. &c.); and being heated with wine, ordered that the vessels of gold and silver which his grandfather Nebuchadnezzar had taken out of the temple at Jerusalem might be brought to the banqueting house, that he and his princes, together with his wives and concubines, might drink out of them, which accordingly was done; and to add to their profaneness, in the midst of their cups, they sang songs in praise of their several idols. But it was not long before a damp was put to the king's mirth, by a hand appearing upon the wall, which in three words wrote the sentence of his condemnation. The king saw the hand that wrote; and being exceedingly affrighted, commanded all his wise men, magicians, and astrologers, to be immediately called, that they might read the writing and explain its meaning. When they came, the king promised, that whoever should expound this writing should be made the third person of his kingdom in place

and

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and power. But the Magi could comprehend nothing of this writing; which increased the disorder and uneasiness that the king was in, together with his whole court: whereupon, at the instance of the queen-mother, Daniel was sent for. The king made him the same offer of honours and presents that he had done to his own magicians if he would explain the writing. Daniel modestly refused those offers: but having undertaken to perform what he required of him, he first reproved the king with great freedom for his ingratitude to God, who had advanced him to the rank of a sovereign, and for the profanation of the vessels which were consecrated to his service; and then proceeded to the interpretation of the words, which were these, *Mene*, *Tekel*, *Upharsin*. *Mene*, says he, which signifies *number*, intimates, that the days both of your life and reign are numbered, or that you have but a short time to live; *Tekel*, which signifies *weight*, intimates, that you have been weighed in the balance of God's justice, and found too light; and *Upharsin*, (or *Peres*, as Daniel has it, and means the same thing), which signifies a *fragment*, intimates, that your kingdom shall be divided and given to the Medes and Persians. Which accordingly came to pass: for that very night, in the midst of their feasting and revelling, the city was taken by surprise, Belshazzar slain, and the kingdom translated to Cyaxares, whom the Scripture calls *Darius the Mede*. See BABYLON.

BELT, the *Great*, a famous strait of Denmark, between the island of Zeeland and that of Funen, at the entrance of the Baltic sea. It is not, however, so commodious, nor so much frequented as the Sound. In 1658 the whole strait was frozen so hard, that Charles Gustavus king of Sweden marched over it with a design to take Copenhagen.

BELT, the *Lesser*, lies to the west of the Great Belt, between the island of Funen and the coast of Jutland. It is one of the passages from the German ocean to the Baltic, though not three miles in breadth, and very crooked.

BELT, *Baltheus*, properly denotes a kind of military girdle, usually of leather, wherewith the sword or other weapons are sustained.—Belts are known among the ancient and middle-age writers by divers names, as ζωη, ζωμα, *zona*, *cingulum*, *reminiculum*, *rinca* or *ringa*, and *baldrellus*. The belt was an essential piece of the ancient armour; insomuch that we sometimes find it used to denote the whole armour. In later ages, the belt was given to a person when he was raised to knighthood; whence it has also been used as a badge or mark of the knightly order.

The denomination *belt* is also applied to a sort of bandages in use among surgeons, &c. Thus we meet with quicksilver belts, used for the itch; belts for keeping the belly tight, and discharging the water in the operation of tapping, &c.

BELT, is also a frequent disease in sheep, cured by cutting their tails off, and laying the sore bare; then casting mould on it, and applying tar and goose grease.

BELTS, in *Astronomy*, two zones or girdles surrounding the body of the planet Jupiter. See ASTRONOMY.

BELTS, in *Geography*, certain straits between the German ocean and the Baltic. The Belts belong to the king of Denmark, who exacts a toll from all ships which pass through them, excepting those of Sweden, which are exempted.

BEL-TEIN, a superstitious custom observed in the Highlands of Scotland. It is a kind of rural sacrifice, performed by the herdsmen of every village on the first of May. They cut a square trench in the ground, leaving a turf in the middle: on that they make a fire of wood, on which they make a large caudle of eggs, butter, oatmeal, and milk; and bring, besides the ingredients of the caudle, plenty of beer and whisky; for each of the company must contribute something. The rites begin with spilling some of the caudle on the ground, by way of libation: on that, every one takes a cake of oatmeal, upon which are raised nine square knobs, each dedicated to some particular being, the supposed preserver of their flocks and herds, or to some particular animal, the real destroyer of them: each person then turns his face to the fire, breaks off a knob, and flinging it over his shoulder, says, *This I give to thee, preserve thou my horses; this to thee, preserve thou my sheep;* and so on. After that, they use the same ceremony to the noxious animal: *This I give to thee, O fox! spare thou my lambs; this to thee, O hooded crow! this to thee, O eagle!* When the ceremony is over, they dine on the caudle; and after the feast is finished, what is left is hid by two persons deputed for that purpose; but on the next Sunday they re-assemble and finish the reliques of the first entertainment. Pennant's Tour.

BELTURBET, a town of Ireland in the county of Cavan, and province of Ulster, situated on the river Earn, in W. Long. 7. 35. N. Lat. 54. 7.

BELTZ, or BELZO, a province of Poland, which fell to the share of Austria in 1795. It was afterwards annexed to Bonaparte's kingdom of Poland, but was restored to Austria in 1815.

BELTZ, or *Belzo*, a town of Austrian Poland, and capital of the province of the same name, seated on the confines of Upper Volhynia, among marshes, in E. Long. 24. N. Lat. 50. 5.

BELVEDERE, in the *Italian Architecture*, &c. denotes either a pavilion on the top of a building, or an artificial eminence in a garden; the word literally signifying a *fine prospect*.

BELVEDERE, a considerable town of Greece, and capital of a province of the same name in the Morea. The province lies on the western coast: it is the most fertile and rich in all the Morea; and from it the raisins called *Belvederes* take their name. The town is situated in E. Long. 22. 0. N. Lat. 38. 5.

BELVIDERE. See CHENOPODIUM, BOTANY *Index*.

BELUNUM, in *Ancient Geography*, a town of Rhætia, above Feltria, in the territory of the Veneti; now *Belluno*, capital of the Bellunese in the territory of Venice. See BELLUNO.

BELUS, in *Ancient Geography*, a small river of Galilee, at the distance of two stadia from Ptolemais, running from the foot of Mount Carmel out of the lake Cendevia. Near this place, according to Josephus, was a round hollow or valley, where was a kind of sand fit for making glass; which, though exported in great quantities, was found to be inexhaustible. Strabo says, the whole of the coast from Tyre to Ptolemais has a sand fit for making glass; but that the sand of the

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the rivulet Belus and its neighbourhood is a better sort; and here, according to Pliny, the making of glass was first discovered.

BEMA, in antiquity, denotes a step or pace. The bema made a kind of itinerary measure among the Greeks, the length of which was equivalent to one cubit and two thirds, or to ten palms. Whence also the term *bematizein*, βηματιζειν, to *measure* a road.

Bema, in ecclesiastical writers, denotes the altar or sanctuary in the ancient churches. In which sense *bema* made the third or innermost part of the church, answering to the chancel among us.

Bema was also used for the bishop's chair, seat, or throne, placed in the sanctuary. It was called *bema* from the steps by which it was to be ascended.

Bema was also used for the reader's desk. This in the Greek church was denominated βημα γνωσων, in the Latin church *ambo*.

Bema is more peculiarly used for the Manichees altar, which was in a different place from that of the Catholics.

Bema was also a denomination given by this sect to the anniversary of the day when Manes was killed, which with them was a solemn feast and day of rejoicing. One of the chief ceremonies of the feast consisted in setting out and adorning their bema or altar with great magnificence.

BEMBEA, a province of the kingdom of Angola in Africa. It is divided into Higher and Lower; and extends on one side along the sea, and on the other divides Angola from the foreign states on the south. The country is large, populous, and abounding with cattle; with the fat of which the inhabitants anoint their heads and bodies, and clothe themselves with their hides coarsely dressed. They are addicted to the same idolatrous superstitions with the rest of the natives, but speak a quite different language. The province is watered by a river called *Lutano* or *San Francisco*, which abounds with crocodiles, sea-horses, and monstrous serpents, that do a great deal of mischief.

BEMBO, Peter, a noble Venetian, secretary to Leo X. and afterwards cardinal, was one of the best writers of the 16th century. He was a good poet both in Italian and Latin; but he is justly censured for the looseness and immodesty of some of his poems. He published, besides these, A History of Venice; Letters; and a book in praise of the duke and duchess of Urbino. He died in 1547, in the 72d year of his age.

BEMSTER, or Bemister, a town of Dorsetshire in England, seated on the river Bert, containing 2290 inhabitants in 1811. W. Long. 3. 15. N. Lat. 50. 45.

BEN. See Behn.

Ben, in *Pharmacy*, the name of an exotic purgative fruit, of the size and figure of a nut; whence it is also called the *ben nut*, sometimes *balanus myrepsica*, or *glans unguentaria*.

Naturalists distinguish two kinds of bens: viz. the great, *ben magnum*, which resembles the filbert, and is by some called *avellana purgatrix*, brought from America; and the small, *ben parvum*, brought from Ethiopia.

Ben-nuts yield, by expression, much oil, which from its property of not becoming rancid, at least for years, is used as a menstruum for the extraction of the odoriferous parts of the flowers of jessamin, violets, roses, hyacinths, lilies of the valley, tuberoses, jonquils, clove julyflowers, and others which like these yield little or no essential oil by distillation, but impart their fragrance to expressed oils. The method of impregnating oil of ben with the odour of flowers is this: Some fine carded cotton is dipped in the oil, and put in the bottom of a proper vessel. On this is spread a thick layer of fresh flowers, above which more cotton dipt in oil is placed; and thus alternately flowers and cotton are disposed, till the vessel (which may be made of tin, with a cover to be screwed on to it, or of porcelain) is full. By digestion during 24 hours in a water-bath, the oil will receive the odour of the flowers.

BENARES, a district of Hindostan Proper in the East Indies, which lies between Bahar and Oude; and comprehends the circars of Benares, Jionpour, Chunar, and Gazypour. It was ceded to the English in 1775; but only came entirely into their hands in 1781, when the rajah was expelled.

Benares, a populous city in the East Indies, and capital of the district of the same name. It is situated on the north side of the Ganges, which is here very broad and the banks are very high. Benares has been much celebrated as the ancient seat of Braminical learning. Several Hindoo temples embellish the banks of the river; and many other of the public and private buildings are extremely magnificent. The streets, however, are narrow, and the houses high, some of them even five stories, which are inhabited by different families. The more opulent inhabitants live in detached houses, which have an open court, and are surrounded by a wall. In the centre of the city there is a large Mahometan mosque, which was built by the emperor Aurengzebe, who destroyed a magnificent Hindoo temple which had been erected on the same spot. Many of the Hindoo temples were demolished by the Mahometans, the ruins of which are still visible in different places round the city. The same manners and customs still prevail among these people, as at the remotest period which history has traced. No innovations either in civil or religious matters have been admitted. An insurrection was excited here in 1781, and by the formidable appearance which it assumed, threatened to prove fatal to the English interest in Hindostan. It was at length suppressed, and the rajah Cheyt Sing was deposed in 1783. Benares has been also long celebrated for its observatory. See Observatory. It is estimated to contain 600,000 souls, and is 425 miles south-east of Delhi, and 400 miles north-west of Calcutta. E. Long. 83. 10. N. Lat. 25. 20.

BENAVARRI, a town of the kingdom of Arragon in Spain, seated on the frontiers of Catalonia. E. Long. 0. 40. N. Lat. 41. 55.

BENAVENTO, a town of Spain, in the kingdom of Leon, and Terra di Campos, with the title of a duchy. It is seated on the river Ela, in W. Long. 5. 0. N. Lat. 42. 4.

BENAVIDUS, or Bonavitus (Marcus Mantua), a celebrated civilian, taught civil law with reputation, during 60 years, at Padua the place of his birth; and died in 1582, aged 93. His principal works are, 1. *Collectanea super Jus Cæsareum*. 2. *Consiliorum*, tom. ii. 3. *Problematum legalium*. 4. *De illustribus Jurisconsultis*, &c.

BENCH, or Banc, in *Law*. See Banc.

Free-

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Free-Bench, King's Bench.

Free-Bench signifies that estate in copyhold-lands which the wife being espoused a virgin, has, after the decease of her husband, for her dower, according to the custom of the manor. As to this free-bench, several manors have several customs; as in the manors of East and West Enbourne, in the county of Berks, and other parts of England, there is a custom, that when a copyhold tenant dies, the widow shall have her free-bench in all the deceased husband's lands, whilst she lives single and chaste; but if she commits incontinency, she shall forfeit her estate: nevertheless, upon her coming into the court of the manor, riding on a black ram, and having his tail in her hand, and at the same time repeating a form of words prescribed, the steward is obliged, by the custom of the manor, to re-admit her to her free-bench.

King's Bench, a court in which the king was formerly accustomed to sit in person, and on that account was moved with the king's household. This was originally the only court in Westminster-hall, and from this it is thought that the courts of common pleas and exchequer were derived. As the king in person is still presumed in law to sit in this court, though only represented by his judges, it is said to have supreme authority: and the proceedings in it are supposed to be *coram nobis*, that is, before the king. This court consists of a lord chief justice and three other justices or judges, who are invested with a sovereign jurisdiction over all matters whether of a criminal or public nature. The chief justice has a salary of 5500l. and the other judges 2400l. each.

All crimes against the public good, though they do not injure any particular person, are under the cognizance of this court; and no private subject can suffer any unlawful violence or injury against his person, liberty, or possessions, but a proper remedy is afforded him here; not only for satisfaction of damages sustained, but for the punishment of the offender; and wherever this court meets with an offence contrary to the first principles of justice, it may punish it. It frequently proceeds on indictments found before other courts, and removed by *certiorari* into this. Persons illegally committed to prison, though by the king and council, or either of the houses of parliament, may be bailed in it; and in some cases even upon legal commitments.—Writs of mandamus are issued by this court, for the restoring of officers in corporations, &c. unjustly turned out, and freemen wrongfully disfranchised.

The court of King's Bench is now divided into a crown side and plea side; the one determining criminal, and the other, civil causes.

On the crown side, or crown office, it takes cognizance of all criminal causes, from high treason down to the most trivial misdemeanour or breach of the peace. Into this court also indictments from all inferior courts may be removed by writ of *certiorari*; and tried either at bar, or at *nisi prius*, by a jury of the county out of which the indictment is brought. The judges of this court are the supreme coroners of the kingdom. And the court itself is the principal court of criminal jurisdiction known to the laws of England. For which reason, by the coming of the court of King's Bench into any county (as it was removed to Oxford on account of the sickness in 1665,) all former commissions of *oyer* and *terminer*, and general gaol-delivery, are at once absorbed and determined *ipso facto*: in the same manner as, by the old Gothic and Saxon constitutions, *Jure vetusto obtinuit, quievisse omnia inferiora judicia dicente jus rege*. Into this court of King's Bench hath reverted all that was good and salutary of the *star-chamber*.

King's Bench || Bendida.

On the plea side, this court determines all personal actions commenced by bill or writ; as actions of debt, upon the case, detinue, trover, ejectment, trespass, waste, &c. against any person in the custody of the marshal of the court, as every person sued here is supposed to be by law.

The officers on the crown side are the clerk and secondary of the crown; and on the side of the pleas there are two chief clerks or prothonotaries, and their secondary and deputy, the custos brevium, two clerks of the papers, the clerk of the declarations, the signer and sealer of bills, the clerk of the rules, clerk of the errors, and clerk of the bails; to which may be added the filazers, the marshal of the court, and the crier.

Amicable Bench. See Amicable.

BENCHERS, in the inns of court, the senior members of the society, who are invested with the government thereof.

BENCOOLEN, a fort and town of Asia, on the south-west coast of the island of Sumatra, belonging to the British. The place is known at sea by a slender mountain called the *Sugar Loaf*, which rises about 20 miles inland. About a quarter of a mile from the sea stands an Indian village, whose houses are small and low, and built on posts. The country about Bencoolen is mountainous and woody, and the air unwholesome, the mountains being continually covered with thick heavy clouds that produce lightning, thunder, and rain. There is no beef to be had, except that of buffaloes, which is not very palatable; and indeed provisions of all kinds, except fruit, are pretty scarce. The chief trade is in pepper, of which great quantities grow on the island. There are frequent bickerings betwixt the natives and the factory, to the no small injury of the East India Company. The factory was once entirely deserted; and had not the natives found that trade decreased by reason of their absence, it is scarcely probable that ever the English would have been invited there again. E. Long. 101. 5. S. Lat. 4. 5.

BEND, in *Heraldry*, one of the nine honourable ordinaries, containing a third part of the field when charged, and a fifth when plain. It is sometimes, like other ordinaries, indented, ingrailed, &c. and is either dexter or sinister. See Heraldry.

In Bend, is when any things, borne in arms, are placed obliquely from the upper corner to the opposite lower, as the bend lies.

BENDER, a town of Bessarabia in European Russia, seated on the river Niester, in E. Long. 29. 5. N. Lat. 46. 40. It is remarkable for being the place of retreat of Charles XII. after he was defeated by the Russians at the battle of Pultowa in 1709.

BENDERMASSEN, a town of the island of Borneo in Asia, and capital of a kingdom of the same name. It has a good harbour; and stands in E. Long. 113. 50. S. Lat. 2. 40.

BENDIDA, in antiquity, a festival, not unlike the Bacchanalia, celebrated by the Athenians in honour of Diana.

BENDING,

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BENDING, in a general sense, the reducing a straight body into a curve, or giving it a crooked form.

The bending of timber-boards, &c. is effected by means of heat, whereby their fibres are so relaxed that you may bend them into any figure.

BENDING, in the sea language, the tying two ropes or cables together: thus they say, *bend the cable*, that is, make it fast to the ring of the anchor; *bend the sail*, make it fast to the yard.

BENDS, in a ship, the same with what are called *wails*, or *wales*: the outmost timbers of a ship's side, on which men set their feet in climbing up. They are reckoned from the water, and are called the *first*, *second*, or *third bend*. They are the chief strength of a ship's sides; and have the beams, knees, and foot-hooks, bolted to them.

BENDY, in *Heraldry*, is the field divided into four, six, or more parts, diagonally, and varying in metal and colour.—The general custom of England is to make an even number; but in other countries they regard it not, whether even or odd.

BENCAPED, among sailors. A ship is said to be *bencaped* when the water does not flow high enough to bring her off the ground, out of the dock or over the bar.

BENEDETTO, St, a considerable town of the Mantuan, in Italy, in E. Long. 11. 25. N. Lat 45. 0.

BENEDICITE, among ecclesiastical writers, an appellation given to the song of the three children in the fiery furnace, on account of its beginning with the word *benedicite*. The use of this song in Christian worship is very ancient, it appearing to have been sung in all the churches as early as St Chrysostom's time.

BENEDICT XIV. Pope, (Prosper Lambertini of Bologna), celebrated for his learning and moderation, which gained him the esteem of all sensible Protestants. He was the patron of learned men and celebrated artists; and an elaborate writer on theological subjects. His works made 12 vols. in folio. He died in 1758.

BENEDICT, St, the founder of the order of the Benedictine monks, was born in Italy about the year 480. He was sent to Rome when he was very young, and there received the first part of his education. At 14 years of age he was removed from thence to Sublaco, about 40 miles distant. Here he lived a most ascetic life, and shut himself up in a cavern, where nobody knew any thing of him except St Romanus, who, we are told, used to descend to him by a rope, and to supply him with provisions. But being afterwards discovered by the monks of a neighbouring monastery, they chose him for their abbot. Their manners, however, not agreeing with those of Benedict, he returned to his solitude; whither many persons followed him, and put themselves under his direction, so that in a short time he built 12 monasteries. In the year 528, or the following, he retired to Mount Cassino, where idolatry was still prevalent, there being a temple of Apollo erected here. He instructed the people in the adjacent country, and having converted them, he broke the image of Apollo, and built two chapels on the mountain. Here he founded also a monastery, and instituted the order of his name which in time became so famous and extended all over Europe. It was here too that he composed his *Regula Monachorum*, which Gregory the Great speaks of as the most sensible and best written piece of that kind ever published. The time of his death is uncertain, but is placed between 540 and 550. He was looked upon as the Elisha of his time; and is reported to have wrought a great number of miracles, which are recorded in the second book of the Dialogues of St Gregory the Great.

BENEDICT, abbot of Peterborough, was educated at Oxford, became a monk in the monastery of Christ's church in Canterbury, and some time after was chosen prior by the members of that society. Though he had been a great admirer of Archbishop Becket, and wrote a life of that prelate, he was so much esteemed by Henry II. that by the influence of that prince he was elected abbot of Peterborough, A. D. 1177. He assisted at the coronation of Richard I. A. D. 1189; and was advanced to be keeper of the great seal, A. D. 1191. But he did not long enjoy this high dignity, as he died on Michaelmas day, A. D. 1193. Besides his life of Archbishop Becket, he composed a History of Henry II. and Richard I. from A. D. 1170 to A. D. 1192; which hath been much and justly esteemed by many of our greatest antiquaries, as containing one of the best accounts of the transactions of those times. A beautiful edition of this work was published at Oxford, in two volumes, by Mr Hearne, A. D. 1735.

BENEDICTINES, in church history, an order of monks, who profess to follow the rules of St Benedict.

The Benedictines, being those only that are properly called *monks*, wear a loose black gown, with large wide sleeves, and a capuche, or cowl, on their heads, ending in a point behind. In the canon law, they are styled *black friars*, from the colour of their habit.

The rules of St Benedict, as observed by the English monks before the dissolution of the monasteries, were as follows: They were obliged to perform their devotions seven times in 24 hours, the whole circle of which devotions had a respect to the passion and death of Christ: they were obliged always to go two and two together: every day in lent they were obliged to fast till six in the evening, and abated of their usual time of sleeping and eating; but they were not allowed to practise any voluntary austerity without leave of their superior: they never conversed in their refectory at meals, but were obliged to attend to the reading of the Scriptures: they all slept in the same dormitory, but not two in a bed; they lay in their clothes: for small faults they were shut out from meals; for greater they were debarred religious commerce, and excluded from the chapel; and as to incorrigible offenders, they were excluded from the monasteries. Every monk had two coats, two cowls, a table-book, a knife, a needle, and a handkerchief; and the furniture of their bed was a mat, a blanket, a rug, and a pillow.

The time when this order came into England is well known; for to it the English owe their conversion from idolatry. In the year 596, Pope Gregory sent hither Augustine, prior of the monastery of St Andrew at Rome, with several other Benedictine monks. St Augustine became archbishop of Canterbury, and the Benedictines founded several monasteries in England, as also the metropolitan church of Canterbury, and all the cathedrals that were afterwards erected.

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Benedictines, Benediction.

Pope John XXII. who died in 1334, after an exact inquiry, found, that, since the first rise of the order, there had been of it 24 popes, near 200 cardinals, 7000 archbishops, 15,000 bishops, 15,000 abbots of renown, above 4000 saints, and upwards of 37,000 monasteries. There have been likewise of this order 20 emperors and 10 empresses, 47 kings and above 50 queens, 20 sons of emperors, and 48 sons of kings: about 100 princesses, daughters of kings and emperors; besides dukes, marquises, earls, countesses, &c. innumerable. The order has produced a vast number of eminent writers and other learned men. Their Rabanus set up the school of Germany. Their Alcuinus founded the university of Paris. Their Dionysius Exiguus perfected the ecclesiastical computation. Their Guido invented the scale of music; and their Sylvester, the organ. They boast to have produced Anselmus, Ildephonsus, Venerable Bede, &c.

There are nuns likewise who follow the rule of St Benedict; among whom those who call themselves *mitigated*, eat flesh three times a week, on Sundays, Tuesdays, and Thursdays; the others observe the rule of St Benedict in its rigour, and eat no flesh, unless they are sick.

BENEDICTION, in a general sense, the act of blessing, or giving praise to God, or returning thanks for his favours. Hence also benediction is still applied to the act of saying grace before or after meals. Neither the ancient Jews nor Christians ever ate without a short prayer. The Jews are obliged to rehearse 100 benedictions per day; of which 80 are to be spoken in the morning. The first treatise of the first order in the Talmud, entitled *Scraim*, contains the form and order of the daily benedictions. It was usual to give benediction to travellers on their taking leave; a practice which is still preserved among the monks. Benedictions were likewise given among the ancient Jews, as well as Christians, by imposition of hands. And when at length the primitive simplicity of the Christian worship began to give way to ceremony, they added the sign of the cross, which was made with the same hand, as before, only elevated, or extended. Hence benediction, in the modern Romish church, is used, in a more particular manner, to denote the sign of the cross made by a bishop, or prelate, as conferring some grace on the people. The custom of receiving benediction, by bowing the head before the bishops, is very ancient; and was so universal, that emperors themselves did not decline this mark of submission. Under the name *benediction*, the Hebrews also frequently understand the presents which friends make to one another, in all probability because they are generally attended with blessings and compliments, both from those who give and those who receive them.

Nuptial BENEDICTION, the external ceremony performed by the priest in the office of matrimony. This is also called *sacerdotal* and *matrimonial benediction*, by the Greeks ιερολογια and ιεροτελεστια. The nuptial benediction is not essential to, but the confirmation of, a marriage in the civil law.

Beatic BENEDICTION, (*benedictio beatica*), is the viaticum given to dying persons. The pope begins all his bulls with this form: *Salutem et apostolicam benedictionem.*

BENEDICTION is also used for an ecclesiastical ceremony, whereby a thing is rendered sacred or venerable. In this sense benediction differs from consecration, as in the latter unction is applied, which is not in the former: Thus the chalice is consecrated, and the pix blessed; as the former, not the latter, is anointed: though, in the common usage, these two words are applied promiscuously.—The spirit of piety, or rather of superstition, has introduced into the Romish church benedictions for almost every thing. We read of forms of benedictions for wax candles, for boughs, for ashes, for church-vessels, and ornaments; for flags or ensigns, arms, first-fruits, houses, ships, pascal eggs, cilicium or the hair-cloth of penitents, churchyards, &c. In general, these benedictions are performed by aspersions of holy water, signs of the cross, and prayers suitable to the nature of the ceremony. The forms of these benedictions are found in the Roman pontifical, in the Roman missal, in the book of ecclesiastical ceremonies printed in Pope Leo X.'s time, and in the rituals and ceremonies of the different churches, which are found collected in Father Martene's work on the rites and discipline of the church.

Benediction, Benefice.

BENEFICE (*beneficium*), in middle-age writers, is used for a fee, sometimes denominated more peculiarly *beneficium militare*. In this sense, benefice was an estate in land, at first granted for life only; so called, because it was held *ex mero beneficio* of the donor: and the tenants were bound to swear fealty to the lord, and to serve him in the wars. In after-times, as these tenures became perpetual and hereditary, they left their name of *beneficia* to the livings of the clergy; and retained to themselves the name of *feuds*.

BENEFICE, in an ecclesiastical sense, a church endowed with a revenue for the performance of divine service; or the revenue itself assigned to an ecclesiastical person, by way of stipend, for the service he is to do that church.

All church-preferments, except bishoprics, are called *benefices;* and all benefices are, by the canonists, sometimes styled *dignities:* but we now ordinarily distinguish between benefice and dignity; applying dignity to bishoprics, deaneries, archdeaconries, and prebendaries; and benefice to parsonages, vicarages, and donatives.

Benefices are divided by the canonists into simple and sacerdotal. In the first there is no obligation but to read prayers, sing, &c. such as canonries, chaplainships, chantries, &c.: the second are charged with the cure of souls, or the direction and guidance of consciences; such as vicarages, rectories, &c.

The Romanists again distinguish benefices into regular and secular. *Regular* or titular benefices are those held by a religious, or a regular who has made profession of some religious order; such are abbeys, priories, conventuals, &c.; or rather, a regular benefice is that which cannot be conferred on any but a religious, either by its foundation, by the institution of some superior, or by prescription: for prescription, forty years possession by a religious makes the benefice regular. *Secular* benefices are only such as are to be given to secular priests, i. e. to such as live in the world and are not engaged in any monastic order. All benefices are reputed secular, till the contrary is made to appear. They are called *secular benefices*, because held by seculars; of which kind are almost all cures.

The canonists distinguish three manners of vacating a

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a benefice, viz. 1. *De jure*, when the person enjoying it is guilty of certain crimes expressed in those laws, as heresy, simony, &c. 2. *De facto*, as well as *de jure*, by the natural death or the resignation of the incumbent; which resignation may be either express or tacit, as when he engages in a state, &c. inconsistent with it, as, among the Romanists, by marrying, entering into a religious order, or the like. 3. By the *sentence of a judge*, by way of punishment for certain crimes, as concubinage, perjury, &c.

Benefices began about 500. The following account of those in England is given as the fact by Dr Burn, viz. that there are 1071 livings not exceeding 10l. per annum: 1467 livings above 10l. and not exceeding 20l. per annum; 1126 livings above 20l. and not exceeding 30l. per annum; 1049 livings above 30l. and not exceeding 40l. per annum; 884 livings above 40l. and not exceeding 50l. per annum; 5597 livings under 50l. per annum. It must be 500 years before every living can be raised to 60l. a-year by Queen Anne's bounty, and 339 years before any of them can exceed 50l. a-year. On the whole, there are above 11,000 church preferments in England, exclusive of bishoprics, deaneries, canonries, prebendaries, priest-vicars, lay-vicars, secondaries, &c. belonging to cathedrals, or choristers, or even curates, to well-beneficed clergymen.

BENEFICE *in commendam* is that, the direction and management of which, upon a vacancy, is given or recommended to an ecclesiastic, for a certain time, till he may be conveniently provided for.

BENEFICIARII, in Roman antiquity, denote soldiers who attended the chief officers of the army, being exempted from other duty. Beneficiarii were also soldiers discharged from the military service or duty, and provided with *beneficia* to subsist on. These were probably the same with the former, and both might be comprised in the same definition. They were old experienced soldiers, who, having served out their legal time, or received a discharge as a particular mark of honour, were invited again to the service, where they were held in great esteem, exempted from all military drudgery, and appointed to guard the standard, &c. These, when thus recalled to service, were also denominated *evocati*; before their recal, *emeriti*.

BENEFICIARII was also used for those raised to a higher rank by the favour of the tribunes or other magistrates. The word *beneficiarius* frequently occurs in the Roman inscriptions found in Britain, where *consulis* is always joined with it; but besides *beneficiarius consulis*, we find in Grutar *beneficiarius tribuni*, *prætorii*, *legati*, *præfecti*, *proconsulis*, &c.

BENEFICIARY, in general, something that relates to benefices.

BENEFICIARY, *Beneficiarius*, is more particularly used for a beneficed person, or him who receives and enjoys one or more benefices. A beneficiary is not the proprietor of the revenues of his church; he has only the administration of them, though unaccountable for the same to any but God.

BENEFICIARY is also used, in middle-age writers, for a feudatory or vassal. The denomination was also given to the clerks or officers who kept the accounts of the *beneficia*, and made the writings necessary thereto.

BENEFICIUM, in military matters among the Romans, denoted a promotion to a higher rank by the favour of some person in authority.

BENEFIELD, SEBASTIAN, an eminent divine of the 17th century, was born in 1559, at Prestonbury in Gloucestershire, and educated at Corpus Christi college in Oxford. In 1608 he took the degree of doctor in divinity, and five years after was chosen Margaret professor in that university. He had been presented several years before to the rectory of Meysey-Hampton, in Gloucestershire. He published Commentaries upon the first, second, and third chapters of Amos; a considerable number of sermons; and some Latin treatises. He died in 1630.

BENEFIT OF CLERGY. See CLERGY.

BENEFIT Societies, institutions common among the labouring classes in Great Britain; and calculated for the relief of the sick, or the support of the aged. See SUPPLEMENT.

BENESOEUF, a town of Egypt, seated on the western shore of the Nile, and remarkable for its hemp and flax. E. Long. 31. 0. N. Lat. 29. 10.

BENEVENTE, a town of the province of Leon, in Spain, seated on the river Esla, in W. Long. 5. 5. N. Lat. 42. 4.

BENEVENTO, a city of Italy, in the kingdom of Naples, with an archbishop's see. It is situated near the confluence of the rivers Sabato and Calore, in a fertile valley called the *Strait of Benevento*. It has frequently suffered by earthquakes, particularly in 1703. E. Long. 14. 57. N. Lat. 41. 6.

The arch of Trajan, now called the *Porta Aurea*, forms one of the entrances to the city. This arch, though it appears to great disadvantage from the walls and houses that hem it in on both sides, is in tolerable preservation, and one of the most magnificent remains of Roman grandeur to be met with out of Rome. The architecture and sculpture are both singularly beautiful. This elegant monument was erected in the year of Christ 114, about the commencement of the Parthian war, and after the submission of Decebalus had entitled Trajan to the surname of Dacicus. The order is Composite; the materials white marble; the height 60 palms; length, 37 and a half; and depth 24. It consists of a single arch, the span of which is 20 palms, the height 35. On each side of it, two fluted columns, upon a joint pedestal, support an entablement and an attic. The intercolumniations and frize are covered with basso-relievos, representing the battles and triumphs of the Dacian war. In the attic is the inscription. As the sixth year of Trajan's consulate, marked on this arch, is also to be seen on all the milliary columns he erected along his new road to Brundusium, it is probable that the arch was built to commemorate so beneficial an undertaking. Except the old metropolis of the world, no city in Italy can boast of so many remains of ancient sculpture as are to be found in Benevento. Scarce a wall is built of any thing but altars, tombs, columns, and remains of entablatures.

The cathedral is a clumsy edifice, in a style of Gothic, or rather Lombard, architecture. This church, dedicated to the Virgin Mary, was built in the sixth century, enlarged in the 11th, and altered considerably in the 13th, when Archbishop Roger adorned it with a new front. To obtain a sufficient quantity of marble for this purpose, he spared neither sarcophagus,

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Benevento. altar, nor inscription; but fixed them promiscuously and irregularly in the walls of his barbarous structure. Three doors (a type of the Trinity, according to the rules established by the mystical Vitruvii of those ages) opened into this façade. That in the centre is of bronze, embossed with the life of Christ, and the effigies of the Beneventine metropolitan, with all his suffragan bishops. The inside offers nothing to the curious observer but columns, altars, and other decorations, executed in the most inelegant style that any of the church-building barbarians ever adopted. In the court stands a small Egyptian obelisk, of red granite, crowded with hieroglyphics. In the adjoining square are a fountain and a very indifferent statue of Benedict XIII. long archbishop of Benevento.

Of the Beneventine history the following abstract is given by Mr Swinburne, in his *Travels in Sicily*. According to some authors (he informs us), Diomed was the founder of Beneventum; whence its origin must be referred to the "years that immediately succeeded the Trojan war. Other writers assign it to the Samnites, who made it one of their principal towns, where they frequently took refuge when worsted by the Romans. In their time its name was *Maleventum*, a word of uncertain etymology: however, it sounded so ill in the Latin tongue, that the superstitious Romans, after achieving the conquest of Samnium, changed it into Beneventum, in order to introduce their colony under fortunate auspices. Near this place, in the 479th year of Rome, Pyrrhus was defeated by Curius Dentatus. In the war against Hannibal, Beneventum signalized its attachment to Rome, by liberal tenders of succour and real services. Its reception of Gracchus, after his defeat of Hanno, is extolled by Livy; and, from the gratitude of the senate, many solid advantages accrued to the Beneventines. As they long partook, in a distinguished manner, of the glories and prosperity of the Roman empire, they also severely felt the effects of its decline, and shared in a large proportion the horrors of devastation that attended the irruption of the northern nations.

"The modern history of this city will appear interesting to those readers who do not despise the events of ages which we usually and justly call dark and barbarous. They certainly are of importance to all the present states of Europe; for at that period originated the original existence of most of them. Had no northern savages descended from their snowy mountains, to overturn the Roman colossus, and break asunder the fetters of mankind, few of those powers, which now make so formidable a figure, would ever have been so much as heard of. The avengers of the general wrongs were, no doubt, the destroyers of arts and literature, and brought on the thick clouds of ignorance, which for many centuries no gleam of light could penetrate; but it is to be remembered, also, that the Romans themselves had already made great progress in banishing true taste and knowledge, and would very soon have been a barbarous nation, though neither Goths nor Vandals had ever approached the frontier.

"The Lombards came the last of the Scythian or Scandinavian hordes to invade Italy. After fixing the seat of their empire at Pavia, they sent a detachment to possess the southern provinces. In 571, Zotto was appointed duke of Benevento, as a feudatory of the king of Lombardy; and seems to have confined his rule to the city alone, from which he sallied forth to seek for booty. The second duke, whose name was Arechis, conquered almost the whole country that now constitutes the kingdom of Naples. His successors appear long to have remained satisfied with the extent of dominion he had transmitted to them. Grimwald, one of them, usuped the crown of Lombardy; but his son Romwald, though a very successful warrior, contented himself with the ducal title. The fall of Desiderius, last king of the Lombards, did not affect the state of Benevento. By an effort of policy or resolution, Arechis the second kept possession; and availing himself of the favourable conjuncture, asserted his independence,—threw off all feudal submission,—assumed the style of prince,—and coined money with his own image upon it; a prerogative exercised by none of his predecessors as dukes of Benevento. During four reigns, this state maintained itself on a respectable footing; and might long have continued so, had not civil war, added to very powerful assaults from abroad, hastened its ruin. Radelchis and Siconulph aspired to the principality; and each of them invited the Saracens to his aid. The desolation caused by this conflict is scarcely to be described. No better method for terminating these fatal dissensions could be devised than dividing the dominions into two distinct sovereignties. In 851, Radelchis reigned as prince at Benevento; and his adversary fixed his court with the same title at Salerno. From this treaty of partition, the ruin of the Lombards became inevitable: a want of union undermined their strength,—foreigners gained an ascendant over them, irresolution and weakness pervaded their whole system of government. The erection of Capua into a third principality was another destructive operation: and now the inroads of the Saracens, the attacks of the eastern and western emperors, anarchy and animosity at home, reduced the Lombard states to such wretchedness, that they were able to make a very feeble resistance to the Norman arms. The city of Benevento alone escaped their sway, by a grant which the emperor Henry II. had made of it to the bishop of Rome, in exchange for the territory of Bamberg in Germany, where the popes enjoyed a kind of sovereignty. From the year 1054 to this day, the Roman see, with some short interruptions of possession, has exercised temporal dominion over this city. Benevento has given three popes to the chair of St Peter; viz. Felix III. Victor III. and Gregory VIII. and, what it is much prouder of, reckons St Januarius in the list of its bishops."

Beneventum || Benfield.

BENEVENTUM, in *Ancient Geography*, a town of the Samnites, formerly called *Maleventum* from the unwholesomeness of the wind, and under that appellation it is mentioned by Livy; but after a Roman colony was led thither in the 485th year of the city, it came to have the name of *Beneventum*, as a more auspicious title. It is mentioned by Horace as an ancient city, said to have been built by Diomedes before the Trojan war. Now BENEVENTO.

BENEVOLENCE, in morals, signifies the love of mankind in general, accompanied with a desire to promote their happiness. See MORALS.

BENFIELD, a town of France, in the department of the Lower Rhine, whose fortifications were demolished

Benfeld, Bengal.

lished in consequence of the treaty of Westphalia. E. Long. 7. 45. N. Lat. 48. 14.

BENGAL, a country of Hindostan in Asia, and one of the most valuable provinces held by the British in India, is bounded on the east by the kingdoms of Assam, Tipra, and Arracan; on the west by Malva and Berar; on the north by Nepal and Bootan; and on the south by Orixa and the bay of Bengal. Its greatest length is about 400 miles, and its breadth, where greatest, is not less than 300; extending from 21 to 27 degrees of north latitude, and from 86 to 92 of east longitude.

1 Climate extremely unhealthy.

As this country lies almost entirely within the torrid zone, and in the middle of a very extensive continent, it is sometimes subject to such extremes of heat as render it very fatal to European constitutions. Dr Lind is of opinion, that the climate of Bengal is the most dangerous in this respect of any of the English territories, excepting Bencoolen on the coast of Sumatra.

2 Extreme heat of the land wind, and its surprising effects.

Part of this unhealthiness arises from the mere circumstance of heat; for in all the southern parts of India, when the wind blows over land, it is so extremely hot and suffocating as scarcely to be borne. The reason of this is evident from the mere inspection of a map of Asia, where it is evident, that whatever wind blows over land, especially in the southern parts, must pass over an immense tract of country strongly heated by the sun; and as in every part of this extensive continent there are sandy deserts of very considerable magnitude, the heat is thus prodigiously increased. This becomes very evident on the falling of a shower of rain at the time the land-wind prevails; for if the wind in its way passes through the shower, the air is agreeably cooled though the sky should be ever so clear; while those who reside only at a few miles distance, but out of the direct line of the shower, will be fainting under the excessive heat. Here, indeed, when the air is clear, the sunbeams are much more powerful than in our climate, insomuch that the light at noon-day is too powerful for the eyes to bear; and the large stars, as Venus and Jupiter, shine with a surprising lustre. Thus the reflection of the sunbeams from the earth must necessarily occasion an extraordinary degree of heat in the atmosphere; so that from the winds above mentioned very great inconveniences sometimes arise, similar to those which are occasioned by the *Harmattan* in Africa. Mr Ives tells us, that it is affirmed they will snap glass if it be too much exposed to them; he has seen the veneering stripped off from a chest of drawers by their means; and they will certainly crack and chap almost every piece of wood that is not well seasoned. In certain places they are so loaded with sand, that the horizon appears quite hazy where they blow, and it is almost impossible to prevent the eyes from being thus greatly injured. They have likewise a very pernicious effect on such people as are exposed to them while sleeping. This seldom fails to bring on a fit of the *barbiers*, a kind of paralytic distemper attended with a total deprivation of the use of the limbs, and which the patient never gets the better of but by removing to some other climate. These hot winds are made use of with great success for cooling liquors, by wrapping a wet cloth round the bottles and exposing it to the air. The reason of this is explained under the article EVAPORATION. Mr Ives remarks, that it will thus cool much sooner than by being exposed to the cool sea-breeze.

Bengal.

3 Inundations of the Ganges, &c. described.

The great cause of the unhealthiness of Bengal, however, is owing to the inundations of the Ganges and Burrampooter, by which such quantities of putrescible matters are brought down as infect the air with the most malignant vapours when the waters retire. Though the rainy season begins in Bengal only in the month of June, the river begins to swell in the mountains of Thibet early in April, and by the latter end of that month in Bengal also. The reason of this is partly the melting of the snow on the mountains of Thibet, and partly the vast collection of vapours brought by the southerly or southwest monsoon, which are suddenly stopped by the high mountains of Thibet. Hence it is obvious, that the accumulation and condensation of these vapours must first take place in the neighbourhood of the mountains which oppose them; and thus the rainy season commences soonest in those places which lie nearest the mountains.

The rivers in Bengal begin to rise at first very slowly, the increase being only at the rate of one inch per day for the first fortnight. It then gradually augments to two and three inches before any quantity of rain falls in the low countries; and when the rain becomes general, the increase at a medium is five inches per day. By the latter end of July, all the lower parts of Bengal, contiguous to the Ganges and Burrampooter, are overflowed, and present a surface of water more than 100 miles wide. This vast collection of fluid, however, is owing in a great measure to the rains which fall on the low country itself; for the lands in the neighbourhood are overflowed some time before the bed of the river is filled. It must be observed, that the ground on the bank of the river, and even to some miles distance, is higher than that which is more remote; and thus a separation is made for a considerable time betwixt the waters of the land-flood and those of the river.

4 Some lands guarded from too copious an inundation.

As some of the lands in Bengal would receive damage from such a copious inundation, they must for this reason be guarded by strong dykes to resist the waters, and admit only a certain quantity. These, collectively taken, are said to be more than 1000 miles in length, and are kept up at an enormous expence; yet they do not always answer the purpose, on account of the looseness of the earth of which they are composed, even though some are of the thickness of an ordinary rampart at the base. One particular branch of the Ganges (navigable only in the rainy season, and then equal in size to the Thames at Chelsea) is conducted for 70 miles between dykes: and when full, the passengers look down upon the adjacent country as from an eminence.

As the tide loses its power of counteracting such an impetuous torrent of fresh water, the height of the inundation gradually diminishes as it approaches the sea, and totally vanishes at the point of confluence; which is owing to the facility with which the waters of the inundation spread over the level of the ocean. But when the force of winds conspires with that of the tide, the waters are retarded in such a manner as sometimes to raise the inundation two feet above the ordinary level; which has been known to occasion the loss of whole crops of rice. In the year 1763, a melancholy

5 Disasters occasioned by too great an inundation.

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Bengal. choly accident happened at Luckipour, when a strong gale of wind, conspiring with a high spring-tide, at a season when the periodical flood was within a foot and a half of its highest pitch, the waters are said to have risen six feet above their ordinary level. Thus the inhabitants of a particular district were swept away with their houses and cattle; and to aggravate the distress, it happened in a part of the country where it was scarce possible to find a tree for a drowning man to escape to.

For some days before the middle of August the inundation is at a stand, and then begins to abate by a cessation of rains in the mountains, though great quantities still continue to fall on the low country. The inundation does not, however, in its decrease, always keep pace with that of the river, by reason of the height of the banks; but after the beginning of October, when the rain has nearly ceased, the remainder goes off quickly by evaporation, leaving the ground exceedingly fertilized.

6 Dangerous effects of the north west winds.

From the time that the monsoon changes in October to the middle of March, the rivers are in a state of tranquillity; when the north-west winds begin, and may be expected once in three or four days till the commencement of the rainy season. These are the most formidable enemies of the inland navigation carried on by the large rivers. They are sudden and violent squalls, attended with rain; and though their duration is commonly but short, sometimes produce fatal effects, whole fleets of trading boats having been sunk by them almost instantaneously. They are more frequent in the eastern than in the western part of Bengal, and happen oftener towards the close of the day than at any other time; but as they are indicated some time before they approach by the rising and singular appearance of the clouds, the traveller has commonly time enough to seek for a place of shelter. It is in the great rivers alone that they are so formidable, and that about the end of May or beginning of June, when the rivers are much increased in width. After the commencement of the rainy season, which varies in different parts from the middle to the end of June, tempestuous weather occasionally happens. At this season, places of shelter are more common that at any other time, by the filling up of the creeks and inlets as the river increases; and on the other hand, the bad weather, when it happens, is of longer continuance than during the season of the north-westers. The rivers being now spread to the distance of several miles, large waves are raised on them, particularly when blowing in a direction contrary to the rapid parts of the stream, which for obvious reasons ought to be avoided.

7 Of the inland navigation in Bengal.

This navigation is performed in safety during the interval between the end of the rainy season and the beginning of the north-westers; an ordinary degree of attention being then only requisite to pilot the boat clear of shallows and stumps of trees. The season of the north-westers requires the greatest care and attention. Should one of these squalls approach, and no creek or inlet offer for shelter, the steep bank of the rivers should be always sought as a place for shelter, if it is not in a crumbling state *, whether it be to the windward or leeward, rather than the other. If this cannot be done, the flat side must be taken up with; and if it be a lee shore, the anchor should be thrown out to prevent driving upon it. In these cases the mast is always supposed to be struck; and, provided this be done, and the cargo judiciously disposed of, there is little danger of any of the boats commonly made use of being overset.

* See *Ganges*.

8 Budgerows, a kind of boats, described.

The boats used in the inland navigation of Bengal are called *budgerocs*, and are formed somewhat like a pleasure barge. Some have cabins 14 feet broad and proportionally long, drawing from four to five feet water. Their motion is very slow, not exceeding the rate of eight miles a-day when moved by their oars; so that their progress down the river must depend principally on the motion of the current. From the beginning of November to the middle or latter end of May, the usual rate of going down the stream is about 40 miles in twelve hours, and during the rest of the year from 50 to 70 miles. The current is strongest while the waters of the inundation are draining off, which happens in part of August and September. In many of the shallow rivers, however, the current is exceedingly slow during the dry months; insomuch that the track-rope is frequently used in going downwards. In towing against the stream, the steep side of the river is generally preferred on account of the depth of water, though the current runs much stronger there than on the opposite side. On these occasions it is necessary to provide a very long track-rope, as well for avoiding the fallen pieces of the steep bank on the one side, as the shallow water on the other, when it becomes necessary to change sides through the badness of the tracking ground. The anchor should always be kept ready for dropping in case the track-rope breaks. The usual rate of towing against the stream is from 17 to 20 miles a-day; and to make even this progress, the windings of the river require the boats to be dragged against the current at the rate of four miles and a half per hour for 12 hours. When the waters are high, a greater progress will be made, notwithstanding the superior strength of the current; because the filling of the river-bed gives many opportunities of cutting off angles and turnings, and sometimes even large windings, by going through creeks.

9 Account of a dreadful famine in 1770.

Bengal produces the vegetables and animals common to other countries in the torrid zone. Its great produce of grain is rice, which is commonly exported from thence into other countries. By various accidents, however, the crop of rice sometimes fails, and a famine is produced; and of this there have been many instances in Bengal as well as in other parts of Hindostan. One of the most deplorable of this kind happened in the year 1770. The nabob and several other men of the country distributed rice *gratis* to the poor until their stocks began to fail, when those donations were of consequence withdrawn. Vast multitudes then came down to Calcutta, the capital English settlement in the province, in hopes of meeting with relief at the place. The granaries of the Company, however, being quite empty, none could be afforded; so that when the famine had prevailed a fortnight, many thousands fell down in the streets and fields; whose bodies, mangled by the dogs and vultures, corrupting in the air, seemed to threaten a plague as the consequence of the famine. A hundred people were daily employed on the Company's account, with doolys, sledges, and bearers,

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Bengal.

bearers, to throw them into the river. At this time the fish could not be eaten, the river being so full of carcases; and many of those who ventured to feed upon them died suddenly. Hogs, ducks, and geese, also fed mostly on carnage; so that the only meat that could be procured was mutton; and this, from the dryness of the season, was so small, that a quarter of it would scarcely weigh a pound and a half.

10 Surprising cloud of insects.

In the month of August a most alarming phenomenon appeared, of a large black cloud at a distance in the air, which sometimes obscured the sun, and seemed to extend a great way over and above Calcutta. The hotter the day proved the lower this cloud seemed to descend, and for three days it occasioned great speculation. The bramins pretended, that this phenomenon, which was a cloud of insects, should make its appearance three times; and if ever they descended to the earth, the country would be destroyed by some untimely misfortune. They said, that above 150 years before there had been such another bad time, when the earth was parched for want of water; and this cloud of insects made its appearance, though it came much lower the second time than it had done before. On the third day, the weather being very hot and cloudy, they descended so low that they could be plainly seen. They seemed to be about the size of a horse-stinger, with a long red body, large head and eyes, keeping close together like a swarm of bees, and to appearance, flying quite on a line. None, however, were caught, as the people were so much frightened by the prognostications of the bramins. Whilst it rained they continued in one position for near a quarter of an hour; then they rose five or six feet at once, and in a little time descended as much, until a strong north-west wind blew for two days successively. During its continuance they ascended and descended, but more precipitately than before; and next morning the air was quite clear. For some days before the cloud made its appearance, the toads, frogs, and insects, which during the rains made a continual noise through the night, disappeared, and were neither heard nor seen, except in the river.

11 Cause of the famine.

This dreadful famine was occasioned by a preternatural drought. In this country they have two harvests; one in April, called the *little harvest*, which consists of the smaller grain; the second called the *grand harvest*, is only of rice. But by a drought which happened in 1769, the great harvest of that year failed, as did also the little one of 1770, which produced the dreadful consequences already mentioned.

12 Vegetable productions.

Among the vegetables produced in Bengal, Mr Ives mentions the areca-tree, the woody part of which is as tough as whalebone. Here is also a beautiful tree called *chulta*, the flower of which is at first a hard green ball on footstalks about four inches in length. This opens, and the calyx is composed of five round thick and succulent leaves; the corolla consists of the like number of fine beautiful white petals. After one day the corolla falls off and the ball closes again, and is sold in the markets. There is a succession of these for several months. The mango tree grows here also in plenty. Its fruit is preferred to all others in the country, excepting very fine pine-apples; the gentlemen eat little else in the hot months when these fruits are in season. If no wine is drunk with them they are apt to produce boils, which are troublesome but healthful. In the walks of Bengal they have a tall tree called the *tutoon*, said to have been first brought into England by Captain Birch. The leaves are of a deep shining green, the lower part rather paler where it is ribbed, and undulated round the edges. The fruit is of the size, shape, and colour of an olive, with a moderately thin husk, and a kernel like that of the date; five or six grow on the same pedicle. Near Calcutta is a large spreading tree called the *russa*, which makes a fine appearance when in full bloom. The natives say, that this and another near the Dutch settlement are the only two in Bengal. They pretend likewise that they can never find the seed; but Mr Ives informs us, that this is to be met with in plenty, though in a bad condition, the ants and other vermin being so fond of them, that not a single pod is ever to be met with that is not touched by one or other of these species of insects. This tree bears flowers of bright crimson, and all the shades from thence down to a bright yellow. They are in such plenty as almost to cover the tree, but have little or no smell. The fruit is a pod of the shape and size of a large garden-bean, containing four or five fleshy seeds, which easily fall into two when dry. They are brown on the outside, white within, and nearly square, but convex on the sides.

13 Birds of an extraordinary size.

Among the animals to be met with in Bengal Mr Ives makes mention of a kind of birds named *argill* or *hurgill* (see ARDEA, sp. 6.). They are very large, and in the evenings would majestically stalk along like as many naked Indians, for which our author at first mistook them. On discovering that they were birds he resolved to shoot one of them; which, however, was very difficult to be done. The Indians showed evident marks of dissatisfaction at the attempt; and informed him that it was impossible to succeed, because these birds were possessed by the souls of bramins. At last, however, he succeeded; and informs that the bird he shot extended 14 feet 10 inches between the tips of the wings; from the tip of the bill to the extremity of the claw was seven feet and a half: the legs were naked, as was also one half of the thighs; the naked parts being three feet in length. The feathers of the wings and back were of an iron colour, and very strong; those of the belly were very long, and on the breast was a great deal of down all of a dirty white. The bill was 16 inches round at the base, nearly of a triangular shape, and of different colours. In the craw was a land tortoise 10 inches long; and a large black male cat was found entire in its stomach.

14 Commerce inland.

Bengal is reckoned the richest and most populous province in the empire of Hindostan. Besides its own consumption, which is certainly very considerable, its exports are immense. One part of its merchandise is carried into the inland country. Thibet takes off a quantity of its cottons, besides some iron and cloths of European manufacture. The inhabitants of those mountains fetch them from Patan themselves, and give musk and rhubarb in exchange.

But the trade of Thibet is nothing in comparison of that which Bengal carries on with Agra, Delhi, and the provinces adjacent to those superb capitals, in salt, sugar, opium, silk, silk-stuffs, and an infinite quantity of cottons, and particularly muslins. These

articles

Bengal. articles, taken together, amounted long ago to more than 1,750,000l. a-year. So considerable a sum was not conveyed to the banks of the Ganges; but it was the means of retaining one nearly equal, which must have issued from thence to pay the duties, or for other purposes. Since the viceroys of the Mogul have made themselves nearly independent, and send him no revenues but such as they choose to allow him, the luxury of the court is greatly abated, and the trade we have been speaking of is no longer so considerable.

15 Maritime.

The maritime trade of Bengal, managed by the natives of the country, has not suffered the same diminution, nor was it ever so extensive, as the other. It may be divided into two branches, of which Catek is in possession of the greater part.

Catek is a district of some extent, a little below the most western mouth of the Ganges. Balasore, situated upon a navigable river, serves it for a port. The navigation of the Maldives, which the English and French have been obliged to abandon on account of the climate, is carried on entirely from this road. Here they load their vessels with rice, coarse cottons, and some silk stuffs, for these islands; and receive cowries in the exchange, which are used for money in Bengal, and sold to the Europeans.

The inhabitants of Catek, and some other people of the Lower Ganges, maintain a considerable correspondence with the country of Asham. This kingdom, which is thought to have formerly made a part of Bengal, and is only divided from it by a river that falls into the Ganges, deserves to be better known, if what is asserted here be true, that gunpowder has been discovered there, and that it was communicated from Asham to Pegu, and from Pegu to China. Its gold, silver, iron, and lead mines, would have added to its fame, if they had been properly worked. In the midst of these riches, which were of very little service to this kingdom, salt was an article of which the inhabitants were so much in want, that they were reduced to the expedient of procuring it from a decoction of certain plants.

In the beginning of the present century, some Bramins of Bengal carried their superstitions to Asham, where the people were guided solely by the dictates of natural religion. The priests persuaded them, that it would be more agreeable to Brama if they substituted the pure and wholesome salt of the sea to that which they used. The sovereign consented to this on condition that the exclusive trade should be in his hands; that it should only be brought by the people of Bengal; and that the boats laden with it should stop at the frontiers of his dominions. Thus have all these false religions been introduced by the influence and for the advantage of the priests who teach, and of the kings who admit them. Since this arrangement has taken place, 40 vessels from 500 to 600 tons burden each are annually sent from the Ganges to Asham laden with salt, which yields 200 per cent. profit. They receive in payment a small quantity of gold and silver, ivory, musk, eagle-wood, gum-lac, and a large quantity of silk.

Excepting these two branches of maritime trade, which, for particular reasons, have been confined to the natives of the country, all the rest of the vessels sent from the Ganges to the different sea-ports of India belong to the Europeans, and are built at Pegu. See Pegu.

A still more considerable branch of commerce, which the Europeans at Bengal carry on with the rest of India, is that of opium. Patna, situated on the Upper Ganges, is the most celebrated place in the world for the cultivation of opium. The fields are covered with it. Besides what is carried into the inland parts, there are annually 3000 or 4000 chests exported, each weighing 300 pounds. It sells upon the spot at the rate of between 24l. and 25l. a chest on an average. This opium is not purified like that of Syria and Persia, which we make use of in Europe; it is only a paste that has undergone no preparation, and has not a tenth part of the virtue of purified opium.

The Dutch send rice and sugar from their settlements to the coast of Coromandel, for which they are paid in specie, unless they have the good fortune to meet with some foreign merchandise at a cheap rate. They send out one or two vessels laden with rice, cottons, and silk: the rice is sold in Ceylon, the cottons at Malabar, and the silk at Surat; from whence they bring back cotton, which is usually employed in the coarser manufactures of Bengal. Two or three ships laden with rice, gum-lac, and cotton stuffs, are sent to Bassora; and return with dried fruits, rose-water, and a quantity of gold. The rich merchandise carried to Arabia is paid for entirely in gold and silver. The trade of the Ganges with the other sea-ports of India brings 1,225,000l. annually into Bengal.

Though this trade passes through the hands of the Europeans, and is carried on under their protection, it is not entirely on their own account. The Moguls, indeed, who are usually satisfied with the places they hold under the government, have seldom any concern in these expeditions; but the Armenians, who, since the revolutions in Persia, are settled upon the banks of the Ganges, to which they formerly only made voyages, readily throw their capital into this trade. The Indians employ still larger sums in it. The impossibility of enjoying their fortunes under an oppressive government does not deter the natives of this country from labouring incessantly to increase them. As they would run too great a risk by engaging openly in trade, they are obliged to have recourse to clandestine methods. 16
Gentoo brokers.
As soon as an European arrives, the Gentoos, who know mankind better than is commonly supposed, study his character; and, if they find him frugal, active, and well informed, offer to act as his brokers and cashiers, and lend or procure him money upon bottomry, or at interest. This interest, which is usually nine per cent. at least, is higher when he is under a necessity of borrowing of the Cheyks. 17
Cheyks, a powerful Indian family.
These Cheyks are a powerful family of Indians, who have, time immemorial, inhabited the banks of the Ganges. Their riches have long ago procured them the management of the bank belonging to the court, the farming of the public revenue, and the direction of the money, which they coin afresh every year, in order to receive annually the benefit arising from the mint. By uniting so many advantages, they are enabled to lend the government 1,750,000l. 2,625,000l. or even 4,375,000l. at a time. When the

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the government finds it impossible to refund the money, they are allowed to indemnify themselves by oppressing the people.

The Europeans who frequent the Ganges have not been sufficiently alarmed at this despotism, which ought to have prevented them from submitting to a dependence upon the Cheyks. They have fallen into the snare, by borrowing considerable sums of these avaricious financiers, apparently at nine, but in reality at thirteen, per cent. if we take into the account the difference between the money that is lent them and that in which they are obliged to make their payments. The engagements entered into by the French and Dutch companies have been kept within some bounds; but those of the English company have been unlimited. In 1755, they were indebted to the Cheyks about 1,225,000l.

The Portuguese, who first frequented this rich country, had the wisdom to establish themselves at Chatigan, a port situated upon the frontier of Arracan, not far from the most eastern part of the Ganges. The Dutch, who, without incurring the resentment of an enemy at that time so formidable, were desirous of sharing in their good fortune, were engaged in searching for a port which, without obstructing their plan, would expose them the least to hostilities. In 1603, their attention was directed to Balasore; and all the companies, rather through imitation than in consequence of any well-concerted schemes, followed their example. Experience taught them the propriety of fixing as near as possible to the markets from whence they had their merchandise; and they sailed up that branch of the Ganges which, separating itself from the main river at Mourcha above Cossimbuzar, falls into the sea near Balasore under the name of the river *Hughly*. The government of the country permitted them to erect warehouses wherever there was plenty of manufactures, and to fortify themselves upon this river.

18 Principal towns.

The first town that is met with in passing up the river is Calcutta, the principal settlement of the English company. See CALCUTTA.

Six leagues higher is situated Frederic Nagore, founded by the Danes in 1756, in order to supply the place of an ancient settlement where they could not maintain their ground. This new establishment has not yet acquired any importance, and there is all the reason imaginable to believe that it will never become considerable.

Two leagues and a half higher lies Chandernagore, a settlement belonging to the French. See CHANDERNAGORE.

At the distance of a mile from Chandernagore is Chinsura, better known by the name of *Dougli*, being situated near the suburbs of that anciently renowned city. The Dutch have no other possessions there, but merely their fort; the territory round it depending on the government of the country, which hath frequently made it feel its power by its extortions. Another inconvenience attending this settlement is a sand bank that prevents ships from coming up to it: they proceed no farther than Tulta, which is 20 miles below Calcutta; and this of course occasions an additional expence to the government.

The Portuguese had formerly made Bandel, which is eighty leagues from the mouth of the Ganges, and a quarter of a league above the Hughly, the principal seat of their commerce. Their flag is still displayed, and there are a few unhappy wretches remaining there, who have forgotten their country after having been forgotten by it. This factory has no other employment than that of supplying the Moors and the Dutch with mistresses.

19 Exports.

The exports from Bengal to Europe consist of musk, gum lac, nicaragua wood, pepper, cowries, and some other articles of less importance brought thither from other places. Those that are the immediate produce of the country are borax, saltpetre, silk stuffs, muslins, and several different sorts of cottons.

It would be a tedious and useless task to enumerate all the places where ticken and cottons, fit for table-linen, or intended to be worn plain, painted, or printed, are manufactured. It will be sufficient to refer to DACCA, which may be looked upon as the general mart of Bengal, where the greatest variety of finest cottons are to be met with, and in the greatest abundance. See DACCA.

The sum total of the purchases made in Bengal by the European nations, amounted a few years ago to no more than 870,000l. One third of this sum was paid in iron, lead, copper, woollens, and Dutch spices: the remainder was discharged in money. Since the English have made themselves masters of this rich country, its exports have been increased, and its imports diminished, because the conquerors have carried away a greater quantity of merchandise, and pay for it out of the revenues they receive from the country. The revenues of Bengal consist chiefly of rents paid to the government for land. In the year 1811-12, they amounted, including those of Behar and Orixa, to 2,590,000l, to which may be added nearly 200,000l for the monopolies of salt and opium.

For the history of Bengal, and its conquest by the British, see the article INDOSTAN.

BENGO, a province of the kingdom of Angola in Africa, having the sea on the west, and the province of Moseche on the east. It produces plenty of banana trees; but the Portuguese have grubbed up vast quantities of these, and cultivated the land, which now abounds with maize, and the manioc root of which bread is made*. The province is divided into a great number of districts, of which the chiefs are natives, but tributary to Portugal, and obliged to till the lands belonging to the Portuguese. They are Christians, and have eight churches.

* See *Jatropha.*

BENGUELA, a province of the kingdom of Angola in Africa, bounded on the east by the river Rimba, on the north by the Coanza, and it extends westward quite to Cape Negro. Benguela was formerly governed by its own kings; but was entirely ruined by the incursions of the barbarous Giagas, so that its being conquered by the Portuguese proved a great happiness. It still retains the title of kingdom, and is allowed to enjoy some small privileges; but is far from being restored to the state of plenty it enjoyed before its destruction by the Giagas already mentioned. It produces abundance of salt, but inferior in quality to that which is made in the province of Chissama. The zimbis also, whose shells are current as money through many countries of Africa, are caught upon the coast. The country, which is mostly mountainous, abounds with

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with elephants, rhinoceroses, lions, tigers, crocodiles, &c. which are very dangerous, and destroy great numbers of cattle.

BENHINNOM, in *Ancient Geography*, a valley in the suburbs, and to the east of Jerusalem, either a part of or conjoined with the valley of Kidron, (Joshua); infamous for sacrificing children, or passing them through the fire. The place in the valley where the idol stood to which the sacrifice was made, was called *Tophet*, (2 Kings xxiii. 10. Jer. vii. 31. 32. and xix. 2.), from beating drums or tabours to drown the cries or shrieks of the children: called also *Geenon* or the *Valley of Ennon*: whence some derive *Gehenna*, the place of future punishment.

BENJAMIN. See BENZOIN and STYRAX.

BENIARAX, an ancient and considerable town in the kingdom of Algiers in Africa, seated in W. Long. 0. 30. N. Lat. 35. 0.

BENIN, a country of Guinea, in Africa, has part of the gulf called the *Bite of Benin*, and the Slave Coast, on the west; part of Gago and Biafara on the north; Myjac and Makoko on the east; and Congo on the south, where it extends about one degree beyond the equinoctial line. The length from east to west is about 600 miles; but its north and south bounds are not so well determined. The land in general is low and woody; in some parts it has rivers and lakes, but in others there is a scarcity of water. There is here a great number of wild beasts, particularly elephants, lions, tigers, leopards, baboons, monkeys, wild boars, deer, &c. The birds are partridges, of which some are blue and some green, turtles, wild ducks, woodcocks, &c. Their grain is Indian corn: they have no potatoes; but plenty of yams, which are of the potato kind, but vastly larger and more coarse: these are their ordinary food, and serve in the room of bread; they have two sorts of beans, like horse beans, but not near so good. Their fruits are cocoa-nuts, cormantine apples, bananas, wild figs, &c.

The negroes have several colours which might serve for painting, and a good sort of soap made with palm-oil and wood-ashes; they have a great deal of cotton, which not only serves for their own use, but is exported to distant places. The river Rio or Benin has a great many arms; some of which are so large that they deserve the name of rivers: it abounds with fish, which the inhabitants eat smoke-dried as well as fresh. The place of trade in this river is at Arebo, about 120 miles distant from its mouth; and to this place the ships may sail up. Those who take this voyage see the mouths of a great many rivers fall into the principal channel to the right and the left; but how far it ascends into the country is not known. A little higher up, the country is very low and marshy, and seems to be divided into islands; and yet there are trees of all sizes growing on the banks; this renders the country very unhealthy, as many of our British sailors have found to their cost; it is also incommoded with vast numbers of flies, called *mosquitoes*, which sting terribly, and render the skin full of pustules. There are three principal villages to which the negroes come from the inland countries to traffic. One is called *Boodadou*, and consists of about 50 houses, or rather huts, for they are made with reeds and covered with leaves. The second, called *Arebo*, was mentioned above: this is much larger than the former, and pretty well stocked with inhabitants; and the houses have much more room, but they are built after the same manner. The third has the name of *Aguton*, and was built upon a hill. It was almost ruined by the wars; but the negroes lately rebuilt it, on account of its agreeable situation. Great Benin is the place of residence of the king.

The inhabitants of Benin are very exact in their trading, and will not recede from any of their old customs: this renders them very slow in their dealings, and backward to pay their debts, which sometimes obliges the traders to sail before they receive satisfaction; but then they are paid as soon as they return. Some of the merchants are appointed by the government, which demands a sort of custom; but it is very trifling. There are three sorts of officers under the king; the first are always near him, and none can address him but by their means: there are several of the second sort; one takes care of the slaves, another of the cattle, another of the streets, another of war, and so on.

Children go almost naked till they are 14, and then they wrap a cotton cloth round their middles; the richer sort put on a sort of callico gowns when they go abroad, with a kind of drawers; but within they are contented with their usual cloth: the better sort of women wear their cotton cloths like petticoats, and have a covering round their shoulders, but take care it shall be open before.

The richer sort of the inhabitants of Benin live upon beef, mutton, and poultry; their drink is water, and brandy when they can get it. The poorer sort live upon dried fish, bananas, and beans; their drink is water and palm-wine. Their chief handicraftmen are smiths, carpenters, and curriers; but they perform all their work in a very bungling manner. The men have as many wives as they can keep, which they take without any ceremony except treating their relations. The wives of the lower sort may go wherever they have a mind; but those of the rich are shut up: they allow their wives to be very familiar with the Europeans, and yet pretend to be very jealous of their own countrymen. When a woman is caught in adultery, she is turned away, and the goods of the man are forfeited to the husband; but if the relations of the woman are rich, they prevail on him to overlook the fault by dint of presents.

They use circumcision, which is performed seven days after the children are born, at which time the father makes a feast for the relations; they have also customs, relating to uncleanness, resembling those of the Jews. Thieves are punished by making the party amends if they can, otherwise they are bastinadoed; but murder is always punished with death. When a person is only suspected of a crime, they have several ways of putting him to trial, like the fire ordeal, or the bitter water of the Jews: but they are of such a nature, that the innocent may be as often condemned as the guilty.

With regard to their religion, they believe in an almighty and invisible God; yet worship images in a human form, and in those of all sorts of animals, making them offerings, every one being his own priest; they look upon these lesser deities as mediators between him and man; some of these idols are in the house, and some in in cabins by themselves. Every fifth day is holy; on which the rich kill cows, sheep, and goats, and others dogs, cats, and fowls, which they distribute among their poor neighbours.

Benin, the capital of a kingdom of the same name, is the residence of their kings, and is seated pretty far in the country: it stands in a plain, and is about four miles in compass. The streets are long and broad: and there are markets twice a-day, where they sell cows, cotton, elephants teeth, European merchandises, and whatever the country produces. The houses are large, with clays walls, and at a distance from each other; they are covered with reeds, straw, and leaves. The women in this place are the greatest slaves; for they go every day to market, manage the household affairs, take care of the children, cook the victuals, and till the ground. The king's palace makes great part of the town; and, its great extent excepted, there is nothing worth taking notice of, it being only a confused heap of buildings, made with boards and clay, without regularity or neatness. In the middle, there is a wooden tower, about 70 feet high, made like a chimney, and on the top is a brazen serpent, hanging with its head downwards; this is pretty well made, and is the most curious thing in the town; there is a gallery of statues, but so wretchedly carved, that there is no knowing what they represent without being told: behind a curtain there are 11 brazen heads, with an elephant's tooth on each; these are the king's idols: his throne is made of ivory, on which he sits in a pavilion of India stuff. The king shows himself but once a year, on the day of a certain festival; and then he is surrounded with his wives and a great number of his officers, who walk out in procession to begin the feast by sacrificing to their gods; this done, he bestows victuals and wine among the multitude, which is imitated by his officers. All the inhabitants of this town and country go under the denomination of the *king's slaves*, and some relations say, that none of them wear any habit till given them by the king: but this seems to be only a salvo to account for the great number of men and women that are daily seen naked in the streets; for if it be true, that the king of Benin can bring 100,000 fighting men into the field, his subjects must be very numerous; and probably his majesty is not rich enough to bestow garments upon them all. The Europeans resort hither to purchase slaves. E. Long. 5. 4. N. Lat. 7. 40.

BENISH-days, among the Egyptians, a term for three days of the week, which are days of less ceremony in religion than the other four, and have their name from the *benish*, a garment of common use, not of ceremony. In Cairo, on Sundays, Tuesdays, and Thursdays, they go to the bashaw's divan; and these are the general days of businesss. Friday they stay at home, and go to their mosques at noon; but though this is their day of devotion, they never abstain from business. The three other days of the week are the benish-days, in which they throw off all business and ceremony, and go to their little summer-houses in the country.

BENNAVENTA, or Bennavenna, (Antonine) a town of Britain, on the Ausona Major, or the Antona of Tacitus: supposed to be Northampton on the Nen; but Camden says it is Wedon, a village six miles to the west of Northampton.

BENNET, Henry, earl of Arlington, was born of an ancient family in Middlesex. In the beginning of the civil war, he was appointed under-secretary to George Lord Digby, secretary of state; afterward entered himself as a volunteer for the royal cause, and did his majesty good service, especially at Andover in Hampshire, where he received several wounds. When the wars were ended, he left not the king when success did, but attended his interest in foreign parts. He was made secretary to the duke of York; received the honour of knighthood from Charles II. at Bruges, in 1658: and was sent envoy to the court of Spain. His majesty, upon his return to England, called him home, made him keeper of his privy purse, and principal secretary of state. He had always a peculiar hatred to the lord chancellor Hyde; who on the other hand considered him as a concealed Papist. In 1670 he was one of the council distinguished by the title of the *Cabal*, and one of those who advised shutting up the exchequer. In 1672 he was made earl of Arlington and Viscount Thetford, and soon after knight of the Garter. In 1673, he was appointed one of the three plenipotentiaries from the court of Great Britain to Cologn, to mediate a peace between the emperor and the king of France. The house of commons, in 1673, drew up articles of impeachment against him. In 1674 he was made chamberlain of his majesty's household, with this public reason, that it was in recompense of his long and faithful service, and particularly for his having performed the office of principal secretary of state for the space of 12 years, to his majesty's great satisfaction. But afterward his interest began to decline, while that of the earl of Danby increased; for upon his return from his unsuccessful journey to Holland in 1675, his credit was so much sunk, that several persons at court diverted the king with mimicking his person and behaviour; yet he held his lord chamberlain's place to the day of his death in 1685. His esteemed letters to Sir William Temple were published after his death.

Bennet, *Christopher*, an eminent physician in the 16th century, was the son of John Bennet, of Raynton, in Somersetshire. He was educated at Lincoln college, Oxford; and gave the public a treatise on consumptions, entitled, *Theatri Tabidorum Vestibulum, &c.* also *Exercitationes Diagnosticæ, cum Historiis demonstrativis, quibus Alimentorum et Sanguinis vitia deteguntur in plerisque morbis, &c.*

Bennet, *Dr Thomas*, an eminent divine, born at Salisbury on the 7th of May 1673, and educated at St John's college, Cambridge. In 1700, he was made rector of James's in Colchester: afterwards he was lecturer of St Olave's, Southwark, and morning-preacher at St Lawrence, Jewry; and at last was presented to the vicarage of St Giles's, Cripplegate, worth 500l. a-year. While he was in this station, he was engaged in several expensive law-suits in defence of the rights of the church, to which he recovered 150l. a-year. He wrote 1. An Answer to the Dissenters Plea for Separation. 2. A Confutation of Popery. 3. A Discourse of Schism. 4. An Answer to a book entitled Thomas against Bennet. 5. A Confutation of

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Quakerism. 6. A brief History of the joint Use of pre-conceived Forms of Prayer. 7. An Answer to Dr Clarke's Scripture-doctrine of the Trinity. 8. A Paraphrase, with Annotations on the Book of Common Prayer. 9. A Hebrew Grammar; and other pieces. He died October 9. 1728, in the 56th year of his age.

BENOIT, Renatus, a famous doctor of the Sorbonne, and curate of Eustathius at Paris, in the 16th century. He was a secret favourer of the Protestant religion; and that his countrymen might be able to read the bible in their own tongue, he published at Paris the French translation, which had been made by the reformed ministers at Geneva. This translation was approved of by several doctors of the Sorbonne before it went to the press, and King Charles IX. had granted a privilege for the printing of it. Yet when it was published it was immediately condemned. He had been before that time confessor to the unhappy Mary queen of Scotland, during her stay in France, and attended her when she returned into Scotland. Some time before the death of Henry III. Dr Benoit, or some of his friends with his assistance, published a book, entitled, *Apologie Catholique*, i. e. The Catholic Apology; in which it was shewn, that the Protestant religion, which Henry king of Navarre professed, was not a sufficient reason to deprive him of his right of succeeding to the crown of France. When Henry IV. was resolved to embrace the Catholic religion, he assisted at that assembly in which King Henry abjured the reformed religion. The king promoted him to the bishopric of Troyes in Champagne 1597, but he could never obtain the pope's bulls to be installed. However, he enjoyed the temporalities of that bishopric till he resigned it. He died in 1608.

BENSERADE, Isaac de, an ingenious French poet of the 17th century, was born at Lyons. He made himself known at court by his verses and his wit, and had the good fortune to please the cardinals de Richelieu and Mazarin. After the death of Richelieu, he got into favour with the duke de Breze, whom he accompanied in most of his expeditions; and when this nobleman died, he returned to court, where his poetry became highly esteemed. He wrote, 1. A Paraphrase upon Job. 2. Verses for Interludes. 3. Rondeaux upon Ovid. 4. Several Tragedies. A sonnet which he sent to a young lady with his Paraphrase on Job being put in competition with the Urania of Voiture caused him to be much spoken of; for what an honour was it to be head of a party against this celebrated author! Those who gave the preference to Benserade's performance were styled the *Jobists*, and their antagonists the *Uranists*; and the dispute long divided the whole court and the wits. Some years before his death, he applied himself to works of piety, and translated almost all the Psalms.

M. l'Abbé Olivet says, that Benserade towards the latter end of his life, withdrew from court, and made Gentilly the place of his retirement. When he was a youth, he says it was the custom to visit the remains of the ornaments with which Benserade had embellished his house and gardens, where every thing savoured of his poetical genius. The bark of the trees was full of inscriptions: and, amongst others, he remembers the first which presented itself was as follows:

Adieu fortune, honneurs adieu, vous et les votres,
Je viens ici vous oublier;
Adieu toi meme amour, bien plus que les autres
Difficile a congedier.

Fortune and honours, all adieu,
And whatsoe'er belongs to you.
I to this retirement run,
All your vanities to shun.
Thou too adieu, O powerful love;
From thee 'tis hardest to remove.

M. Voltaire is of opinion that these inscriptions were the best of his productions, and he regrets that they have not been collected.

Benserade suffered at last so much from the stone, that, notwithstanding his great age, he resolved to submit to the operation of cutting. But his constancy was not put to this last proof; for a surgeon letting him blood, by way of precaution, pricked an artery, and, instead of endeavouring to stop the effusion of blood, ran away. There was but just time to call F. Commire, his friend and confessor, who came soon enough to see him die. This happened the 19th of October 1691, in the 82d year of his age.

BENSHEIM, a town of Germany in the grand duchy of Hesse, seated in E. Long. 8. 45. N. Lat. 52. 23.

BENSON, Dr George, a learned dissenting minister, born at Great Salkeld, in Cumberland, in 1699. His love of learning was so successful, that, at 11 years of age, he was able to read the Greek Testament. He afterwards studied at Dr Dixon's academy at Whitehaven, from whence he removed to the university of Glasgow. In 1721, he was chosen pastor of a congregation of Dissenters at Abingdon in Berkshire; in 1729, he received a call from a society of dissenters in Southwark, with whom he continued 11 years; and in 1740, was chosen by the congregation of Crutched Friars, colleague to the learned and judicious Dr Lardner. From the time of his engaging in the ministry he proposed to himself the critical study of the Scriptures, particularly of the New Testament, as a principal part of his business. The first fruits of these studies which he presented to the public was, A Defence of the reasonableness of Prayer, with a Translation of a Discourse of Maximus Tyrius, containing some popular Objections against Prayer, and an Answer to these. The light which Mr Locke had thrown on the obscurest parts of St Paul's epistles, by making him his own expositor, encouraged and determined Mr Benson to attempt to illustrate the remaining epistles in the same manner. In 1731, he published a Paraphrase and Notes on the Epistle to Philemon, as a specimen. This was well received, and the author encouraged to proceed in his design. With the epistle to Philemon was published "A short dissertation, to prove from the spirit and sentiments the apostle discovered in his epistles, that he was neither an enthusiast nor impostor; and consequently that the religion which he asserted he received immediately from heaven, and confirmed by a variety of miracles, is indeed divine." This argument hath since been improved and illustrated, with great delicacy and strength, in a review of the apostle's entire conduct and character by Lord Lyttelton. Mr Benson proceeded with great diligence and reputation to publish Paraphrases

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phrases and Notes on the two Epistles to the Thessalonians, the first and second to Timothy, and the Epistle to Titus; adding, Dissertations on several important Subjects, particularly on Inspiration. In the year 1735, our author published his History of the first Planting of Christianity, taken from the Acts of the Apostles, and their Epistles, in 2 vols 4to. In this work, besides illustrating throughout the history of the Acts and most of the epistles, by a view of the history of the times, the occasion of the several epistles, and the state of the churches to whom they were addressed, he established the truth of the Christian religion on a number of facts, the most public, important, and incontestable. He also wrote, The Reasonableness of the Christian Religion; The History of the Life of Jesus Christ; A Paraphrase and Notes on the seven Catholic Epistles; and several other works which procured him great reputation. One of the universities in Scotland sent him a diploma, with a doctor's degree; and many of high rank in the church of England, as Herring, Hoadley, Butler, Benson, Coneybeare, &c. showed him great marks of favour and regard. He died in the year 1763, in the 64th year of his age.

BENTHAM, Thomas, bishop of Litchfield and Coventry, was born at Shirburn in Yorkshire in the year 1513, and educated in Magdalene college, Oxford. He took the degree of bachelor of arts in 1543, and in 1546 was admitted perpetual fellow, and proceeded master of arts the year following, which was that of Edward VI's accession to the crown. He now threw off the mask of Popery, which during the equivocal reign of Henry VIII. he had worn with reluctance. When Mary came to the crown, being deprived of his fellowship by her visitors, he prudently retired to Basil in Switzerland, where for some time he expounded the Scriptures to the English exiles in that city; but, being solicited by some Protestants in London, he returned to London before the death of the queen, and was appointed superintendant of a private congregation in the city. Immediately on the accession of Elizabeth, Bentham was preferred in the church, and in the second year of her reign was consecrated bishop of Litchfield and Coventry. He died at Eccleshal in Staffordshire in 1578, aged 65. He was buried in the chancel of the church there; and a monument was erected, with the effigy of himself, his wife, and four children, with the following inscription:

Hac jacet in tumba Benthamus, episcopus ille
Doctus, divinus, largus, pascens, pius, almus.
Ob. 19. *Feb.* 1578.

Bishop Bentham had the character of a pious and zealous reformer, and was particularly celebrated for his knowledge of the Hebrew language. His works are, 1. Exposition of the Acts of the Apostles; manuscript. 2. A Sermon on Christ's Temptation; Lond. 8vo. 3. Epistle to M. Parker; manuscript. 4. The Psalms, Ezekiel, and Daniel, translated into English in Queen Elizabeth's Bible.

BENTINCK, W. H. C. third duke of Portland, a late British statesman. See Supplement.

BENTIVOGLIO, Guy, cardinal, born at Ferrara, in the year 1579. He went to study at Padua, where he made a considerable proficiency in polite literature. Upon his leaving the university, he went to reside at Rome, where he became universally esteemed. He was sent nuncio to Flanders, and then to France; in both which employments his behaviour was such as gave great satisfaction to Paul V. who made him a cardinal, which was the last promotion he made, a little before his death, which happened on the 28th of January 1621. Bentivoglio was at this time in France, where Louis XIII. and all the French court congratulated him on his new dignity; and when he returned to Rome, his Christian majesty entrusted him with the management of the French affairs at that court. Pope Urban VII. had a high regard for him on account of his fidelity, disinterestedness, and consummate knowledge in business. He was beloved by the people, and esteemed by the cardinals; and his qualities were such, that in all probability he would have been raised to the pontificate on the death of Urban, which happened on the 29th of July 1644; but having gone to the conclave during the time of the most intolerable heats at Rome, it affected his body to such a degree, that he could not sleep for 11 nights afterwards; and this want of rest threw him into a fever, of which he died the 7th of September 1644, aged 65. He has left several works; the most remarkable of which are, A History of the Civil Wars of Flanders, An Account of Flanders, with Letters and Memoirs.

Bentivoglio, a small town of Italy in the territory of Bologna, with a castle, situated in E. Long. 11. 34. N. Lat. 44. 47.

BENTLEY, Richard, an eminent critic and divine, was born at Oulton, in the parish of Rothwell, near Wakefield. His ancestors, who were of some consideration, possessed an estate, and had a seat at Hepenstall, in the parish of Halifax. His grandfather James Bentley was a captain in King Charles I.'s army at the time of the civil wars; and being involved in the fate of his party, had his house plundered, his estate confiscated, and was himself carried prisoner to Pomfret Castle, where he died. Thomas Bentley, the son of James, and father of Dr Bentley, married the daughter of Richard Willis of Oulton, who had been a major in the royal army. This lady, who was a woman of exceeding good understanding, taught her son Richard his accidence. To his grandfather Willis, who was left his guardian, he was in part indebted for his education; and having gone through the grammar school at Wakefield with singular reputation, both for his proficiency and his exact and regular behaviour, he was admitted of St John's college, Cambridge, under the tuition of Mr Johnson, on the 24th of May 1676; being then only four months above 14 years of age. On the 22d of March 1681-2, he stood candidate for a fellowship, and would have been unanimously elected, had he not been excluded by the statutes on account of his being too young for priest's orders. He was then a junior bachelor, and but little more than 19 years old. It was soon after this that he became a schoolmaster at Spalding. But that he did not continue long in this situation is certain from a letter of his grandfather Willis's, still preserved in the family, from which it appears, that he was with Dr Stillingfleet at the deanery of St Paul's on the 25th of April 1683. He had been recommended by his college to the dean as preceptor to his son; and Dr Stillingfleet gave Mr Bentley his choice whether he would carry his pupil to Cambridge.

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Bentley. Cambridge or Oxford. He fixed upon the latter university on account of the Bodleian library, to the consulting of the manuscripts of which he applied with the closest attention. Being now of age, he made over a small estate which he derived from his family to his elder brother, and immediately laid out the money he obtained for it in the purchase of books. In July 1683, he took the degree of master of arts at St John's college, Cambridge. In 1692, his patron being advanced to the see of Worcester, collated him to a prebend in that church, and also made him his domestic chaplain. That learned prelate, as well as Dr Will. Lloyd, then bishop of Litchfield, had seen many proofs of our author's extraordinary merit, when they concurred in recommending him as a fit person to open the lectures upon Mr Boyle's foundation, in defence of natural and revealed religion. This gave him a fine opportunity of establishing his fame. He saw it well; and resolved to push it to the utmost. Sir Isaac Newton's *Principia* had been published but a few years, and the book was little known and less understood. Mr Bentley therefore determined to spare no pains in displaying to the best advantage the profound demonstrations which that excellent work furnished in proof of a Deity; and that nothing might be wanting to complete the design, he applied to the author and received from him the solution of some difficulties which had not fallen within the plan of his treatise *. In short, our author's sermons at Boyle's lectures were universally admired, and highly raised his reputation as a preacher; notwithstanding that escape which laid him open to the raillery of Dr Keil, viz. of proving the moon not to turn round her axis, because she always shows the same face to the earth. In 1693, he was made keeper of the royal library at St James's.

* Vid. *Four Letters from Sir Isaac Newton to Dr Bentley*, Lond. 1756.

In the following year arose the famous dispute between him and the honourable Mr Boyle, in relation to the epistles of Phalaris; of which Mr Boyle had published a very fine edition, with a Latin version of the text. These epistles the Doctor asserted to be spurious, the production of some sophist, and altogether contemptible as a literary performance. The principal pieces which appeared in this noted controversy were, 1. Dr Bentley's dissertation upon the epistles of Themistocles, Socrates, Euripides, Phalaris, and the Fables of Æsop, at the end of the second edition of Mr Wotton's Reflections on Ancient and Modern Learning: but afterwards printed by Dr Bentley entire, and added with great additions to his farther defence of it, in answer to Mr Boyle. 2. "Dr Bentley's Dissertation on the Epistles of Phalaris and the Fables of Æsop examined by the Honourable Charles Boyle, Esq." a book more commonly known by the title of *Boyle against Bentley*. 3. Dr Bentley's Answer to the above, commonly known by the name of *Bentley against Boyle;* a curious piece, interspersed with a great deal of true wit and humour. From the caprice or partiality of the age the victory was adjudged to Mr Boyle, and the ridicule of the writs exercised upon Dr Bentley. Thus Dr Garth, in the Dispensary,

So Diamonds take a lustre from their foil,
And to a BENTLEY *'tis we owe a* BOYLE.

Dr Bentley had also some wags who were his enemies *even* at Cambridge, who drew his picture in the hands of Phalaris's guards, who were putting him into their master's bull, and out of the Doctor's mouth came a label with these words, *I had rather be* ROASTED *than* BOYLED. And Dean Swift, in his Tale of a Tub, had some strokes at Dr Bentley upon this occasion, but more especially in his Battle of the Books, where, on account of Dr Bentley's Dissertation of Phalaris, &c. being annexed to Mr Wotton's Reflections on Learning, and their being great friends, he makes Mr Wotton and Dr Bentley, standing side by side, in each other's defence, to be both transfixed to the ground by one stroke of the javelin of Mr Boyle, and this he heightens by the simile of a cook's spitting a brace of woodcocks. Nay, so strong is the influence of literary prejudice and fashion, that many even of Dr Bentley's friends considered Boyle's Examination as unanswerable. Nor could they be convinced of the contrary, till the Doctor, first asking them where it was so impregnable, and confuting one article after another upon the spot, as fast as they instanced, assured them it was all of the same kind. This he effectually showed in his answer. It now, however, seems to be the settled opinion of the literary world, that the Doctor has not only the evident advantage in respect of learning and argument, but that he is little, if at all, inferior to his antagonist in point of wit and smartness. It may not, however, be amiss to recite a few testimonies on the subject. Mr Walpole, speaking of Mr Boyle's translation of the Epistles of Phalaris, says, "This work occasioned the famous controversy with Dr Bentley;—who alone, and unworsted, sustained the attacks of the brightest geniuses in the learned world, and whose fame has not suffered by the wit to which it gave occasion." Mr Towers, in his British Biography, expresses himself in the following terms: "In the controversy between him and Mr Boyle, the popular clamour, indeed, was in favour of the latter; but Bentley's is unquestionably a much more valuable performance than that of Boyle. The latter, considered as a mere English composition, has the advantage in point of style; and pleased the generality, by the personal satire which it contained against Dr Bentley, who had many enemies. But Bentley had greatly the superiority with respect to just reasoning, critical sagacity, and extent of learning; and his vindication of himself also contained many shrewd and sarcastical strokes against Mr Boyle and his performance. Much has been said in favour of Mr Boyle, as a genteel and polite writer; and it must be confessed, that Dr Bentley's manner was often too assuming, and that he was deficient in point of civility. But notwithstanding this, there was, perhaps, a much greater want of real candour and politeness, whatever affectation of them there might be, in the very contemptuous and unfair manner in which Dr Bentley was treated throughout Mr Boyle's book, than in any thing which Bentley had said against Boyle. Bentley, with all his foibles, was too respectable a character to be a proper subject of such treatment: though Swift, Garth, and Pope, have joined in countenancing the popular prejudices against him." Mr Dodwell, who resided at Oxford during the controversy, who made himself in some sort a party in it, and who had a very particular court paid to him by the Christ-Church men, declared to them that he never learned so much from any book of the size in his life,

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Bentley.

life, as he had done from Dr Bentley's Answer to Boyle.

In 1696, at the public commencement, Mr Bentley had been created doctor of divinity by the university of Cambridge; and some time thereafter, admitted, *ad eundem*, in the university of Oxford.

In 1700 he was presented to the mastership of Trinity college, Cambridge, which is reckoned worth near 1000l. per annum. Upon this promotion he resigned his prebend of Worcester; and, in 1701, was collated to the archdeaconry of Ely. Being thus placed in a state of ease and affluence, he entered into matrimony, and indulged his inclination in critical pursuits; and the fruits of his labours, which he occasionally published, all displayed such erudition and sagacity, that, by degrees, he obtained the character of being the greatest critic of the age. In the mean while, however, he carried matters with so high a hand in the government of his college, that, in 1709, a complaint was brought before the bishop of Ely, as visitor, against him, by several of the fellows, who charged him with embezzling the college money, and other misdemeanors. In answer to this, he presented his defence to the bishop, which he published in 1710, under the title of *The present State of Trinity College*, 8vo; and thus began a quarrel, which was carried on with the most virulent animosity on each side, for above 20 years, when it at last ended in the Doctor's favour. In 1716, upon the death of Dr James, he was appointed regius professor of divinity in the former university; annexed to which was a good benefice in the bishopric of Ely. His majesty King George I. on a visit to the university in 1717, having, as usual, nominated by mandate several persons for a doctor's degree in divinity, our professor, to whose office it belonged to perform the ceremony called *creation*, demanded four guineas from each person, besides a broad piece of gold, and absolutely refused to create any doctor without these fees: hence there arose a long and warm dispute, during which, the doctor was first suspended, and then degraded; but on a petition to his majesty for relief from that sentence, the affair was referred to the court of King's-bench, where the proceedings against him being reversed, a mandamus was issued, charging the university to restore him. With regard to Dr Bentley's long dispute with his college, Mr Whiston represents his having been induced in a single instance, after four years of unexceptionable conduct, to recede from the excellent rule of *detur digniori*, in the election to a fellowship, as the first false step which led to others, and was very prejudicial to his own happiness. A concise and accurate account of his controversies with his college and the university, and of the publications which appeared on these occasions, may be seen in Mr Gough's anecdotes of topography. There are likewise, in the Harleian collection of manuscripts in the British Museum, N° 7523, some authentic papers, relative to the proceedings of the university against Dr Bentley. Dr Bentley was endowed with a natural hardiness of temper, which enabled him to ride out both these storms without any extraordinary disturbance, or interruption to his literary pursuits. In his private character, though he is generally allowed to have been too fond of money, he was hearty, sincere, and warm in his friendship, an affectionate husband, and a most indulgent father. He loved hospitality and respect; maintained the dignity and munificence of the ancient abbots in house-keeping at his lodge, which he beautified; and, in conversation, tempered the severity of the critic with such a peculiar strain of vivacity and pleasantry, as was very entertaining. He died at his lodge in Trinity college, on the 14th of July 1742, at 80 years of age. To his latest hour, he could read the smallest Greek Testament without spectacles; and he died of a young man's disorder, a pleuritic fever. He was of a large and robust frame of body, and of strong features. These gave a dignity, perhaps a severity, to his aspect, which probably heightened the opinion many had conceived of the haughtiness and roughness of his temper. But, in fact, he was of so tender a disposition, that he never read a touching story without tears. It was not, indeed, till after he had been afflicted with a slight paralytic stroke, that this particular effect of the softness of his nature was in every case apparent: so that it may possibly be imputed, in some degree, to his disorder. It is, however, certain that previous to that event he was endued with great tenderness and sensibility. In the contest about the visitatorial power, when he met Bishop Moore, he was so struck with seeing his old friend appear in a hostile manner against him, that he fainted away in the court.

When we consider the great abilities and uncommon erudition of which Dr Bentley was possessed, it reflects some disgrace on our country, says Dr Kippis, that even his literary reputation should be so long treated with contempt; that he should be represented as a mere verbal critic, and as a pedant without genius. The unjust light in which he was placed, was not entirely owing to the able men who opposed him in the Boylean controversy: it arose perhaps principally from the poets engaging on the same side of the question, and making him the object of their satire and ridicule. The "flashing Bentley" of Pope will be remembered and repeated by thousands who know nothing of the Doctor's real merit. Having mentioned this epithet, we shall add the candid note of the poet's right reverend editor. "This great man with all his faults, deserved to be put into better company. The following words of Cicero describe him not amiss: "*Habuit à natura genus quoddam acuminis, quod etiam arte limaverat, quod erat in reprehendis verbis versutum et solers; sed sæpe stomachosum, nonnunquam frigidum, interdum etiam facetum.*" In the fourth book of the Dunciad, Mr Pope introduces our critic at greater length, and with still greater severity. Perhaps it may be found that the asperity of Mr Pope was not entirely owing to the combination of certain wits and poets against Dr Bentley, but to personal resentment. We are told that Bishop Atterbury, having Bentley and Pope both at dinner with him, insisted on knowing what opinion the Doctor entertained of the English Homer. He for some time eluded the question; but at last, being urged to speak out, he said, "The verses are good verses; but the work is not Homer, it is Spondanus." It must indeed be acknowledged, that one cause of Dr Bentley's having enemies, was his not always bearing his faculties with sufficient meekness. He appears to have had a considerable degree of literary pride, and to have spoken of himself and others with uncommon freedom. Mr Whiston informs us of the Doctor's having

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Bentley.

ving said, "That when he himself should be dead, Wasse would be the most learned man in England." Dr Salter, who was extremely devoted to the memory of Dr Bentley, confessed that he was remarkable for his *fastus*, especially towards his equals, and for speaking highly of himself. But at the same time, he is described by Dr Salter as having been a very amiable and pleasant man in private life, and as possessing much good nature, though he had been otherwise represented. This account agrees with the most authentic information from different quarters. It is related of Dr Bentley, that he used to pull off his hat to the younger students, but would not do it to the fellows of his college. Being asked the reason for making this difference, he answered, "That the young ones might come to something; but for the others, they never could be good for any thing."

The Doctor's principal works, besides those already mentioned, were, 1. Animadversions and Remarks on the poet Callimachus. 2. Annotations on the two first Comedies of Aristophanes. 3. Emendations, &c. on the Fragment of Menander and Philemon. 4. Remarks upon Collins's discourse of freethinking. 5. Beautiful and correct editions of Horace, Terence, Phædrus, and Milton, with notes.

In 1721 he published Proposals for printing a new edition of the Greek Testament, and St Hierom's Latin version; in which edition he intended to make no use of any manuscript that was not at least 1000 years old. Upon these proposals Dr Middleton published some remarks; and the work never made its appearance. "If Dr Middleton's attack contributed to this event (Dr Kippis observes), he certainly did no little disservice to the cause of sacred literature. The completion of Dr Bentley's noble undertaking was the principal employment of the latter part of his life. He had collected and collated all the manuscripts of Europe to which access could be obtained. For this purpose, his nephew Thomas Bentley, LL. D. well known in the republic of letters, travelled through Europe at his uncle's expence. The work was of such magnitude, that he found it necessary, for the first time, to publish proposals for printing it by subscription. The whole was completed for publication; and he had received 2000l. in part of the subscription, all of which he returned to the subscribers when he took the resolution of not letting it appear in the world during his own life. The work is now in the possession of his executor Dr Richard Bentley, one of the senior fellows of Trinity College, and rector of Nailston near Ashby in Leicestershire; and it is hoped that at some future period it may yet see the light:—Other valuable remains of Dr Bentley are still in existence; some of which are in the hands of his executor, and some in those of Mr Cumberland his grandson. The latter gentleman is possessed of the Doctor's classic books, with his marginal notes. From these notes Mr Cumberland hath published an edition of Lucan; which though not perfect throughout, is full and complete with regard to the four first books. The same gentleman has a Homer of our great critic's, with many marginal notes and corrections, preparatory to an edition of it which he intended to have given. Dr Bentley's critical correspondence with his numerous literary acquaintance, which must be very instructive and entertaining, is not only preserved, but designed to be laid before the public."

Bentley ‖ Berchem.

The Doctor's publication of Milton, it is said, was owing to Queen Caroline. Her majesty represented to him, that he had printed no edition of an English classic, and urged him to undertake Milton. His notes upon this great poet have been the worst received of any of his critical performances. The learned Bishop Newton speaks of them with considerable severity, intermixed, however, with some applause.

BENZOIN, in *Materia Medica*, a concrete resinous juice, obtained from a species of styrax. See CHEMISTRY and MATERIA MEDICA *Index*.

BERMAS, a coarse cloth, all made with cotton-thread, which comes from the East Indies, and particularly from Surat.

BERAR, a province of Asia, in the British East Indian possessions, adjoining to the province of Bengal. It abounds in corn, rice, pulse, and poppies, from which last they extract opium; and sugar-canes grow almost without cultivation. One fourth of the inhabitants are Mahometans and three fourths Hindoos.

BERAUM, a royal city of Bohemia, and capital of a circle of the same name. E. Long. 14. 25. N. Lat. 50. 2.

BERAY, a town of Normandy in France, situated in W. Long. 1. 20. N. Lat. 49. 6.

BERBERIS, the BARBERRY. See BOTANY *Index*.

BERBICE, a river of Terra Firma in America, which falls into the North sea, in S. Lat. 6. 30. The district on both sides of the river has the same name, and was long a Dutch colony, but in 1814 was ceded to Britain. See BERBICE, SUPPLEMENT.

BERCARIA, BERQUERIA, or *Berkeria*, in middle-age writers, denotes a sheep-fold, sheep-cote, sheep-pen, or other enclosure, for the safe keeping a flock of sheep.—The word is abbreviated from *berbicaria*; of *berbex*, detorted from *vervex*. Hence also a shepherd was denominated *berbicarius* and *berquarius*.

BERCHEROIT, or BERKOITS, a weight used at Archangel, and in all the Russian dominions, to weigh such merchandises as are heavy and bulky. It weighs about 364lb. English avoirdupois weight.

BERCHEM, or BERGHEM, NICHOLAS, an excellent painter, was a native of Haerlem, and born in 1624. He received instructions from several very eminent masters: and it was no small addition to their fame that Berchem was their scholar. The charming pictures of cattle and figures by this admirable master are justly held in the highest estimation. He has been singularly happy in having many of them finely engraved by John Visscher, an artist of the first rank. Berchem had an easy expeditious manner of painting, and an inexpressible variety and beauty in the choice of sites for his landscapes; executing them with a surprising degree of neatness and truth. He possessed a clearness and strength of judgment, and a wonderful power and ease in expressing his ideas; and although his subjects were of the lower kind, yet his choice of nature was judicious, and he gave to every subject as much of beauty and elegance as it would admit. The leafing of his trees is exquisitely and freely touched; his skies are clear; and his clouds float lightly, as if supported by air. The distinguishing characters of the pictures of Berchem are, the breadth and just distribution

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stribution of the lights; the grandeur of his masses of light and shadow; the natural ease and simplicity in the attitudes of his figures, expressing their several characters; the just gradation of his distances; the brilliancy and harmony, as well as the transparence, of his colouring; the correctness and true perspective of his design; and the elegance of his composition: and where any of those marks are wanting, no authority ought to be sufficient to ascribe any picture to him. He painted every part of his subjects so extremely well, as to render it difficult to determine in which he excelled most; his trees, buildings, waters, rocks, hills, cattle, and figures, being all equally admirable.

BERCHETT, Peter, an eminent history painter, was born in France in 1659, and at the age of 18 was employed in the royal palaces. He came to England in 1681, to work under Rambour, a French painter of architecture; but, after staying a year, returned to Marli. He came again, and was sent by King William to the palace he was building at Loo, where he was employed 15 months; and then came a third time to England, where he had sufficient business. We are informed by Mr Walpole, that he then painted the ceiling of the chapel of Trinity college, Oxford, the staircase at the duke of Schomberg's in Pall-mall, and the summer-house at Ranelagh. His drawings in the academy were much approved. Towards the close of his life he retired to Marybone, where he painted only small pieces of fabulous history, and died there in January 1720.

BERDASH, in antiquity, was a name formerly used in England for a certain kind of neck-dress; and hence a person who made or sold such neckcloths was called a *berdasher*, from which is derived our word *haberdasher*.

BERECYNTHIA, the mother of the gods, in the Pagan theology.

BERENGARIANISM, a name given by ecclesiastical writers to the opinion of those who deny the truth and reality of the body and blood of Christ in the eucharist. The denomination took its rise from Berengarius, archdeacon and scholiasticus of the church of St Mary at Anjou about the year 1035, who maintained, that the bread and wine, even after consecration, do not become the true body and blood of our Lord, but only a figure and sign thereof.

Berengarianism was strenuously opposed by Lanfranc, Guitmond, Adelmannus, Albericus, &c. Divers synods were held, wherein the author was condemned at Rome, Versailles, Florence, Tours, &c. He retracted, and returned again more than once; signed three several Catholic confessions of faith; the first in the second council of Rome, the second in the third, and the third in the fourth council of the same city. But he still relapsed to his former opinion when the storm was over; though Mabillon maintains he soon recovered from his fourth fall, and died an orthodox Catholic in 1088.

BERENICE, daughter of Ptolemy Auletes king of Egypt, succeeded her father before his death. This banished prince implored the assistance of the Romans. Pompey restored him. Berenice, to support herself on the throne, allured a prince, whose name was Seleucus, descended from the kings of Syria, and admitted him to her nuptial bed, and to her sceptre. She was soon weary of him, and put him to death. She next cast her eye on Archelaus, who married her, and put himself at the head of her troops to repulse the Romans. He was killed in a battle. Ptolemy returned to Alexandria, and put his rebellious daughter to death.

Berenice, wife of Ptolemy Euergetes king of Egypt, cut off her hair in pursuance of a vow, and consecrated it in the temple of Venus. This deposit being afterwards lost, Connon the mathematician, in compliment to her, declared that the queen's locks had been conveyed to heaven, and composed those seven stars near the tail of the bull, called to this day *coma Berenices*.

Berenice, daughter of Costobarus and of Salome sister to Herod the Great, was married first to Aristobulus, son of the same Herod and Mariamne. He having a brother who married the daughter of Archelaus king of Cappadocia, often upbraided Berenice that he was married below himself in wedding her. Berenice related all these discourses to her mother, and exasperated her so furiously, that Salome, who had much power over Herod's mind, made him suspect Aristobulus, and was the principal cause that urged this cruel father to get rid of him. She married again; and having lost her second husband, went to Rome, and got into the favour of Augustus. But, above all, she insinuated herself into the good graces of Antonia, the wife of Drusus, which in the end proved of great service to Agrippa.

Berenice, grand-daughter of the preceding, and daughter of Agrippa I. king of Judea, has been much talked of on account of her amours. She was betrothed to one Marcus, but he died before the marriage. Soon after, she married his uncle Herod, who at the desire of Agrippa, both his brother and father-in-law, was created king of Chalcis by the emperor Claudius. She lost her husband in the eighth year of the emperor Claudius; and in her widowhood, it was rumoured she committed incest with her brother Agrippa. To put a stop to this report, she offered herself in marriage to Polemon king of Cilicia, provided he would change his religion. He accepted her offers, was circumcised, and married her. Berenice soon left him to follow her own ways, and he abandoned Judaism to return to his former religion. She was always very well with her brother Agrippa, and seconded him in the design of preventing the desolation of the Jews. She got Titus into her snares; but the murmurs of the Roman people hindering her from becoming his wife, there remained nothing for her but the title of mistress or concubine of the emperor. The French stage, in the 17th century, resounded with the amours of Titus and Berenice.

Berenice, in *Ancient Geography*, the name of several cities, particularly of a celebrated port-town in the Sinus Arabicus: Now *Suez*; which see.

Berenice's Hair, *Coma Berenices*. See Berenice.

BERE-regis, a town of Dorsetshire in England, in W. Long. 2. 15. N. Lat. 50. 40.

BERESOW, a division of the province of Tobolsk in Siberia. It is bounded on the north by the straits of Waigatz, on the east by a large bay of the Frozen ocean, which runs into the land towards the south, and at the 65th degree of latitude separates into two arms; one of which is called the *Obskaia-Guba*, or

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Oby-bay; and the other *Tazowskaia-Guba*, or the bay of *Tazow*. The river Oby empties itself into the former, and the Taz into the latter. This district was under the Russian dominion long before the other parts of Siberia were conquered, being reduced by the Czar Gabriel so early as the year 1530.

BEREWICHA, or BEREWICA, in our old writers, denotes a village or hamlet belonging to some town or manor, situated at some distance therefrom.—The word frequently occurs in Doomsday-book: *Istæ sunt berewichæ ejusdem manerii.*

BERG, a duchy of Germany, in the circle of Westphalia. It is bounded on the north by the duchy of Cleves, on the west by the county of Mark and the duchy of Westphalia, on the south by Wetteravia, and on the east by the diocese of Cologne, from which it is separated by the Rhine. It contains about 1188 square miles, with 295,000 inhabitants. It is very fruitful along the Rhine, but mountainous and woody towards the county of Mark. It was formerly subject to the elector palatine, but since 1815 has been included in the grand duchy of the Lower Rhine, which belongs to Prussia. The duchy of Berg was taken from Bavaria in 1806, and bestowed upon Murat, afterwards king of Naples. It is a populous and flourishing district. The principal rivers, besides the Rhine, are the Wipper, Agger, and Sieg.

BERG, *St Winox*, a town of the Low Countries, in the country of Flanders, fortified by Vauban, and subject to France. It is seated on the river Colme, six miles from Dunkirk, and 21 from Ypres. The air is often very unwholesome, especially to strangers. The river Colme serves instead of a canal to go to Hondshot, St Omer's, and Gravelines. There is likewise another canal to go to Dunkirk. The villages in its territory are very famous for butter and cheese, of which they send a great quantity to Flanders. Fort Lapin and Fort Suisse are within cannon shot of this place, and Fort St Francis is seated on the canal, near three miles from the town. E. Long. 2. 25. N. Lat. 50. 57.

BERG-ZABERN, a town of France, in the department of the Lower Rhine. E. Long. 7. 55. N. Lat. 49. 4.

Berg-Gruin, in *Natural History*, the name of an earth used in painting, and properly called *green okre*, though not known among the colour-men under that name. It is found in many parts of Germany, Italy, and England, commonly in the neighbourhood of copper-mines, from particles of which metal it receives its colour. In many parts of Germany, they have a purer kind of this, distinguished by no peculiar name, but separated by art from the waters draining from the copper-mines, and differing no otherwise from this native substance, than as the washed okres of Oxfordshire, &c. do from those sent us in their natural condition. The characters by which the native kind is known from other green earths, are these: it is a dense compact substance, considerably heavy, and of a pale but not disagreeable green; of a rough and uneven, but not dusty surface, and somewhat unctuous to the touch. It adheres firmly to the tongue; does not break easily between the fingers; nor at all stains the hands. It is of a brackish disagreeable taste, and does not ferment with acids.

BERGAMASCO, a province of Italy, in the Austro-Venetian territories. It is bounded on the east by the

Bressan, on the north by the Valteline, on the west and south by the Milanese. It extends about 36 leagues from north to south, and 30 from east to west. It is watered by several rivers, which render it very fertile, and particularly it produces a great number of chesnuts. It has mines of iron, and quarries of marble, and other stones of which they make millstones. There are a great number of villages, but no city except Bergamo the capital. The people are very industrious, and make the best of their natural productions. They are well stocked with cattle, and make fine tapestry. Their language is the most corrupt of any in Italy.

BERGAMO, JAMES PHILIP DE, an Augustin monk, born at Bergamo in 1434, wrote in Latin a Chronicle from the creation of the world to the year 1503, and a Treatise of Illustrious Women. He died in 1518.

BERGAMO, anciently *Bergomum*, a large and strong town of Italy, in the Venetian territory, and capital of the province of Bergamasco. It has a strong citadel, and is the see of a bishop. Its situation near the Alps makes the inhabitants subject to swellings in their throats, owing to the badness of the Alpine waters. E. Long. 9. 38. N. Lat. 45. 42.

BERGAMOT, a species of citron, produced at first casually by an Italian's grafting a citron on the stock of a bergamot pear-tree, whence the fruit produced by this union participated both of the citron-tree and the pear-tree. The fruit hath a fine taste and smell, and its essential oil is in high esteem as a perfume. The essence of bergamot is also called *essentia de cedra*. It is extracted from the yellow rind of the fruit by first cutting it in small pieces, then immediately squeezing the oil out of them into a glass vessel. This liquor is an etherial oil. A water is distilled from the peel as follows: Take the outer rind of three bergamots, a gallon of pure proof-spirit, and four pints of pure water; draw off a gallon in a balneum mariæ, then add as much of the best white sugar as will be agreeable. Or take of the essence of bergamot three drams and a half, of rectified spirit of wine three pints, of volatile sal ammoniac a dram; distil off three pints in a balneum mariæ.

BERGAMOT is also the denomination of a coarse tapestry, manufactured with flocks of silk, wool, cotton, hemp, ox, cow, or goat's hair, and supposed to be invented by the people of Bergamo in Italy.

BERGARAC, a very rich, populous, and trading town of France, seated on the river Dordogne, in E. Long. 0. 37. N. Lat. 50. 57.

BERGAS, a town of Romania, in European Turkey, and the see of a Greek archbishop. It is seated on the river Larissa, in E. Long. 27. 30. N. Lat. 41. 17.

BERGEN, anciently *Bergi*, a city of Norway, and capital of the province of Bergenhus. It is the see of a bishop, and has a strong castle and a good port. It is a large place; but is subject to fires, as being all built of wood. It is surrounded with mountains, and the inhabitants amount to 15,000. The country is generally barren; in consequence of which, most of the corn used is imported. The principal trade is in stock-fish, fir, and deal-boards. E. Long. 5. 45. N. Lat. 60. 11.

BERGEN, a town of Pomerania in Germany, and capital

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pital of the isle of Rugen, now subject to Prussia. E. Long. 13. 0. N. Lat. 54. 30.

BERGEN-OP-ZOOM, a town of the Low Countries, in Dutch Brabant, and in the marquisate of the same name. It is seated on an eminence, in the middle of a morass, about a mile and a half from the eastern branch of the Scheld, with which it has a communication by a navigable canal. The houses are well built, the market-places and squares handsome and spacious, and the place contains about 4800 inhabitants. The church before the last siege was reckoned a good building. It has a very advantageous situation on the confines of Brabant, Holland, Zealand, and Flanders. It is strong by nature as well as by art, being so secured by the morasses about it, which are formed by the river Zoom, that it was reckoned impregnable. It was, however, taken in 1747 by the French, but it is thought not without the help of treachery. The fortifications are allowed to be the masterpiece of that great engineer Cohorn. It had been twice besieged before without success. When the marquis of Spinola invested it, he was forced to raise the siege with the loss of 10,000 men; and, in 1814, an unsuccessful attempt to take it was made by a British force under Sir Thomas Graham. E. Long. 4. 15. N. Lat. 51. 30.

BERGHEM. See BERCHEM.

BERGHMONT, an assembly or court held upon a hill in Derbyshire, for deciding controversies among the miners.

BERGMAN, SIR TORBERN, a celebrated chemist and natural philosopher, was born in the year 1735 at Catharineberg in Westgothland. His father was receiver-general of the finances, and had destined him to the same employment; but nature had designed him for the sciences. To them he perceived an irresistible inclination from his earliest years, and nature proved more powerful than the will of his friends. His first studies were confined to mathematics and physics: and the efforts that were made to divert him from science having proved ineffectual, he was sent to Upsal, with permission to follow the bent of his inclination. Linnæus at that time filled the whole kingdom with his fame. Instigated by his example, the Swedish youth flocked around him: and accomplished disciples leaving his school, carried the name and the system of their master to the most distant parts of the globe. Bergman was struck with the splendour of his renown; he attached himself to the man whose merit had procured it, and by whom he was very soon distinguished. He applied himself at first to the study of insects, and made several ingenious researches into their history; among others into that of the genus of *tenthredo*, so often and so cruelly preyed on by the larvæ of the ichneumons, that nestle in their bowels and devour them. He discovered that the leech was oviparous; and that the coccus aquaticus is the egg of this animal, from whence issue ten or twelve young. Linnæus, who had at first denied this fact, was struck with astonishment when he saw it proved. *Vidi et obstupui!* were the words he pronounced, and which he wrote at the foot of the memoir when he gave it his sanction. Mr Bergman soon distinguished himself as an astronomer, naturalist, and geometrician; but these are not the titles by which he acquired his fame. The chair of chemistry and mineralogy, which had been filled by the celebrated Wallerius, becoming vacant by his resignation, Mr Bergman was among the number of the competitors: and without having before this period discovered any particular attention to chemistry, he published a memoir on the preparation of alum that astonished his friends as well as his adversaries. Nobody was able to conceive how in so short a time he could have made a course of experiments so complete, on a subject so new to him. His dissertation was warmly attacked in the periodical publications, and Wallerius himself criticised without reserve. But in the midst of so many enemies, he possessed a firm friend. The prince Gustavus, now king of Sweden, and then chancellor of the university, took cognizance of the affair. After having consulted two persons, the most able to give him advice, and whose testimony went in favour of Bergman, he addressed a memorial, written with his own hand, in answer to all the grievances alleged against the candidate, to the consistory of the university and to the senate, who confirmed the wishes of his Royal Highness.

Mr Bergman had now a hard duty to fulfil: he had to satisfy the hopes that were conceived of him; to fill the place of Wallerius; and to put envy to silence. He did not follow the common track in the study of chemistry. As he had received the lessons of no master, he was tainted with the prejudices of no school. Accustomed to precision, and having no time to lose, he applied himself to experiments without paying any attention to theories: he repeated those often which he considered as the most important and instructive, and reduced them to method; an improvement till then unknown. He first introduced into chemistry the process by analysis, which ought to be applied to every science; for there should be but one method of teaching and learning, as there is but one of judging well. These views have been laid down by Mr Bergman in an excellent discourse, which contains, if we may say so, his profession of faith in what relates to the sciences. It is here that he displays himself without disguise to his reader; and here it is of importance to study him with attention. The productions of volcanoes had never been analyzed when Messrs Ferber and Troil brought a rich collection of these into Sweden. At the sight of them Mr Bergman conceived the design of investigating their nature. He examined first of all the matters least altered by the fire, and the forms of which were still to be discerned: he followed them in their changes progressively; he determined, he imitated their more complicated appearances; he knew the effects which would result from the mixture and decomposition of the saline substances which are found abundantly in these productions. He discovered such as were formed in the humid way; and then in his laboratory he observed the process of nature; that combat of flames and explosions; that chaos in which the elements seem to clash and to confound one another, unveiled themselves to his eyes. He saw the fire of volcanoes kindled in the midst of pyritical combinations, and sea-salt decomposed by clays; he saw fixed air disengaged from calcined calcareous stones, spreading upon the surface of the earth, and filling caverns in which flame and animal life are equally extinguished; he saw the sulphureous acid thrown out in waves, convert itself into the vitriolic by mere contact with the air; and distilling through the rocks, form the alum veins of the Solfatara. He saw the bitumens as they melted; the inflammable and sulphureous airs exhaling; and the waters become mineral and impregnated with the fire and vapours of these stupendous furnaces, preparing for the beings that move and dispute on the crust of the abyss, a remedy for pain and a balsam for disease.

The continual application which Mr Bergman bestowed on his studies having affected his health, he was advised to interrupt them if he wished to prolong his life: but he found happiness only in study, and wished not to forfeit his title to reputation by a few years more of inactivity and languor. He exhausted his strength, and died in the month of June in the year 1784. The university of Upsal paid the most distinguished honours to his memory; and the academy of Stockholm consecrated to him a medal to perpetuate the regret of all the learned in Europe for his loss. His Physical and Chemical Essays have been collected and translated by Dr Edmund Cullen, and published in 2 vols. 8vo.

BERGOMUM, in *Ancient Geography*, a town of the Transpadana, built by the Gauls on their incursions into Italy. Now called *Bergamo*, in the territory of Venice. E. Long. 10. N. Lat. 45. 40.

BERIA, BERIE, *Berry*, signifies a large open field; and those cities and towns in England which end with that word are built on plain and open places, and do not derive their names from boroughs as Sir Henry Spelman imagines. Most of our glossographers in the names of places have confounded the word *berie* with that of *bury* and *borough*, as if the appellative of ancient towns: whereas the true sense of the word *berie*, is a flat wide champaign, as is proved from sufficient authorities by the learned Du Fresne, who observes that *Beria Sancti Edmundi*, mentioned by Mat. Paris. sub ann. 1174, is not to be taken for the town, but for the adjoining plain. To this may be added, that many flat and wide meads, and other open grounds, are called by the name of *beries* and *bery-fields*; the spacious meadow between Oxford and Islay was in the reign of King Athelstan called *Bery;* as is now the largest pasture-ground in Quarendon in the county of Buckingham, known by the name of *Beryfield.* And though these meads have been interpreted demesne or manor meadows, yet they were truly any flat or open meadows that lay adjoining to any villa or farm.

BERING, SINUS, of Copenhagen, a Latin lyric poet, flourished about 1560.

BERING'S STRAITS, the name of that narrow division of the old and new world, where the distance between Asia and America is only 13 leagues. They are so named from Captain Vitus Bering, a Dane by birth, and employed on the same plan of discovery in these parts as our great countryman Cook was in the late voyage. He was in the service of Peter the Great: who, by the strength of an extensive genius, conceiving an opinion of the vicinity of America to his Asiatic dominions, laid down a plan of discovery worthy of so extraordinary a monarch, but died before the attempt was begun; but his spirit survived in his successor. Bering, after a tedious and fatiguing journey through the wilds of Siberia, arrived in Kamtschatka, attended with the scanty materials for his voyage, the greatest part of which he was obliged to bring with him through a thousand difficulties. He sailed from the river of Kamtschatka on July 15. 1728; and on the 15th of August saw Serdze Kamen, or the heart-shaped rock, a name bestowed on it by the first discoverer.—From Serdze Kamen, to a promontory named by Captain Cook *East Cape*, the land trends south-east. The last is a circular peninsula of high cliffs, projecting far into the sea due east, and joined to the land by a long and very narrow isthmus, in lat. 66. 6. This is the Tschutski Noss of our navigators, and forms the beginning of the narrow straits or division of the old and new world. The distance between Asia and America in this place, as already mentioned, is only 13 leagues. The country about the cape, and to the north-west of it, was inhabited. About mid-channel are two small islands, named by the Russians the *isles of St Diomedes;* neither of them above three or four leagues in circuit. It is extremely extraordinary that Bering should have sailed through this confined passage, and yet that the object of his mission should have escaped him. His misfortune could only be attributed to the foggy weather, which he must have met with in a region notorious for mists; for he says that he saw land neither to the north nor to the east. Our generous commander, determined to give him every honour his merit could claim, has dignified these with the name of *Bering's Straits.* The depth of these straits is from 12 to 29 or 30 fathoms. The greatest depth is in the middle, which has a slimy bottom; the shallowest parts are near each shore, which consist of sand mixed with bones and shells. The current or tide was very inconsiderable, and what there was came from the west. From East Cape the land trends south by west. In lat. 65. 36. is the bay in which Captain Cook had the interview with Tschutski. Immediately beyond is the bay of St Laurence, about five leagues broad in the entrance and four deep, bounded at the bottom by high land. A little beyond is a large bay, either bounded by low land at the bottom, or so extensive as to have the end invisible. To the south of this are two other bays; and in N. Lat. 64. 13. Long. 186. 36. is the extreme southern point of the land of the Tschutski. This formerly was called the *Anadirskoi Noss.* Near it Bering had conversation with eight men, who came off to him in a *baidar* or boat covered with the skins of seals; from which Bering and others have named it the *Tschutski Noss.*

BERITH, a simple mentioned in Scripture, used for cleansing or taking out spots (Jer. ii. 22.). Some will have it to be the *kali* or salt-wort, from the ashes of which soap is made; and in our version it is rendered *soap:* others, after Rudbeck, made it to be the dye of the purple fish.

BERKELEY, GEORGE, the celebrated bishop of Cloyne, was the eldest son of William Berkeley, Esq. of Thomastown in the county of Kilkenny; a cadet of the family of Earl Berkeley of Berkeley castle. At eight years of age he was sent to the school of the Ormond foundation at Kilkenny, from which Swift had a few years before been removed to the university. Before Berkeley had attained his fourteenth year he was admitted a pensioner in Trinity college, Dublin, in which whilst B. A. he obtained a fellowship. Some of

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Berkeley. of his first essays as a writer were published in the Spectator and Guardian, which entertaining works he adorned with many pieces in favour of virtue and religion. His learning and his virtues, his wit and agreeable conversation, made his friendship sought and his acquaintance cultivated by many great and learned men: and among others by the earl of Peterborough, Dr Swift, Dr Arbuthnot, Mr Pope, and Mr Addison. The earl took him as chaplain and secretary of embassy into Italy; and during his absence on that occasion he became senior fellow of his college, and was in 1717 created D. D. by *diploma*.

Upon his return, his acquaintance among the great was considerably extended; and Lord Burlington, who at Rome had conceived for him a high esteem on account of his skill in architecture, obtained for him, through the duke of Grafton, then (1721) lord-lieutenant of Ireland, the king's grant of the deanery of Down, worth 200ol. per annum. Such however was the narrow system of politics at that time prevalent in the Irish cabinet, that though his majesty had actually signed the grant, the lords justices recommended *back* for the deanery of Down Swift's Dean *Daniel*, celebrated for having in a state sermon styled Pompey an *unfortunate gentleman*: and such was Dr Berkeley's humility and mildness of temper, that he could not be prevailed upon to dispute the matter, or even to expostulate on the subject. His patron Lord Burlington procured for him afterwards (1724) the deanery of Derry, the next best in Ireland to that of Down; and upon this preferment the Doctor resigned his fellowship.

In the year 1722 his fortune received a considerable increase from an event by him very unexpected. Upon his first going to London (1717) he sent one morning a note to Swift, desiring that they might dine together that day at a tavern. The dean of St Patrick's returned for answer, that they might enjoy one another's company at their ease where he himself was engaged to dine, with the family of Mrs Esther Vanhomrigh (the celebrated Vanessa); and thither he took Mr Berkeley. Some years before her death this lady removed to Ireland, and fixed her residence at Cell-bridge, a pleasant village in the neighbourhood of Dublin, most probably with a view of frequently enjoying the company of a man for whom she had conceived a very singular attachment. But finding herself totally disappointed in that expectation, she altered her intention of making the dean of St Patrick's her heir, and left the whole of her fortune (8000l.) to be divided equally between her near relation Judge Marshal of the common pleas in Ireland, and Dr Berkeley, whom she had never seen but once in her life, and that at the distance of nine years.

In the interval between Dr Berkeley's return from abroad and his preferment to the deanery of Derry, his mind had been employed in conceiving a noble and benevolent plan for the better supplying of the churches in our foreign plantations, and for converting the savage Americans to Christianity, by erecting a college in the Summer Islands. To this proposal the address and abilities of its author procured, after a tedious attendance on the great, an apparently successful reception; for he obtained a charter for its foundation, together with a parliamentary grant of 20,000l. for carrying it into execution, to which were added several large subscriptions from individuals, to be paid as soon as the public bounty should be received. Upon the faith of this, our philosopher embarked for America; where he became so generally and so justly venerated by all descriptions of men, that each vied with the other which should most honour him. The queen, with whom he was a favourite, had endeavoured to dissuade him from this enterprise, by offering him her interest for an English bishopric; but he replied, that he should prefer the headship of St Paul's college at Bermuda to the primacy of all England. From that headship he was to enjoy a revenue of 100l. per annum: and was bound by his charter to resign his deanery, then worth 1100l. per annum, within a year and a half after the 20,000l. should be paid by government. That sum was never paid; and after two years residence on Rhode Island and its neighbouring continent, during which time every interest of piety and virtue was near to his heart and cultivated by his labours, the dean was obliged to return to Europe, and abandon one of the noblest designs that had ever entered into the human heart to form.

In August 1728, immediately before his departure for America, he entered into marriage with Anne, the eldest daughter of the right honourable John Forster, Esq. speaker of the Irish house of commons; which lady died in 1785. In May 1734 he was consecrated bishop of Cloyne, and vacated his deanery. On that occasion he said to his few intimates, "I will never accept of a translation." At Cloyne he distinguished himself by pastoral vigilance, prelatical hospitality, and constant residence. Through the whole of his clerical life, he was, while his health permitted, a constant and an extemporaneous preacher; nor is it known that he ever reduced a single sermon to writing, except one preached before the society for propagating the gospel in foreign parts, which at their request was published. He endeared himself to the people of his diocese by promoting at once their temporal and their spiritual happiness. He endeavoured by all means to raise a spirit of industry, and to propagate the arts of cultivation and agriculture in that neglected country; and it may be truly said, that never man laboured more earnestly to amass a fortune or to aggrandize a family, than he did to promote the best interests of mankind, considered either as citizens on earth or as candidates for heaven.

The earl of Chesterfield, who had never seen him but once, and that when they were both young men, on being made lord lieutenant of Ireland sent to him a most respectful offer of the then vacant see of Clogher, of more than double the value of Cloyne, promising at the same time his recommendation to any other richer see that might be vacated during his administration. But the good bishop declined the generous offer, requesting the lord lieutenant not to think of him on any other vacancy, as he was resolved never to quit his first bishoprick for any other. In 1751, finding the infirmities of age come upon him, and wishing to retire from the care of his diocese to superintend the education of his son (then nominated a student of Christ-church, and now prebendary of Canterbury), that the revenues of the church might not be misapplied, nor the interests of religion suffer by the absence of the pastor from his

his flock, he made great interest for leave to resign his bishopric, of which the income was then not less than 1700l. per annum. Failing of success in this application, he let the lands of his demesne at Cloyne, on very easy terms, at the rent of 200l. which he directed to be distributed annually among the poor house-keepers of Cloyne, Youghall, and Aghadda, until his return.

At Oxford he lived highly respected by the learned members of that great university, till the hand of Providence unexpectedly deprived them of the pleasure and advantage derived from his residence among them. On Sunday evening, January 14th 1753, as he was sitting in the midst of his family, and just after he had concluded an extemporaneous comment on the 15th chapter of 1 Cor. he was instantly translated, without a groan, from earth to heaven. A polypus in the heart was the cause of his dissolution. About a minute before his death he had seated himself on a couch and turned his face towards the wall; and had he not ceased speaking *in the middle of a sentence*, his lady and his son would not immediately have discovered their loss. His remains were, with much funeral solemnity, interred at Christ-church, his friend Bishop Conybeare, then dean of that cathedral, performing the last service. An elegant marble monument, with a spirited inscription by the present archbishop of York, marks the spot where his ashes rest. As to his person, he was of the tall middle size; his countenance was very handsome, and full of meaning and benignity; and his bodily strength was uncommonly great, even to the last year of his life: but he was subject to grievous nervous colics, in which he thought tar-water gave him more efficacious relief than any other medicine. Mr Pope sums up his character in one line. After mentioning some particular virtues which characterized other prelates then living, he ascribes

To Berkeley ev'ry virtue under heav'n.

An admirable description is given of him in the following anecdote. Bishop Atterbury, having heard much of Mr Berkeley, wished to see him. Accordingly he was one day introduced to that prelate by the earl of Berkeley. After some time, Mr Berkeley quitted the room: on which Lord Berkeley said to the bishop, "Does my cousin answer your lordship's expectations?" The bishop, lifting up his hands in astonishment, replied, "So much understanding, so much knowledge, so much innocence, and such humility, I did not think had been the portion of any but angels, till I saw this gentleman." His knowledge is said to have been extended to the minutest objects, and included the arts and business of common life. Thus Dr Blackwell, in his Memoirs of the court of Augustus, having made an observation, "that the ingenious mechanic, the workers in stone and metal, and improvers in trade, agriculture, and navigation, ought to be searched out and conversed with no less than the professors of speculative science," adds the following eulogium on our prelate: "In this respect I would with pleasure do justice to the memory of a very great though singular sort of a man, Dr Berkeley, better known as a philosopher and intended founder of an university in the Bermudas or Summer Islands, than as bishop of Cloyne in Ireland. An inclination to carry me out on that expedition, as one of the young professors on his new foundation, having brought us often together, I scarce remember to have conversed with him on that art, liberal or mechanic, of which he knew not more than the ordinary practitioners. With the widest views, he descended into a minute detail, and grudged neither pains nor expence for the means of information. He travelled through a great part of Sicily on foot; clambered over the mountains and crept into the caverns, to investigate its natural history, and discover the cause of its volcanoes: and I have known him sit for hours in forgeries and founderies to inspect their successive operations. I enter not into his peculiarities either religious or personal: but admire the extensive genius of the man, and think it a loss to the western world that his noble and exalted plan of an American university was not carried into execution. Many such spirits in our country would quickly make learning wear another face."

He published many ingenious works, particularly, "An essay towards a new theory of vision:" "The principles of human knowledge;" the singular notions in which gave rise to much controversy: "Alciphron, or the minute philosopher:" one of the most elegant and genteel defences of that religion which he was born to vindicate both by his virtues and his ingenuity: "The Analyst;" in which he endeavours to show that Sir Isaac Newton's doctrine of fluxions is more incomprehensible than any mystery in the Christian religion: "The Querist;" in which the true interests of Ireland are pointed out in a very striking light: and "Siris, or a treatise on tar-water," which, under his sanction, became for a while a very popular medicine. In the Gentleman's Magazine for January 1777, it is said that the adventures of Signior Gaudentio di Lucca have been generally attributed to Bishop Berkeley; but we have the best authority to say that they were not the offspring of his pen. The bishop never saw the work till it was put into his hands by his son; and when he read it, he expressed no small contempt for the style of a writer who describes his hero as a *tall, clean-made gentleman;* though he owned his fancy to be often brilliant. We believe the adventures of Gaudentio di Lucca were written by a Romish priest for his amusement when a prisoner in the Tower of London.

BERKSHIRE, is an inland county of England, which contained the whole of that British principality inhabited by the Atrebatii, who are supposed to have been originally from Gaul. When Constantine divided the island into Roman provinces in 310, this principality was included in Britannia Prima, the first division, whose boundaries were the English channel on the south, and the Thames and Severn on the north. On the Romans quitting the island, and civil dissensions enabling the Saxons to establish the Heptarchy, this part of the country was included in the kingdom of the West Saxons, which commenced in 519, and continued till 828, when it became the only remaining sovereignty, having conquered all the others, and they were incorporated by the name of England, under Egbert; whose grandson, Alfred, a native of Wantage, in this county, in 889 divided his kingdom into counties, hundreds, and parishes, and at this time this division first received its appellation of Berkshire, or Berocshire. At present it is in the Oxford circuit, the province

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Berkshire province of Canterbury, and diocese of Salisbury. The general shape of it somewhat resembles the form of a slipper or sandal. It is 42 miles long, 28 broad, about 137 in circumference, and contains an area of 438,977 acres, or by other accounts, 476,170. It is situated north-west of London; has 140 parishes, 62 vicarages, 12 market towns but no city, 671 villages; is divided into 20 hundreds; sends nine members to parliament, two for the county, two for Windsor, two for Reading, two for Wallingford, and one for Abingdon; and pays 10 parts of the proportion of the land-tax. In 1811 the number of houses was 22,104, and the whole population 118,277. Its principal river is the Thames. It also has the Kennet, great part of which is navigable; the Loddon, the Ocke, and the Lambourne, a small stream, which, contrary to all other rivers, is always highest in summer, and shrinks gradually as winter approaches. The air of this county is healthy even in the vales; and though the soil is not the most fertile, yet it is remarkably pleasant. It is well stored with timber, particularly oak and beech, and produces great plenty of wheat and barley. Its principal manufactures are woollen cloth, sail-cloth, and malt.

Its market towns are Abingdon, Faringdon, Hungerford, East Ilsley, Lower Lambourne, Maidenhead, Newbury, Ockingham, Reading, Wallingford, Wantage, and Windsor, remarkable for its royal castle, as the county is for White horse-hill, near Lambourne, where is the rude figure of a horse, which takes up near an acre of ground on the side of a green hill, said to have been made by Alfred in the reign of his brother Ethelred, as a monument to perpetuate a victory over the Danes in 872, at Ashdown, now Ashburg-Park.

The Roman Watling-street, from Dunstable, enters Berkshire, at the village of Streatley, between Wallingford and Reading, and crossing this county proceeds to Marlborough. Another Roman road from Hampshire enters this county, leads to Reading and Newbury, the Spinæ of Camden, where it divides: one branch extends to Marlborough in Wilts, and the other to Cirencester in Gloucestershire. A branch from the Icknield-street proceeds from Wallingford to Wantage.

There is a Roman camp near Wantage on the brow of a hill, of a quadrangular form; there are other remains of encampments at East-Hampstead, near Ockingham, near White-horse-hill, near Pusey, and upon Sinodun-hill, near Wallingford. At Lawrence Waltham is a Roman fort, and near Denchworth is Cherbury castle, a fortress of Canute. Ussington castle, near White-horse hill, is supposed to be Danish; and near it is Dragon-hill, supposed to be the burying-place of Uter Pendragon, a British prince. Near White-horse hill are the remains of a funeral monument of a Danish chief slain at Ashdown by Alfred. In this county the following antiquities are worthy the notice of travellers: Abingdon church and abbey: Aldworth castle, near East Ilsley; Bysham monastery; Dunnington castle; Lambourne church; Reading abbey; Sunning chapel; Wallingford church and castle. Windsor castle beggars all description for situation, &c. Berkshire is an earldom belonging to a branch of the Howard family, the representative being earl of Suffolk and Berkshire. See BERKSHIRE, SUPPLEMENT.

Berlin. BERLIN, a city of Germany, capital of the electorate of Brandenburg, and of the whole Prussian dominions, seated in E. Long. 13. 37. N. Lat. 52. 53. This city is one of the largest, best built, and best governed, of any in Germany. The streets are large, straight, clean, and well paved, and some of them very long and elegant. There are also several large and beautiful squares, with pleasant walks. It is surrounded with handsome gardens, which produce excellent fruit. The river Spree, that crosses the city, has a communication with the Havel Oder, and Elbe, which greatly facilitate commerce. The French refugees have greatly contributed to the embellishment of Berlin, by introducing various manufactures and arts. It contained 153,000 inhabitants in 1803.

Berlin is divided into five parts, without reckoning the suburbs, which are very large. The houses in these last are almost all of wood; but so well plastered, that they seem to be of stone. In the suburb called *Spandau*, is a house belonging to the royal family, with well contrived apartments, and furnished in a very fine taste. In the suburb of Stralau is a house and garden belonging to the king. The royal gate of the city is defended by a half moon, and two bastions, covered with brick; it fronts the royal street, which is one of the longest and most frequented in the city. It contains very handsome houses, particularly those belonging to some of the ministers of state.

The royal street is crossed by five others, which are large and fine. On the new bridge, which is of stone, over the Spree, is an equestrian statue of William the Great, which is esteemed an excellent piece of workmanship. The elector is represented in a Roman habit, and his horse stands on a pedestal of white marble adorned with basso relievos, and four slaves bound to the base.

After this bridge is past, the king's palace appears, which is a grand and superb edifice; it is four stories high, and the apartments are extremely magnificent. No palace in Europe has such a great quantity of silver tables, stands, lustres, branched candlesticks, &c. In the knights hall there is a buffet, which takes up all one side, where there are basons and cisterns of gilt silver, of extraordinary magnitude. The furniture of the great apartment is extremely rich; and there is a very handsome gallery, adorned with paintings, representing the principal actions of Frederick I. Formerly there were fine gardens to the palace, but they are now turned into a place of arms. The king's stables are large, stand near the palace, and front the great street. Externally they make a Gothic appearance, but within they are very magnificent. The mangers are of stone, and the pillars that divide the stalls are of iron, adorned with the king's cypher, gilt. Over the racks are pictures representing the finest horses which the king's stud has produced. Over the stables there are large rooms, containing all sorts of horse furniture, particularly the horse-equipage of Frederick I. all the metallic part of which is gold, set with diamonds. Besides these, there are handsome lodgings for the officers of the stables. Over the riding-house is a theatre, where plays have been acted, and balls have been made for the entertainment of the court,

The arsenal consists of four grand buildings, that form a court in the middle, like a college: each front has

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has three large porticoes. On the principal gate is a medallion of Frederick II. in bronze; and the four cardinal virtues, of a colossal stature, placed on pedestals on each side of the portico, seem to look at the portrait of the king, which is supported by Fame and Victory. The Corinthian order is prevalent in the first stage, and is managed with a great deal of art. The whole edifice is surrounded in the upper part with a balustrade, adorned with trophies and statues, among which is Mars seated on a heap of several sorts of arms. This altogether forms a noble and majestic decoration. It is bounded with iron in the shape of cannon, which are placed at proper distances, and support iron chains that hang like festoons, to prevent passengers from approaching the windows below. The lower rooms are filled with a great number of brass cannon; the walls and pillars which sustain the floor are set off with cuirasses and helmets. The upper story contains several rooms filled with arms, which are disposed in a curious order. Behind the arsenal is the house of the general of the artillery, which includes the foundery, where they are continually at work. Besides this, there are other places where they keep the train of artillery.

The opera-house is an elegant modern edifice. The front has a noble portico supported by Corinthian columns, and a pediment adorned with basso relievos and statues. The columns that support the roof throw the whole into a grand saloon. It has three galleries, and is said to be capable of containing 2000 persons.

A rampart and fosse separate Worder from Dorothea Stadt, or the New Town, inhabited chiefly by French. There are seven great alleys or walks, which divide this quarter into two parts. The middle walk is broader than the rest, and is surrounded with balustrades, having a grass-plot in the middle: this is for persons that take the air on foot. The alleys on each side are paved, and serve for those that come abroad in coaches. These alleys, which are about three miles in length, are terminated with a bar, that leads towards the park. The alleys with trees are bounded by rows of houses. In one of these is a building, formerly called the *lesser stables*, and now made into lodgings for the guards. The apartments above these are occupied by the academy of painting and the academy of arts and sciences. Behind these is the observatory, where there is a great number of astronomical and mathematical intruments.

There are other things worthy of observation, such as the cabinet of medals, and of the antiquities belonging to the king; that of natural curiosities; the chemical laboratory, and its furnaces and medals, of a new invention: the theatre for anatomical demonstrations; the royal library, which is one of the completest in Germany, and has many scarce books and manuscripts.

The city was taken in 1760 by an army of Russians, Austrians, Saxons, &c. who entered on the 9th of October. They totally destroyed the magazines, arsenals, and founderies, seized an immense quantity of military stores, and a number of cannon and arms; called first for the immediate payment of 800,000 guilders, and then laid on a contribution of 1,900,000 German crowns: not satisfied with this, many irregularities were committed by the soldiery; but, on the whole, though some shocking actions were committed, a far more exact discipline was observed than from such troops could have been expected upon such an occasion, where there was every incentive which could work upon the license of a conquering army. Their officers no doubt with great difficulty preserved even that degree of order.

But though their behaviour was tolerable with regard to the private inhabitants, there was something shocking and ungenerous in their treatment of the king's palaces. The apartments of the royal castle of Charlottenburg were entirely plundered, the precious furniture spoiled, the pictures defaced, without even sparing the antique statues collected by Cardinal Polignac, which had been purchased by the house of Brandenburg. The castle of Schonhausen, belonging to the queen, and that of Fredericsfeld, belonging to the Margrave Charles, were also plundered.

The palace of Potsdam, the famous Sans-souci, had a better fate; Prince Esterhazi commanded there, and it was preserved from the smallest violation. The prince, on viewing the palace, only asked which picture of the king resembled him most; and being informed, desired that he might have leave to take it, together with two German flutes which the king used, to keep them, he said, in memory of his majesty. This was a sort of taking very different from pillage.

They staid in the city four days: but hearing that the king, apprehensive of this stroke, was moving to the relief of his capital, they quitted it on the 13th of October; and having wasted the whole country round for a vast extent, and driven away all the cattle and horses they could find, retreated by different routes out of Brandenburg.

Berlin, a sort of vehicle, of the chariot kind; taking its name from the city of Berlin, in Germany: though some attribute the invention of it to the Italians, and derive the word from *berlina*, a name given by them to a sort of stage, whereon persons are exposed to public shame. The berlin is a very convenient machine to travel in, being lighter, and less apt to be overturned, than a chariot. The body of it is hung high, on shafts, by leathern braces; there being a kind of stirrup, or footstool, for the conveniency of getting into it: instead of side-windows, some have screens to let down in bad, and draw up in good, weather.

BERME, in *Fortification*, a space of ground left at the foot of the rampart, on the side next the country, designed to receive the ruins of the rampart, and prevent their filling up the fosse. It is sometimes palisadoed, for the more security; and in Holland it is generally planted with a quickset hedge. It is also called *lisiere*, *relais*, *foreland*, *retrait*, *pais de souris*, &c.

BERMUDAS, or Summer-islands, a cluster of small islands in the Atlantic ocean, lying almost in the form of a shepherd's crook, in W. Long. 65. N. Lat. 32. 30. between 200 and 300 leagues distant from the nearest place of the continent of America, or any of the other West-India islands. The whole number of the Bermudas islands is said to be about 400, but very few of them are habitable. The principal is St George's, which is not above 16 miles long, and three at most in breadth. It is universally agreed, that the nature of this and the other Bermudas islands has undergone a surprising alteration for the worse since they were first discovered;

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Bermudas. covered; the air being much more inclement, and the soil much more barren than formerly. This is ascribed to the cutting down those fine spreading cedar trees for which the islands were famous, and which sheltered them from the blasts of the north wind, at the same time that it protected the undergrowth of the delicate plants and herbs. In short, the Summer islands are now far from being desirable spots; and their natural productions are but just sufficient for the support of the inhabitants, who, chiefly for that reason, perhaps, are temperate and lively even to a proverb. At first tobacco was raised upon these islands; but being of worse quality than that growing on the continent, the trade is now almost at an end. Large quantities of ambergris were also originally found upon the coasts, and afforded a valuable commerce; but that trade is also reduced, as likewise their whale trade, though the perquisites upon the latter form part of the governor's revenue, he having 10l. for every whale that is caught. The Bermudas islands, however, might still produce some valuable commodities, were they properly cultivated. There is here found, about three or four feet below the surface, a white chalk stone which is easily chisseled, and is exported for building gentlemen's houses in the West Indies. Their palmetto leaves, if properly manufactured, might turn to excellent account in making women's hats; and their oranges are still valuable. Their soil is also said to be excellent for the cultivation of vines, and it has been thought that silk and cochineal might be produced; but none of these things have yet been attempted. The chief resource of the inhabitants for subsistence is in the remains of their cedar wood, of which they fabricate small sloops, with the assistance of the New England pine, and sell many of them to the American colonies, where they are much admired. Their turtle-catching trade is also of service; and they are still able to rear great variety of tame-fowl, and have wild ones abounding in vast plenty. All the attempts to establish a regular whale fishery on these islands have hitherto proved unsuccessful; they have no cattle, and even the black hog breed, which was probably left by the Spaniards, is greatly decreased. The water on the islands, except that which falls from the clouds, is brackish; and at present the same diseases reign there as in the Caribbee islands. They have seldom any snow, or even much rain: but when it does fall, it is generally with great violence, and the north or north-east wind renders the air very cold. The storms generally come with the new moon; and if there is a halo or circle about it, it is a sure sign of a tempest, which is generally attended with dreadful thunder and lightning. The inhabited parts of the Bermudas islands are divided into nine districts called *tribes*. 1. St George. 2. Hamilton. 3. Ireland. 4. Devonshire. 5. Pembroke. 6. Pagets. 7. Warwick. 8. Southampton. 9. Sandys. There are but two places on the large island where a ship can safely come near the shore, and these are so well covered with high rocks that few will choose to enter in without a pilot; and they are so well defended by forts, that they have no occasion to dread an enemy. St George's town is at the bottom of the principal haven; and is defended by nine forts, on which are mounted 70 pieces of cannon that command the entrance. The town has a handsome church, a fine library, and a noble town-house, where the governor, council, &c. assemble. Besides these there are about 1000 houses well built. The tribes of Southampton and Devonshire have each a parish-church and library, and the former has a harbour of the same name; there are also scattered houses and hamlets over many of the islands, where particular plantations require them. The inhabitants are clothed chiefly with British manufactures, and all their implements for tilling the ground and building are made in Britain.

It is uncertain who were the first discoverers of the Bermudas islands. John Bermudas a Spaniard is commonly said to have discovered them in 1527; but this is disputed, and the discovery attributed to Henry May an Englishman. As the islands were without the reach of the Indian navigation, the Bermudas were absolutely uninhabited when first discovered by the Europeans. May above mentioned was shipwrecked upon St George's; and with the cedar which they felled there, assisted by the wreck of their own ship, he and his companions built another which carried them to Europe, where they published their accounts of the islands. When Lord Delaware was governor of Virginia, Sir Thomas Gates, Sir George Summers, and Captain Newport, were appointed to be his deputy-governors; but their ship being separated by a storm from the rest of the squadron, was in the year 1609 wrecked on the Bermudas, and the governors disagreeing among themselves, built each of them a new ship of the cedar they found there, in which they severally sailed to Virginia. On their arrival there, the colony was in such distress, that Lord Delaware, upon the report which his deputy-governors made him of the plenty they found at the Bermudas, despatched Sir George Summers to bring provisions from thence to Virginia in the same ship which brought him from Bermudas, and which had not one ounce of iron about it, except one bolt in the keel. Sir George, after a tedious voyage, at last reached the place of his destination, where, soon after his arrival, he died, leaving his name to the islands, and his orders to the crew to return with black hogs to the colony of Virginia. This part of his will, however, the sailors did not choose to execute; but setting sail in their cedar ship for England, landed safely at Whitechurch in Dorsetshire.

Notwithstanding this dereliction of the island, however, it was not without English inhabitants. Two sailors, Carter and Waters, being apprehensive of punishment for their crimes, had secreted themselves from their fellows when Sir George was wrecked upon the island, and had ever since lived upon the natural productions of the soil. Upon the second arrival of Sir George, they enticed one Chard to remain with them; but differing about the sovereignty of the island, Chard and Waters were on the point of cutting one anothers throats, when they were prevented by the prudence of Carter. Soon after, they had the good fortune to find a great piece of ambergris weighing about 80 pounds, besides other pieces, which in those days were sufficient, if properly disposed of, to have made each of them master of a large estate. Where they were, this ambergris was useless; and therefore they came to the desperate resolution of carrying themselves and it in an open boat to Virginia or to Newfoundland, where they hoped to dispose of their treasure to advantage. In the mean time, however, the

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Bermudas. Virginia Company claimed the property of the Bermudas islands; and accordingly sold it to 120 persons of their own society, who obtained a charter from King James for their possessing it. This New Bermudas Company, as it was called, fitted out a ship with 60 planters on board to settle on the Bermudas, under the command of one Mr Richard Moor, by profession a carpenter. The new colony arrived upon the island just at the time the three sailors were about to depart with their ambergris; which Moor having discovered, he immediately seized and disposed of it for the benefit of the company. So valuable a booty gave vast spirit to the new company; and the adventurers settled themselves upon St George's island, where they raised cabins. As to Mr Moor, he was indefatigable in his duty, and carried on the fortifying and planting the island with incredible diligence; for we are told, that he not only built eight or nine forts or rather blockhouses, but inured the settlers to martial discipline. Before the first year of his government was expired, Mr Moor received a supply of provisions and planters from England; and he planned out the town of St George as it now stands. The fame of this settlement soon awakened the jealousy of the Spaniards, who appeared off St George's with some vessels; but being fired upon from the forts, they sheered off, though the English at that time were so ill provided for a defence, that they had scarcely a single barrel of gunpowder on the island. During Moor's government the Bermudas were plagued with rats, which had been imported into them by the English ships. This vermin multiplied so fast in St George's island, that they even covered the ground, and had nests in the trees. They destroyed all the fruits and corn within doors; nay, they increased to such a degree, that St George's island was at last unable to maintain them; and they swam over to the neighbouring islands, where they made as great havock. This calamity lasted five years, though probably not in the same degree, and at last it ceased all of a sudden.

On the expiration of Moor's government, he was succeeded by Captain Daniel Tucker, who improved all his predecessor's schemes for the benefit of the island, and particularly encouraged the culture of tobacco. Being a severe disciplinarian, he held all under him so rigidly to duty, that five of his subjects planned as bold an enterprise for liberty as was perhaps ever put in execution. Their names were Barker, who is said to have been a gentleman; another Barker, a joiner; Goodwin, a ship-carpenter; Paet, a sailor; and Saunders, who planned the enterprise. Their management was as artful as their design was bold. Understanding that the governor was deterred from taking the pleasure of fishing in an open boat, on account of the dangers attending it, they proposed to build him one of a particular construction, which accordingly they did in a secret part of the island; but when the governor came to view his boat, he understood that the builders had put to sea in it. The intelligence was true: for the adventurers, having provided themselves with a few necessaries they wanted, sailed for England; and notwithstanding the storms they encountered, their being plundered by a French privateer, and the incredible miseries they underwent, they landed in 42 days time at Corke in Ireland, where they were generously relieved and entertained by the earl of Thomond.

Bermudas. Bern.

In 1619 Captain Tucker resigned his government to Captain Butler. By this time the high character which the Summer islands bore in England rendered it fashionable for men of the highest rank to encourage their settlement; and several of the first nobility of England had purchased plantations among them. Captain Butler brought over with him 500 passengers, who became planters on the islands, and raised a monument to the memory of Sir George Summers. The island was now so populous (for it contained about a thousand whites), that Captain Butler applied himself to give it a new constitution of government by introducing an assembly, the government till this time being administered only in the name of the governor and council. A body of laws are likewise drawn up, as agreeable to the laws of England as the situation of the island would admit of. One Mr Barnard succeeded Captain Butler as governor, but died six weeks after his arrival on the island; upon which the council made choice of Mr Harrison to be governor, till a new one should be appointed. No fewer than 3000 English were now settled in the Bermudas, and several persons of distinction had curiosity enough to visit it from England. Among these was Mr Waller the poet, a man of fortune, who being embroiled with the parliament and commonwealth of England, spent some months in the Summer islands, which he has celebrated in one of his poems as the most delightful place in the world. The dangers attending the navigation, and the untowardly situation of these islands, through their distance from the American continent, seem to be the reasons why the Bermudas did not now become the best peopled islands belonging to England, as we are told that some time ago they were inhabited by no fewer than 10,000 whites. The inhabitants, however, never showed any great spirit for commerce, and thus they never could become rich. This, together with the gradual alteration of the soil and climate already taken notice of, soon caused them to dwindle in their population; and at present the number of white inhabitants is only 5462, and of blacks 4919. Even these seem much more inclined to remove to some other place than to stay where they are; so that unless some beneficial change take place, the state of the Bermudas must daily grow worse. The exports in 1810 amounted to 36,600l.

BERN, one of the cantons of Switzerland, which holds the second rank among the 13; but as it was formerly by far the largest in extent, containing almost one-third of the whole country, it might be considered as the first. It is bounded to the north by the cantons of Basil and Solothurn, and the Austrian forest-towns; to the south by the lake of Geneva, the Valais, and duchy of Savoy; to the east by Uri, Underwald, Lucern, and the county of Baden; and to the west by Solothurn, Neufchatel, Franche-Compte, the district of Biel, and the land of Gex. It is the most fruitful, the richest, and was by much the largest, of all the cantons, extending in length about sixty leagues, and about thirty where broadest. It yields not only plenty of grain, fruit, and pasture; but also good wine, a variety of coloured earths and clays, sand-stone, mundick, gypsum, pit-coal,

coal, sulphur, and iron-ore. Here likewise are large herds of cattle, great and small; and, in consequence of that, great quantities of milk, butter, and cheese. The rivers that water this canton are the Aar, the Emmat, the Wigger, the Aa, the Rusz, the Limmat, the Sanen, the Sensen, and the Kandel. The principal lake is that of Geneva: the length of which is about 18 leagues, and the greatest breadth between three and four. The depth in some places is near 400 fathoms, in others not above 40. The Rhone enters it at the east end, near Bouveret, and issues out again at the west close by Geneva. In summer its waters are much swelled by the melting of the snow on the mountains. This lake, however, is not entirely surrounded by the territory of Bern, but partly by Savoy and the country of Gex (the former of which belongs to the king of Sardinia, and the latter to France), and the territory of Sion. Its borders are extremely fertile and beautiful, being much embellished with vineyards, which yield excellent wine, and interspersed with towns and villages, betwixt which a considerable commerce is carried on. The other great lakes, that are wholly or partly within this canton, are those of Neufchatel, Biel, Murte, Thun, Brien, and Halwyl, which all abound in fish, particularly that of Geneva, where trouts are sometimes caught weighing 40 or 50 pounds. In that of Biel, called also the *Nydau-lake*, are two small islands, one of which is very beautiful. This lake is about three leagues in length and one in breadth. Along the whole west and north-west sides of the canton runs that chain of mountains called by the general name of *Jura;* but the several mountains of which it is composed have all their particular names. This canton is well cultivated, and very populous, and before it was dismembered contained 407,000 souls. German is the prevailing language, but almost all the people of fashion speak either French or Italian; even the common people in the Pais de Vaud, and other places that lie towards France or Italy, speak a corrupt French or Italian, or a jargon composed of both. The established religion here and in the other Protestant cantons is Calvinism, the same both in doctrine and discipline as in Holland; nor is any other tolerated, except in the common bailiages, and the vale of Frick. The ministers are divided into deaneries and classes, and hold yearly chapters or synods. They are kept in a greater dependence on the civil power here than in the other cantons, and not suffered to interfere with matters of state. The city of Bern first joined the confederacy in the year 1353. Towards the defence thereof the canton now furnishes 2000 men. Every male from 16 to 60 is enrolled in the militia, and about a third of them regimented. There are officers for every district, whose province it is to see that the men be regularly exercised; that their arms, ammunition, and clothing, be in good condition; and that they be kept in constant readiness to march. Once a-year they are drawn out to a general review. The same attention is paid to those that belong to the train of artillery. Some regiments consist of married, and some of unmarried men; some of foot, others of dragoons. There is also one regiment and a troop of cuirassiers. The latter consists entirely of burghers of Bern. Both the horsemen and footmen find their horses, arms, and accoutrements. Besides the arms and artillery in the arsenal at Bern, all the castles, where the country governors or bailiffs reside, are well furnished with them. At Bern is a constant guard or garrison of 200 men, and a small garrison at Fort Arburg. In the same city is also an office, which grants licenses for levies to foreign powers, and where the recruits make their appearance and are registered. The bailiffs have the chief direction of affairs in their several districts, being generals of the militia, and presiding in the courts of justice; but, in civil causes above a certain value, an appeal lies from them to Bern; and, in capital cases, their sentence must be confirmed by the great council before it can be executed. When any bailiwick is to be disposed of, as many balls as there are competitors are put into a bag, whereof one is gilt, and he that draws that has the bailiwick.

Mr Keysler observes, that the wealthiest peasants in Switzerland are those of Bern; it being difficult to find a village without one, at least, who is worth between 20,000 or 30,000 guilders, and sometimes even 60,000. He says, the common people of both sexes wear straw hats, and that the women's petticoats are tied up so near their arm-pits, that hardly an hand's-breadth is left for their shape; that the inns, not only in this canton but throughout Switzerland, are in general very good; that the manners of the people were in many respects, greatly changed within 50 years before he visited them, which was about 50 years ago, and consequently must be much more so now; that instead of the plainness and honest simplicity of their ancestors, the love of superfluities and high living greatly prevailed; that luxury, pomp, and that infatuation for foreign productions which had infected most parts of Europe, had also extended its contagious influence to Switzerland, though not to such a degree as in many other countries. Dr Burnet says, that drinking is so common, and produces so many quarrels and disorders, that the bailiffs not only subsist by the fines payable for them, but often get estates, carrying perhaps 20,000 crowns at the end of five years to Bern; that their law is short and clear, insomuch that the most intricate suit is ended after two or perhaps three hearings, either in the first instance before the bailiff, or in the second at Bern; that the civility expressed in this country to women, at first meeting them, is not by saluting them, but by shaking them by the hand, and that none but strangers take off their hats to them. Mr Addison says, that the peasants are generally clothed in a coarse kind of canvas, the manufacture of the country, and that their holiday-clothes go from father to son; so that it is not uncommon to see a countryman in his great-grandfather's doublet and breeches; that the belief of witchcraft prevailed among them so much, that there were some executions on that account while he was in the country; that the question, or torture, is used not only in this canton but all over Switzerland; that though the subjects of the state are rich, the public is poor; and though they could oppose a sudden invasion, yet they could not spare the reinforcements and recruits that would be necessary in a long war. A law passed in 1764, rendering the government an aristocracy, gave great offence to the people; and in consequence of this the canton made a feeble defence when invaded by the French in 1798. A democratic constitution was then set up, and a part of the canton was separated from the rest, and the two new cantons of

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Bern. of Aargau and Vaud created out of it. The canton again received a small increase in 1815; and at present contains 3872 square miles, and 215,000 inhabitants.

Bern, a city of Switzerland, and capital of the canton of that name, is situated in E. Long. 7. 40. N. Lat. 40. 0. It is said that the taking of a bear on the day on which the foundation of this city was laid, gave occasion to its name; hence it is often in Latin called *Arctopolis*, i. e. the city of the bear, and has a bear for its coat of arms. It is almost surrounded by the river Aar. The houses are mostly built of white freestone, and in the principal streets have piazzas or arches under them, for the conveniency of walking dry in wet weather. Most of the streets are paved with flints, and traversed by a canal lined with freestone, which is brought from a considerable distance, and is very useful in carrying off the filth of the city, extinguishing fires, and other purposes. The city is large, containing 13,340 inhabitants by the last enumeration; and it has several churches, of which one is called the *Great Church*, and the first minister *the dean*, who is the head of the city clergy. From an inscription near the great door of this church, it appears, that the first stone of it was laid in 1421. Over the same door is a representation of the last judgment, in which the sculptor hath placed the pope among the damned. In this city is also a college with eight professors, a large public library, and a museum; a stately granary, in which a great quantity of corn is always kept; a guildhall; a well stored arsenal; and several hospitals. In the arsenal is a wooden statue of the famous Tell, which represents him as taking aim at the apple placed on the head of his son. There is also the statue of Berchtold von Zahringen, the founder of the city; and two large horns of buffaloes, or wild bulls, called in Latin *Uri*, such as are used in war by the canton of Uri, instead of trumpets, and taken from it in the year 1712. Hard by also hang the grotesque dresses of those who blew them. The inhabitants of Uri, who boast their descent from the old Tau, bear a buffalo's head on their risci, coat of arms; and the person who blows the great horn in time of war, is called the *bull of Uri*. In the Dominican church, a hole in the wall is always shown to strangers, by means of which, it having a communication with the cell of a monk in an adjoining monastery, the pious fraud of making an image of the Virgin appear to speak was once carried on, which for a while answered the purposes of the monks very well; but they were at last detected and punished. This city, though larger, is not so populous nor so well built as that of Zurich. On the east side of it is a handsome stone bridge; and near the great church is a very fine platform some hundred feet in height, which makes a most delightful walk, being planted with limes, and commanding a charming prospect, particularly of the mountains of the Grisons, covered with snow in the midst of summer. In 1654 a student of divinity, being on horseback, and in liquor, leaped over this terrace without receiving any other hurt than breaking a leg, and lived many years after; but the horse was killed. In the upper part of the city are always kept a number of bears in two enclosures, with fir trees for them to clamber and play upon. Of the burghers of Bern, only those are qualified for the government and magistracy of the city who are the descendants of such as were made burghers before the year 1635. Other qualifications are also necessary; in particular, they must not be under 30 years of age, and must be enrolled in one of the 12 companies. To obtain a country government, or to hold any considerable employment, the candidate must also be married. The great council, in which the sovereignty of the canton is vested, consists, when full, of 229; but is generally much short of that number, 80 or more often dying before their places are filled up. The lesser council senate, or, as it is called, the *daily council*, because it meets every day, Sundays and holidays excepted, consists of 27 members, including the two prætors or advoyers, the four tribunes of the people, the two treasurers, and the two heimlichers, or secrecy-men, so called, because to them all secrets relating to the state are discovered. The members of the great and little councils mutually fill up the vacancies that happen in these two colleges. How the bailiffs are chosen we have already taken notice. Our limits will not permit us to enter into any farther detail with respect to the government: only it is to be observed in general, that all the officers of any note are chosen out of the great or little councils; and that all the bailiffs and castellans of the canton continue six years in office. The trade of the city is not very great; but was less before the French refugees settled therein: some, however, doubt whether it has been a gainer by them; as by their introduction of French modes and luxury, they have helped to banish the ancient Helvetic simplicity and frugality. The territory immediately under its jurisdiction is divided into four governments, with which the four venners, or standard-bearers, are invested. It declared for the Reformation in 1528, after a solemn disputation. Here the British envoy to the cantons resides.

Bern, Bern-Machine.

Bern-Machine, the name of an engine for rooting up trees, invented by Peter Sommer, a native of Bern in Switzerland.

This machine is represented by a figure on Plate LXXXVIII. drawn from a model in the machine room of the Society for the Encouragement of Arts, &c. It consists of three principal parts; the beam, the ram, and the lever. The beam ABC, (N° 1.) of which only one side is seen in the figure, is composed of two stout planks of oak three inches thick at least, and separated by two transverse pieces of the same wood at A and C, about three inches thick. These planks are bored through with corresponding holes, as represented in the figure, to receive iron pins, upon which the lever acts between the two sides of the beam, and which is shifted higher and higher as the tree is raised or rather pushed out of its place. The sides are well secured at the top and bottom by strong iron hoops. The iron pins on which the lever rests should be an inch and a quarter, and the holes through which they pass an inch and a half in diameter. The position of these holes is sufficiently indicated by the figure. The foot of the beam, when the machine is in action, is secured by stakes represented at G, driven into the earth. The ram D, which is made of oak, elm, or some other strong wood, is capped with three strong iron spikes, represented at *f*, which take fast hold of the tree. This ram is six or eight inches square;

square; and a slit is cut lengthwise through the middle of it, from its lower end at K to the first ferule *a*, in order to allow room for the chain *g h* to play round the pulley K, which should be four inches thick, and nine inches in diameter. This ram is raised by means of the chain *g h*, which should be about ten feet long, with links four inches and three quarters in length, and an inch thick. One end of this chain is fastened to the top of the beam at C, while the other, after passing through the lower part of the ram, and over the pulley K, terminates in a ring or link represented N° 3. the two ears *m n* of which serve to keep it in a true position between the two planks of the beam. In this ring the hook P is inserted. The hook is represented in profile, N° 2. where F is the part that takes hold of the ring. But it must be observed that the parts of this machine, represented at N° 2, 3. are drawn on a scale twice as large as the whole engine. The hook F, N° 2. should be made of very tough iron, as well as the handle D, and the arch E *c*. This handle should be two inches thick at *z*, where it joins to the hook, and the thickness gradually lessen by degrees up to the arch, which need not be more than half an inch thick. On each side of the pin *z*, is a semicircular notch, *x*, *y*, which rests alternately on the pins when the machine is worked. The hole D, and the arch E*c*, serve to fix a long lever of wood EF, N° 1. by means of two iron pins; and by this contrivance the lever is either raised or depressed at pleasure, in order to render the working of the machine easy in whatever part of the beam the lever may be placed: for without this contrivance the extremity of the lever EF, would, when the handle is near the top of the beam, be much higher than men standing upon the ground could reach. It must however be remembered, that the lever is often shortened by this contrivance, and consequently its power lessened.

The machine is worked in the following manner: It is placed against a tree, in the manner represented in the figure, so that the iron spikes at *f* may have hold of the tree, and the end of the beam A be supported by stakes represented at G. The iron handle, N° 2. is placed in the opening between the two planks of the beam, and the wooden lever fixed to it by means of the iron pins already mentioned. The hook F takes hold of the chain, and one of the iron pins is thrust into the outer row of holes, by which means the outer notch *x* will rest on the pin, which will be now the centre of motion; and the end of the lever E, N° 1. being pressed downwards, the other notch *y*, N° 2. will be raised, and at the same time the chain, and consequently the ram. The other iron pin is now to be thrust into the hole in the inner row, next above that which was before the centre of motion, and the end of the lever E elevated or pushed upwards, the latter pin on which the notch *y* rests now becoming the centre of motion. By this alternate motion of the lever, and shifting the pins, the chain is drawn upwards over the pulley K, and consequently the whole force of the engine exerted against the tree. There is a small wheel at L, in order to lessen the friction of that part of the machine.

From this account the reader will very easily perceive that the machine is nothing more than a single pulley compounded with a lever of the first and second order. It must however be remembered, that as the push of the engine is given in an oblique direction, it will exert a greater or lesser force against the horizontal roots of the tree in proportion to the angle formed by the machine with the plane of the horizon; and that the angle of 45° is the maximum, or that when the machine will exert its greatest force against the horizontal roots of the tree.

BERNACLE, a species of goose. See ANAS, ORNITHOLOGY *Index*.

BERNARD, ST, the first abbot of Clairvaux, was born in the year 1091, in the village of Fountaine, in Burgundy. He acquired so great a reputation by his zeal and abilities, that all the affairs of the church appeared to rest upon his shoulders, and kings and princes seemed to have chosen him for a general arbitrator of their differences. It was owing to him that Innocent II. was acknowledged sovereign pontiff, and after the death of Peter Louis anti-pope, that Victor, who had been named *successor*, made a voluntary abdication of his dignity. He convicted Abelard at the council of Sens, in the year 1140. He opposed the monk Raoul; he persecuted the followers of Arnaud de Bresse; and, in 1148, he got Gilbert de la Porvicé, bishop of Poitiers, and Eonde l'Etoile, to be condemned in the council of Rheims. By such zealous behaviour he verified (says Mr Bayle) the interpretation of his mother's dream. She dreamed, when she was with child of him, that she should bring forth a white dog, whose barking should be very loud. Being astonished at this dream, she consulted a monk, who said to her, "Be of good courage; you shall have a son who shall guard the house of God, and bark loudly against the enemies of the faith." But St Bernard went even beyond the prediction, for he barked sometimes against chimerical enemies: he was more happy in exterminating the heterodox, than in ruining the infidels; and yet he attacked these last, not only with the ordinary arms of his eloquence, but also with the extraordinary arms of prophecy. He preached up the crusade under Louis the Younger, and by this means he enlarged the troops of the crusaders beyond expression: but all the fine hopes with which he flattered the people were disappointed by the event; and when complaint was made that he had brought an infinite number of Christians to slaughter without going out of his own country, he cleared himself by saying that the sins of the croises had hindered the effect of his prophecies. In short, he is said to have founded 160 monasteries, and to have wrought a great number of miracles. He died on the 20th of August 1153, at 63 years of age. The best edition of his works is that of 1690, by Father Mabillon.

BERNARD, *Dr Edward*, a learned astronomer, linguist, and critic, was born at Perry St Paul, on the 2d of May, 1638, and educated at Merchant-Taylor's school, and St John's college, Oxford. During his stay at school, he had laid in an uncommon fund of classical learning; so that, on his going to the university, he was a great master of all the elegancies of the Greek and Latin tongues, and not unacquainted with the Hebrew. On his settling in the university, he applied himself with great diligence to history, philology, and philosophy; and made himself master of the Hebrew, Syriac, Arabic, and Coptic languages, and then applied himself to the study of the mathematics under the famous Dr Wallis. Having successively taken the degrees,

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Bernard. degrees of bachelor and master of arts, and afterwards that of bachelor of divinity in 1668, he went to Leyden to consult several oriental manuscripts left to that university by Joseph Scaliger and Levinus Warnerus. At his return to Oxford, he collated and examined the most valuable manuscripts in the Bodleian library; which induced those who published any ancient authors, to apply to him for his observations or emendations from the manuscripts at Oxford; which he readily imparted, grudging neither time nor pains to serve the learned; and by this means he became engaged in a very extensive correspondence with the learned of most countries. In the year 1669, the famous Christopher Wren, Savilian professor of astronomy at Oxford, having been appointed surveyor-general of his majesty's works, and being much detained at London by this employment, he obtained leave to name a deputy at Oxford, and pitched upon Mr Bernard, which engaged the latter in a more particular application to the study of astronomy. In 1676, he was sent by the earl of Arlington to France, in order to be tutor to the dukes of Grafton and Northumberland, sons to King Charles II. by the duchess of Cleveland, who then lived with their mother at Paris: but the simplicity of his manners not suiting the gaiety of the duchess's family, he returned about a year after to Oxford, and pursued his studies; in which he made great proficiency, as his many learned astronomical and critical works show. He composed tables of the longitudes, latitudes, right ascensions, &c. of the fixed stars; Observations in Latin on the Obliquity of the Ecliptic; and other pieces inserted in the Philosophical Transactions. He also wrote, 1. A Treatise of the ancient Weights and Measures. 2. *Chronologiæ Samaritanæ Synopsis*, in two tables. 3. Testimonies of the Ancients concerning the Greek Version of the Old Testament by the Seventy; and several other learned works. He was a person of great piety, virtue, and humanity, and died on the 12th of January, 1696, in the 59th year of his age, leaving behind him a great number of learned and valuable manuscripts.

Bernard, *James*, professor of philosophy and mathematics, and minister of the Walloon church at Leyden, was born September 1. 1658, at Nions in Dauphiné. Having studied at Geneva, he returned to France in 1679, and was chosen minister of Venterol, a village in Dauphiné. Some time after, he was removed to the church of Vinsobres in the same province. But the persecution raised against the Protestants in France having obliged him to leave his native country, he retired to Holland, where he was received with great civility, and was appointed one of the pensionary ministers of Gauda. In July 1688, he began a political publication entitled *Histoire abregée de l'Europe*, &c. which he continued monthly till December 1688, and makes five volumes in 12mo. In 1692, he began his *Lettres Historiques*, containing an account of the most important transactions in Europe, with necessary reflections. He carried on this work, which was also published monthly, till the end of the year 1698. It was afterwards continued by other hands, and consists of a great many volumes. Mr Le Clerc having left off his *Bibliothèque Universelle*, in 1691, Mr Bernard wrote the greatest part of the 20th volume, and by himself carried on the five following to the year 1693. In 1698, he collected and published *Actes et Negociations de la paix de Ryswic*, in four volumes 12mo. In 1699 he began the *Nouvelles de la republique de lettres*, which continued till December 1710. Mr Bernard having acquired great reputation by his works, as well as by his sermons at Gauda and the Hague, the congregation of the Walloon church at Leyden became extremely desirous to have him for one of their ministers; and a vacancy happening in 1705, he was unanimously chosen. About the same time, Mr de Volder professor of philosophy and mathematics at Leyden having resigned, Mr Bernard was appointed his successor; and the university presented him with the degrees of doctor of philosophy and master of arts. His public and private lectures took up a great part of his time; yet he did not neglect his pastoral function, but composed his sermons with great care: he wrote also two excellent treatises, one on a late repentance, the other on the excellency of religion. In 1716, he published a supplement to Morri's dictionary in two volumes folio. The same year he resumed his *Nouvelles de la republique des lettres*; which he continued till his death, which happened the 27th of April, 1718, in the 60th year of his age.

Bernard | Bernera.

Bernard, *St*, the Great; a mountain in Savoy and Switzerland, between Valais and the valley of Aoust, at the source of the rivers Drance and Doria. The top is always covered with snow; and there is a great monastery seated thereon, where the monks always entertain travellers without distinction of religion for three days.

BERNARDINE, St, was born at Massa in Tuscany, in 1380. In 1404 he entered into a Franciscan monastery near Sienna, where he became an eminent preacher; and was afterward sent to Jerusalem, as commissary of the Holy Land. On his return to Italy, he visited several cities, where he preached with such applause, that the cities of Ferrara, Sienna, and Urbino, desired Pope Eugenius IV. to appoint him their bishop: but Bernardine refused the honour, accepting only the office of vicar-general of the friars of the observance for all Italy. He repaired and founded above 300 monasteries in that country; died in 1444; was canonized in 1450 by Pope Nicholas; and his works were published at Venice in 1591, in 4 vols. 4to.

BERNARDINES, an order of monks, founded by Robert abbot of Moleme, and reformed by St Bernard. They wear a white robe, with a black scapulary; and when they officiate they are clothed with a large gown, which is all white, and hath great sleeves, with a hood of the same colour.—The Bernardines differ very little from the Cistercians. They had their origin toward the beginning of the 12th century.

BERNAY, a town of Upper Normandy in France, seated on the river Carantone, in E. Long. 0. 50. N. Lat. 49. 6.

BERNBURG, a town of Germany, in the circle of Upper Saxony, and principality of Anhalt, where a branch of the house of Anhalt resides. It is seated on the river Sara, in E. Long. 12. 30. N. Lat. 51. 55.

BERNERA, one of the Western Isles of Scotland, lying about two leagues to the southward of Harries. It is about five miles in circumference; the soil is sandy, but when manured with the alga marina, extremely fertile,

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fertile, producing an increase of thirty-fold of barley; nay, one grain has been known to produce 14 ears when the season was remarkably favourable. The face of the island is extremely agreeable in summer, exhibiting a pleasing variety of corn fields and clover pastures. Here is a fresh-water lake called *Lochbruis*, diversified with small islands, and abounding with eels, which the natives by the help of lights catch in the night-time, as they fall down a rivulet towards the sea in heaps twisted together. There are two chapels in this island dedicated to St Asaph and St Columbus; and near the former is a stone standing about eight feet above the ground. At the east end of this island there is a strange reciprocation of the flux and reflux of the sea, and another no less remarkable upon the west side of the Long island. The tides from the south-west run along northward; so that during the ordinary course of the tides the flood runs east in the frith where Bernera lies, and the ebb runs west: thus the sea ebbs and flows regularly for four days before, and as long after, the full and change of the moon; the spring tides generally rising 14 feet perpendicular, and the others proportionably: but for four days before, and as many after, the quarter moons, there is a singular variation; at that time a southerly moon making high water, the course of the tide being eastward, it begins to flow at half an hour after nine in the morning, and continues to flow till half an hour after three in the afternoon, when it is high water; but when it begins to ebb, the current still runs eastward, until it is low water; so that the tide runs eastward 12 hours together, that is, from half past nine in the morning till half past nine at night; yet, when the night-tide begins to flow, the current turns and runs westward all night for 12 hours, during both flood and ebb: thus the reciprocations continue, one flood and ebb running eastward and another westward, till within four days of the full and change of the moon; then they resume their ordinary course, running east during the six hours of flood, and west during the six hours of ebb. There is another phenomenon in these tides no less remarkable than that just now mentioned. Between the vernal and autumnal equinox, that is, during one half of the year, the tides about the quarter moons run all day eastward and all night westward; and during the other six months their course is reversed, being westward in the day and eastward in the night.

BERNICLA, the trivial name of a species of goose. See ANAS, ORNITHOLOGY *Index*.

BERNICLE, a species of lepas. See LEPAS, CONCHOLOGY *Index*.

BERNIER, NICHOLAS, an eminent musician and composer, was born at Mante on the Seine, in the year 1664. By his merit in his profession he attained to be conductor of the music in the chapel of St Stephen, and afterwards in that of the king. The regent duke of Orleans admired his works, and patronized their author. This prince having given him a motet of his own composition to examine, and being impatient for his observations thereon, went to the house of Bernier, and entering his study, found the abbé de la Croix there criticising his piece, while the musician himself was in another room carousing and singing with a company of his friends. The duke broke in upon and interrupted their mirth, with a reprimand of Bernier for his inattention to the task assigned him. This musician died at Paris in 1734. His five books of Cantatas and Songs for one and two voices, the words of which were written by Rousseau and Fuselier, have procured him great reputation. There are besides of his composition Les Nuits de Sceaux, and many motets, which are still in great esteem.

BERNIER, *Francis*, surnamed the *Mogul*, on account of his travels and residence in that country, was born at Angers in France; and after he had taken his degree of doctor of physic at Montpelier, left his country in 1654, went to Egypt, to the Holy Land, and to the kingdom of the Mogul, where he was physician to that monarch, attended him in his journeys, and stayed there 12 years. Upon his return to France, he published the history of the countries he had visited; and spent the remainder of his life in composing various other works, particularly an Abridgment of the philosophy of Gassendus in 8 vols 12mo. His first work is esteemed to be the best account we have of the countries which are the subject of it.

BERNINI, JOHN LAURENCE, commonly called *Cavalier Bernin*, a Neapolitan, famous for his skill in painting, sculpture, architecture, and mechanics. He first began to be known under the pontificate of Paul V. Rome is indebted to this artist for some of its greatest ornaments; and there are in the church of St Peter no less than 15 different works of his hand. He died at Rome in 1680.

BERNO, abbot of Richenou, in the diocese of Constance, who flourished about the year 1008, is celebrated as a poet, rhetor, musician, philosopher, and divine. He was the author of several treatises on music, particularly of one *De Instrumentis Musicalibus*, beginning with the words *Musicam non esse contem!* which he dedicated to Arrabon, archbishop of Mentz. He also wrote *De Mensura Monochordi*. But the most celebrated of his works is a treatise *De Musica seu Tonis*, which he wrote and dedicated to Pelegrines archbishop of Cologne, beginning *Vero mundi isti advenæ et peregrino*. This latter tract is part of the Baliol manuscript, and follows the Enchiridion of Odo: it contains a summary of the doctrines delivered by Boetius, an explanation of the ecclesiastical tones, intermixed with frequent exhortations to piety, and the application of music to religious purposes. He was highly favoured by the emperor Henry II. for his great learning and piety; and succeeded so well in his endeavours to promote learning, that his abbey of Richenou was as famous in his time as those of St Gal and Cluni, then the most celebrated in France. He died in 1048; and was interred in the church of his monastery, which but a short time before he had dedicated to St Mark.

BERNOULLI, JAMES, a celebrated mathematician, born at Basil the 27th of December 1654. Having taken his degrees in the university of Basil, he applied himself to divinity, not so much from inclination as complaisance to his father. He gave very early proofs of his genius for mathematics, and soon became a geometrician, without any assistance from masters, and at first almost without books: for he was not allowed to have any books of this kind; and if one fell by chance into his hands, he was obliged to conceal it, that he might not incur the reprimands of his father, who designed him for other studies. This severity made him

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Bernoulli. him choose for his device, Phaeton driving the chariot of the sun, with these words, *Invito patre sidera verso*, "I traverse the stars against my father's inclination:" This had a particular reference to astronomy, the part of mathematics to which he at first applied himself. But the precautions of his father did not avail, for he pursued his favourite study with great application. In 1676 he began his travels. When he was at Geneva, he fell upon a method to teach a young girl to write, though she had lost her sight when she was but two months old. At Bourdeaux he composed universal gnomonic tables, but they were never published. He returned from France to his own country in 1680. About this time there appeared a comet, the return of which he foretold; and wrote a small treatise upon it, which he afterwards translated into Latin. He went soon after to Holland, where he applied himself to the study of the new philosophy. After having visited Flanders and Brabant, he went to Calais, and passed over from thence to England. At London he contracted an acquaintance with all the most eminent men in the several sciences; and had the honour of being frequently present at the philosophical societies held at the house of the famous Mr Boyle. He returned to his native country in 1682; and he exhibited at Basil a course of experiments in natural philosophy and mechanics, which consisted of a variety of new discoveries. In 1682, he published his essay of a new system of comets; and the year following, his dissertation on the weight of air. Mr Leibnitz, about this time, having published in the *Acta Eruditorum* at Leipsic some essay of his new *Calculus differentialis*, or *infinimens petits*, but concealed the art and method of it; Mr Bernoulli, and one of his brothers, discovered, by the little which they saw, the beauty and extent of it: they endeavoured to unravel the secret; which they did with such success, that Mr Leibnitz declared, that the invention belonged to them as much as to himself. In 1687, the professorship of mathematics at Basil being vacant, Mr Bernoulli was appointed his successor. He discharged this trust with universal applause; and his reputation drew a great number of foreigners from all parts to hear his lectures. He had an admirable talent in teaching, and adapting himself to the different genius and capacity of his scholars. In 1699, he was admitted into the academy of sciences at Paris as a foreign member, and in 1701 the same honour was conferred upon him by the academy of Berlin. He wrote several pieces in the *Acta Eruditorum* of Leipsic, the *Journal des Sçavans*, and the *Histoire de l' Academie des Sciences*. His assiduous application to these studies brought upon him the gout, and by degrees, a slow fever, of which he died the 16th of August 1705, in the 58th year of his age.—Archimedes having found out the proportion of a sphere to a cylinder circumscribed about it, ordered it to be engraven upon his monument. In imitation of him Mr Bernoulli appointed, that a spiral logarithmical curve should be inscribed upon his tomb, with these words, *Eadem mutata resurgo;* in allusion to the hopes of the resurrection, which are represented in some measure by the properties of the curve which he had the honour of discovering.

Bernoulli, *Daniel*, a celebrated physician and philosopher, was born at Groningen, February 9. 1700. He was intended by his parents for trade, but his genius led him to different pursuits. He passed some time in Italy, and at 24 refused to be president of an academy meant to have been established at Genoa. He spent several years at St Petersburg with great credit; and in 1733 returned to Basil, where he successively filled the chair of physic, natural and speculative philosophy. In his first work, *Exercitationes Mathematicæ*, he took the only title he then had, viz. "Son of John Bernoulli," and would never suffer any other to be added to it. This work appeared in Italy with the great inquisitor's privilege added to it, and it classed Bernoulli in the rank of inventors. He gained or divided nine prizes, which were contended for by the most illustrious mathematicians in Europe, from the academy of sciences. The only man who has had success of the same kind is Euler, his countryman, disciple, rival, and friend. His first prize he gained at 24 years of age. In 1734 he divided one with his father: but this hurt the family union: for the father construed the contest itself into a want of respect; and the son did not sufficiently conceal that he thought (what was really the case) his own piece better than his father's. Besides this, he declared for Newton, against whom his father had contended all his life. In 1740, Mr Bernoulli divided the prize "On the Tides of the Sea" with Euler and Maclaurin. The academy at the same time crowned a fourth piece, whose only merit was that of being Cartesian; but this was the last public act of adoration paid by it to the authority of the author of the Vortices, which it had obeyed perhaps too long. In 1748, Mr Daniel Bernoulli succeeded his father in the academy of sciences, and was himself succeeded by his brother John; this place, since its first erection, i. e. 84 years, never having been without a Bernoulli to fill it. He was extremely respected at Basil; and to bow to Daniel Bernoulli, when they met him in the streets, was one of the first lessons which every father gave his child. He used to tell two little adventures, which he said had given him more pleasure than all the other honours he had received. He was travelling with a learned stranger, who, being pleased with his conversation, asked his name: "I am Daniel Bernoulli," answered he with great modesty; "And I," said the stranger (who thought he meant to laugh at him), "I am Isaac Newton." Another time he was giving a dinner to the famous Koenig the mathematician, who boasted, with a sufficient degree of self-complacency, of a difficult problem he had resolved with much trouble. Bernoulli went on doing the honours of his table; and, when they went to drink coffee, presented him with a solution of the problem more elegant than his own. He died in March 1782.

Beroea. BEROEA, in *Ancient Geography*, a noble city of Macedonia, to the south of Edessa, or Ægæ, and south-east of Cyrtus. The people are commended in Scripture for their reception of the Gospel on a fair and impartial examination.—Another *Berœa*, of Syria (Stephanus); called also *Beroe*, and by the inhabitants *Beroëa*. It was the standing tradition for some ages, that it is the modern Aleppo; called *Chalep* in Nicetas, Nicephorus, and Zonaras; from which it is supposed the present appellation *Aleppo* is derived; distant 90 miles from the Levant sea and the port of Scanderoon, and about 100 miles west of the Euphrates. E. Long. 36. 0. N. Lat. 36. 30.

BEROOT,

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BEROOT, or BAIROUT, a town of Phœnicia, a province of Syria, in Turkey in Asia. It is the ancient Berytus; but there are now no remains of its former beauty, except its situation. It stands in a plain, which from the foot of Lebanon runs out into the sea, narrowing to a point, about two leagues from the ordinary line of the shore, and on the north side forms a pretty long road, which receives the river of Nahr-el-Salib, called also *Nahr-Bairout*. This river has such frequent floods in winter, as to have occasioned the building of a considerable bridge; but it is in so ruinous a state as to be impassable. The bottom of the road is rock, which chafes the cables, and renders it very insecure. From hence, as we proceed westward towards the point, we reach, after an hour's journey, the town of Beroot. This belonged to the Druzes, till lately that it was taken from them, and a Turkish garrison placed in it. Still however it continues to be the emporium of the Maronites and the Druzes, whence they export their cottons and silks, almost all of which are destined for Cairo. In return, they receive rice, tobacco, coffee, and specie, which they exchange again for the corn of the Bekaa and the Hauran. This commerce maintains near 6000 or 8000 persons. The dialect of the inhabitants is justly censured as the most corrupt of any in the country: it unites in itself the 12 faults enumerated by the Arabian grammarians.—The port of Beroot, formed like all the others on the coast by a pier, is like them choked up with sand and ruins. The town is surrounded by a wall, the soft and sandy stone of which may be pierced by a cannon ball without breaking or crumbling; which was unfavourable to the Russians in their attack: but in other respects this wall, and its old towers, are defenceless. Two inconveniences will prevent Beroot from ever becoming a place of strength; for it is commanded by a chain of hills to the south-east, and is entirely destitute of water, which the women are obliged to fetch from a well at the distance of half a quarter of a league, though what they find there is but indifferent. By digging in order to form reservoirs, subterraneous ruins have been discovered; from which it appears, that the modern town is built on the ancient one. The same may be observed of Latakia, Antioch, Tripoli, Saide, and the greater part of the towns on the coast; which has been occasioned by earthquakes that have destroyed them at different periods. We find likewise, without the walls to the west, heaps of rubbish, and some shafts of columns, which indicate that Beroot has been formerly much larger than at present. The plain around it is entirely planted with white mulberry trees, which are young and flourishing; by which means the silk produced here is of the very finest quality. In descending from the mountains (says M. Volney), no prospect can be more delightful than to behold, from their summits or declivities, the rich carpet of verdure formed by the tops of these useful trees in the distant bottom of the valley. In summer, it is inconvenient to reside at Beroot on account of the heat and the warmth of the water: the town, however, is not unhealthy, though it is said to have been so formerly. It has ceased to be unhealthy since the Emir Fakr-el-din planted the wood of fir trees, which is still standing a league to the southward of the town. E. Long. 35. 38. N. Lat. 34. 18.

BEROSUS, priest of the temple of Belus at Babylon, in the time of Ptolemy Philadelphus, wrote the History of Chaldea, which is often cited by the ancients, and of which Josephus gives some curious fragments. The Athenians, according to Pliny, caused his statue, with a golden tongue, to be placed in their Gymnasium.

BERRE, a town of France, in the department of the Mouths of the Rhone, seated on a lake of the same name. It contains 1800 inhabitants, and is remarkable for the quantity and goodness of the salt that is made there. E. Long. 4. 32. N. Lat. 43. 32.

BERRETINI DA CORTONA, PIETRO, painter of history and landscape, was born at Crotona in 1596; and, according to some writers, was a disciple of Andrea Commodi; though others affirm that he was the disciple of Baccio Ciarpi, and the author of the Abrege says he was successively the disciple of both: but he is allowed to have been as great and as enlarged a genius as any of his profession, and to have painted more agreeably than most of the artists who were his cotemporaries. He went young to Rome, and applied himself diligently to study the antiques, the works of Raphael, Buonaroti, and Polidoro; by which he so improved his taste and his hand, that he distinguished himself in a degree superior to any of the artists of his time. He worked with remarkable ease and freedom; his figures are admirably grouped; his distribution is truly elegant; the chiaro-scuro is judiciously observed; and through his whole compositions there appears uncommon grace: but De Piles observes, that it was not such a grace as was the portion of Raphael and Corregio; but a general grace, consisting rather in a habit of making the airs of his head always agreeable, than in a choice of expressions suitable to each subject. In his large compositions, the colouring had a good effect; but his colouring in fresco is far superior to what he performed in oil: nor do his easel pictures appear so finished as might be expected from so great a master, when compared with what he painted in a larger size. By the best judges it seems to be agreed, that although this master was frequently incorrect; though not always judicious in his expressions; though irregular in his draperies, and apt to design his figures too short and too heavy; yet, by the magnificence of his composition, the delicate airs of his figures, the grandeur of his decorations, and the astonishing beauty and gracefulness of the whole together, he must be allowed to have been the most agreeable mannerist that any age hath produced.—He died in 1669. Some of his most capital works are in the Barberini palace at Rome, and the Palazzo Pitti at Florence.

BERRETONI, NICOLO, history-painter, was born at Macerata in 1617, and was a disciple of Carlo Maratti, with whom he studied design and colouring for some years; and attained such excellence, that he excited even the jealousy and envy of his master, who seemed to be apprehensive of finding a powerful competitor and rival in his pupil.—His early works, after he quitted the school of Maratti, were in the style and taste of Guido; and they could not possibly have a more high encomium or recommendation. He died in 1682.

BERRIMAN, DR WILLIAM, was the son of Mr John Berriman apothecary in Bishopsgate-street, London, where he was born in 1688. He studied at Oriel college, Oxford, where he took his several degrees, and became curate and lecturer of All-hallows in in Thames-street, and lecturer of St Michael's Queenhithe. In 1720, he was appointed domestic chaplain to Dr Robinson bishop of London, who soon after collated him to the living of St Andrew's Undershaft; and in 1727, he was elected fellow of Eton college. He died in 1750, in the 62d year of his age. He wrote, 1. A seasonable Review of Mr Whiston's Account of Primitive Doxologies. 2. A Historical Account of the Trinitarian Controversy, in eight sermons, at Lady Moyer's lecture. 3. Brief Remarks on Mr Chandler's Introduction to the History of the Inquisition. 4. Sermons at Boyle's lectures, 2 vols 8vo. 5. Christian Doctrines and Duties explained and recommended, in 2 vols. 8vo; and other works.

BERRY. See BACCA.

BERRY, a province of France, which had the title of a duchy. It now forms the two departments of Cher and Indre; and is bounded on the north by Salome, on the south by Marche, on the east by Nivernois and Bourbonnois, and on the west by Touraine. It is 90 miles in length from north to south, and 73 in breadth from east to west. The air is very temperate; and the soil produces wheat, rye, and wine little inferior to Burgundy; that of Sancerre, St Satur, and Lavernusse, is the best. The fruits are in plenty, and pretty good. The pastures are proper to fatten sheep. This country produces also a good deal of hemp and flax. There are mines of iron and silver, but they are neglected. The stone quarries, within half a league of Bourges, are very serviceable. In the parish of St Hilare there is a mine of ochre, made use of in melting metals and for painting. Near Bourges there is a cold mineral spring, which has a clammy fat pellicle over it every morning, of different colours. It lets fall a fine black smooth sediment, which has the same smell, and almost the same taste, as gunpowder, which makes some conclude it partakes of sulphur, vitriol, and ochre. The pellicle is as thick as a crown piece; and when put on a red-hot fire-shovel, will bounce and sparkle, as will also the sediment. It is certain there is saltpetre in these waters, though vitriol seems to be the most predominant. These waters, drank on the spot, temperate the heat of the blood and humours, open obstructions, and strengthen the fibres. Berry is watered by several rivers; the principal of which are the Loire, the Creuse, the Cher, the Indre, the Orron, the Evre, the Aurette, the Maulon, the Great and Little Saudre, the Nerre, &c. Near Liniers, there is a lake 20 miles round. Berry is divided into the Upper and the Lower, and Bourges is the capital city. The inhabitants of Bourges carry on a small trade with corn down the Loire; but that of the wine above mentioned is much more considerable, it being transported to Paris by means of that river and the canal of Briare. But the principal commerce consists in the fat cattle which they send to Paris, and the great number of sheep; these last bear fine wool, which is used in the manufactures of this province and other parts of the kingdom. There are two sorts of manufactures in Berry; the one for cloths and serges, and the other for knit and wove stockings. There is likewise a great quantity of hemp, which is transported elsewhere; for they have not yet got the art of manufacturing it themselves. At Aubigny there are 2000 persons generally employed in the making of cloth.

BERSABE, in *Ancient Geography*, a town in the tribe of Simeon (Joshua); the south boundary not only of its own tribe but of the whole land of Israel, as appears from the common expression "from Dan to Bersabe:" in our translation it is Beersheba. It was the residence of the patriarchs; as first of Abraham, from whom it took its name, and of Isaac. It signifies the well or fountain of the oath; dug by Abraham, and claimed as his property by covenant and the religion of an oath, against the insults of the Philistines. Eusebius and Jerome say, that there was a citadel and large village of that name in their time. It was called *Beersheba of Judah* in 1 Kings xix. 3. not to distinguish it from the Beersheba of Galilee, which probably did not then exist, but to ascertain the limits of the kingdom of Judah. In the lower age called *Castrum Versabini.*

BERSARII, in writers of the middle age, a kind of hunters, or sportsmen, who pursued wild beasts in forests and chases. The word seems derived from the barbarous Latin *bersare*, "to shoot with a bow;" on which principle it should properly denote archers only, or bowmen. Or it might be derived from *bersa*, "the fence or pales of a park;" in which view, it should primarily import those who hunt or poach in parks or forests.

Hincmar speaks of a kind of inferior officers in the court of Charlemagne, under the denomination of *bersarii*, *veltrarii*, and *beverarii*. Spelman takes the first to denote those who hunted the wolf; the second, those who had the superintendency of the hounds for that use; and the third, those who hunted the beaver.

BERSELLO, a fortified town of Italy in the Modenese. It was taken by Prince Eugene in 1702; and by the French in 1703, who were obliged to abandon it in 1707. It is seated near the confluence of the rivers Linza and Po, in E. Long. 10. 30. N. Lat. 44. 55.

BERSUIRE, a town of France in the department of the two Sevres. W. Long. 0. 27. N. Lat. 46. 52.

BERTHOUD FERDINAND, an eminent French chronometer maker. See SUPPLEMENT.

BERTINERO, a town of Romagna in Italy, with a strong citadel. It is the see of a bishop; and is seated on a hill, in E. Long. 11. 47. N. Lat. 44. 8.

BERTRAND, ST, a town of France in the department of Upper Garonne. E. Long. 0. 38. N. Lat. 43. 2.

BERVY, a sea-port and royal burgh in the county of Mearns in Scotland. Population 927 in 1811. W. Long. 2. 0. N. Lat. 56. 40.

BERWICK, THE DUKE OF, was natural son of James II. by Mrs Arabella Churchill, sister to the great duke of Marlborough. He followed the fate of his father, and came into France after the revolution with James II. Here the duke of Berwick was recommended to the court by his superior merit. He was created marshal of France, knight of the Holy Ghost, duke and peer of France, grandee of Spain, commander in chief of the French armies; in all which stations his behaviour was such, that few equalled, perhaps none surpassed him. He lived in an age when the renowned prince of Orange and many other of the greatest men commanded against him. His courage was of the cool steady kind; always possessing himself; taking all advantages; not foolishly, rashly, or wantonly throwing away the lives of his soldiers. He kept up on all occasions the most strict discipline; and did not spare punishment among

among his soldiers for marauding and other crimes, when properly deserved; for which some inconsiderate people have blamed him. He has been reflected upon, by the very zealous and violent adherents of the Stuart family, for not being sufficiently attached to that party, which was his own family. But by a cool examination of his actions, it will appear, that his behaviour in this particular was, as in most parts of his life, sensible and just. When he accepted of employments, received honours, dignities, and became a naturalized Frenchman, he thought it his duty, as an honest man, to become a Frenchman, and a real subject to the monarch who gave him bread; and to be, or not to be, in the interest of the Stuart family, according to the will and commands of the sovereign whom he served, and in the interest of France according to time and circumstances; for there is no serving two masters well. But when ordered by his king to be in that family's interest, he acted with the greatest sincerity; and took the most effectual and sensible methods to serve that unhappy house, as the following anecdote, if true, and it has great appearance of probability on its side, proves. The duke of Marlborough, after the signing of the treaty of Utrecht, was censured by the British parliament for some of the army contracts in relation to bread and forage; upon which he retired into France: and it was then credibly asserted, the duke of Marlborough was brought over to the interest of the Stuart family; for it is now past a doubt, that Queen Anne had a very serious intention of having her brother upon the throne of England after her death: and several circumstances, as well as the time of that duke's landing in England, make many people believe he was gained over to the Stuart party. If the duke of Berwick was, directly or indirectly, the means of gaining his uncle over to that interest, he more effectually served it, than that rash mock army of unhappy gentlemen who were taken prisoners at Preston in 1715 had it in their power to do. In a word, the duke of Berwick was, without being a bigot, a moral and religious man; and showed by his life and actions, that morality and religion are very compatible and consistent with the life of a statesman and a great general; and if they were oftener united in these two professions, it would be much happier for the rest of mankind. He was killed by a cannon-ball at the siege of Philipsburg in 1738.

Berwick, a county of Scotland; bounded by the river Tweed on the south; by East Lothian on the north; by the German ocean on the east; and on the west by the counties of Roxburgh, Peebles and Mid-Lothian. Its extent in length may be stated at 34 miles, and its breadth 19. This county is nominally divided into three districts, viz. Lauderdale, Lammermuir, and Merse or March. The first is that opening or valley in the Lammermuir hills, through which the river Leader runs. Lammermuir comprehends the ridge of hills which separate this county from East-Lothian, extending from the head of Leader water to the sea, below the town of Berwick. The Merse or March includes that fertile and populous plain, stretching from the hills, along the banks of the Tweed. Berwickshire contains one royal borough, viz. Lauder, and several large towns and villages, as Dunse, Coldstream, Coldingham, Ayton, and Eyemouth. The chief rivers are the Tweed, the Leader, the Eye, the Whittadder, and Blackadder. The two roads to London pass through the county. In the Merse the state of agriculture is excellent; and, though so late as 60 years ago, the greater part was barren and uncultivated, it is now mostly enclosed and improved. The county of Berwick exports from the ports of Berwick and Eyemouth, above 80,000 bolls of victual; and the same quantity is annually carried to the weekly markets of Edinburgh, Dalkeith, Haddington, and Dunbar. There is plenty of marl in the county; but the farmers prefer lime as the most profitable, though at the distance of 18 or 20 miles. The minerals in this district hitherto discovered, are few, and these are by no means valuable. Coal has been found only in small quantities near Eyemouth. There is plenty of freestone fit for building, and both rock and shell marl are found in different places. Copper has been wrought in the neighbourhood of Lauder; and some years ago, a mine of the same metal was discovered in the parish of Buncle. The parish of Mordington contains ironstone, but of too small value to render it an object of manufacture. The rocks which compose the Lammermuir hills, are chiefly *schistus*, with alternate strata of sandstone. At Eyemouth is a rock of the species called puddingstone, in the pieces of which it is not uncommon to find fragments of porphyry, granite, and even limestone. Near the Whittadder, in the parish of Chirnside, is a species of gypsum, which has been of great use as a manure. The celebrated mineral well, called *Dunse Spa*, which is somewhat similar to Tunbridge, is situated about a mile from the town of Dunse. The rivers contain trout, and salmon; of which last a great quantity is annually exported from Berwick to London. From the situation of this county, on the border of England, it was necessary that it should be strongly fortified; accordingly, there are numerous strong castles and fortified places in almost every parish in the county. The following is the population of the county of Berwick according to the parishes, taken at two periods, from the Statistical History of Scotland.

	Parishes.	Population in 1755.	Population in 1790—98.
1	Abbey	80	164
	Ayton	797	1245
	Buncle	691	622
	Channelkirk	531	600
5	Chirnside	383	961
	Cockburnspath	919	883
	Coldingham	2313	2391
	Cranshaws	214	164
	Dunse	2593	3324
10	Earlston	1197	1351
	Eccles	1489	1780
	Edrom	898	1336
	Eyemouth	792	1000
	Fogo	566	450
15	Fouldean	465	344
	Gordon	737	912
	Greenlaw	895	1210
	Home	959	1000
	Hutton	751	920
20	Ladykirk	386	590
	Langton	290	435
	Lauder	1795	2000

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No.	Parishes.	Population in 1755.	Population in 1790—1798.
	Lennel	1493	2521
	Litgertwood	398	422
25	Longformacus	399	452
	Mertoun	502	557
	Mordington	181	335
	Nenthorn	497	400
	Polwarth	251	288
30	Swinton	494	898
	Westruther	591	730
32	Whitsome	399	590
		24946	30875
	Population in 1811		30,779

See BERWICKSHIRE, SUPPLEMENT.

BERWICK, *North*, a royal borough, and sea-port in the county of East Lothian in Scotland, containing 700 inhabitants. W. Long. 2. 29. N. Lat. 55. 56.

BERWICK-upon-Tweed, is a town on the border of England, and Scotland, and a county of itself. It stands on the north or the Scotish side of the river Tweed; and is pleasantly situated on an easy declivity, almost close to the sea. It has a ditch on the north and east; but on the south and west it has high walls, regularly fortified, and planted with cannon, and to which the river serves as a moat. The houses are generally well built; and the town-house is a handsome structure, with a lofty turret, in which are eight bells, and a fine clock which tells the quarters, with four dials, one on each side the square. The church is a neat building, but has no bells. The bridge is 947 feet long, and is supported by fifteen arches. The barracks form a large regular square, and will hold two regiments of foot very conveniently. The town is governed by a mayor, recorder, town-clerk, and four bailiffs; and has a coroner, a treasurer, four serjeants at mace, and a water bailiff. It had a strong castle, which now lies quite in ruins. It has a market on Saturdays, extremely well supplied; and a fair on Friday in Trinity-week for black cattle and horses. Corn and eggs are shipped from hence for London and other ports; but the principal trade is the salmon which are caught in the Tweed, and reckoned to be as good as any in the kingdom. Some are sent alive, and some pickled in kits by persons who subsist on that employment, and are called *salmon coopers*. A new pier was begun for the harbour in 1811. Though this town is not admitted to be either in England or Scotland, the English judges hold assizes here; and it is subject to the bishop of Durham. It sends two members to parliament. Population 7746 in 1811. W. Long. 1. 35. N. Lat. 55. 58.

BERY, or BURY, the villa or seat of habitation of a nobleman, a dwelling or mansion-house, being the chief of a manor: from the Saxon *beorg*, which signifies a *hill* or *castle*; for heretofore noblemen's seats were castles situated on hills, of which we have still some remains; as in Herefordshire there are the *beries* of Stockton, Hope, &c. It was anciently taken for a sanctuary.

BERY. See BERIA.

BERYL, in *Natural History*, called by our lapidaries *aqua marina*, is a pellucid gem of a bluish green colour, found in the East Indies and about the gold mines of Peru: we have also some from Silesia, but what are brought from thence are oftener coloured crystals than real beryls; and when they are genuine, they are greatly inferior both in hardness and lustre to the oriental and Peruvian kinds.

The beryl, like most other gems, is met with both in the pebble and columnar form, but in the latter most frequently. In the pebble form it usually appears of a roundish but flatted figure, and commonly full of small flat faces, irregularly disposed. In the columnar or crystalline form it always consists of hexangular columns, terminated by hexangular pyramids. It never receives any admixture of colour into it, nor loses the blue and green, but has its genuine tinge in the degrees from a very deep and dusky to the palest imaginable of the hue of sea-water.

The beryl, in its perfect state, approaches to the hardness of the garnet, but is often softer; and its size is from that of a small tare, to that of a pea, a horse-bean, or even a walnut. It may be imitated by adding to 20 pounds of crystal-glass made without magnesia, six ounces of calcined brass or copper, and a quarter of an ounce of prepared zaffre.—The properties of the beryl were very wonderful in the opinion of the ancient naturalists; it kept people from falling into ambuscades of enemies, excited courage in the fearful, and cured diseases of the eyes and stomach. It does none of these things now; because people are not simple enough to believe it has the virtue to do them.

BERYL-Crystal, in *Natural History*, a species of what Dr Hill calls *ellipomacrostyla*, or imperfect crystals, is of an extremely pure, clear, and equal texture, and scarce ever subject to the slightest films or blemishes. It is ever constant to the peculiarity of its figure, which is that of a long and slender column, remarkably tapering towards the top, and very irregularly hexangular. It is of a very fine transparence, and naturally of a pale brown, and carries such evident marks of distinction from all brown crystals, that our lapidaries call it, by way of eminence, the *beryl crystal*, or simply the *beryl*.

BERYTUS, in *Ancient Geography*, a sea-port town of Phœnicia on the Mediterranean, so ancient as to be thought to have been built by Saturn. It was destroyed by Tryphon, but rebuilt by the Romans. Agrippa placed here two legions, whence it became a colony. It enjoyed the *jus Italicum*, and had an excellent school for the study of the law in Justinian's time. Now BEROOT; which see.

BES, or BESSIS, in Roman antiquity, two-thirds of the as. See AS.

BES also denotes two-thirds of the jugerum. See JUGERUM.

BESAILE, signifies the father of a grandfather.

BESAILE, in *Law*, a writ that lies where the great-grandfather was seized in fee of any lands, &c. at the time of his death: and after his decease a stranger enters thereon, the same day, and keeps out the heir.

BESANCON, a city of France, capital of the Franche Compte, now the department of Doubs. It is one of the most ancient cities of Europe, was formerly the see of an archbishop, and had a parliament as well as a university. It is seated on the river Dreux, which

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which divides it into two parts, the greatest of which is a peninsula. The entrance is shut up by a mountain, on which they have built a large citadel, which commands all the city. There are many names of places in and about the city, that are plainly corruptions of the Latin, and are marks of its antiquity, as Chamars, *Campus Martis;* Chamuse, *Campus Musarum;* Chandane, *Campus Dianæ*, &c. The metropolitan church is built at the bottom of St Stephen's hill; and is a very handsome structure with a high tower steeple. The great altar is placed in the middle choir, where on high days they expose reliques in silver shrines, enriched with gold and jewels. There are several tombs and other things remarkable in the churches; and after you have past the church of Notre Dame, and the square that it looks into, you come to a triumphal arch, erected in honour of the emperor Aurelian, on which are several figures of men and animals, pretty entire. It serves as a gate to the cloister of St John the Great. The great hospital of the order of the Holy Ghost is a structure worth seeing. The streets are wide and handsome; and the houses are well built with free-stone, and covered with slate, chiefly about the square called *Battan*, which is adorned with a fountain, the water of which proceeds from a statue of Bacchus. The river Dreux is passed over by a stone bridge. The market-place is at the entrance; and on the left is another square, adorned with a fountain, where the great street begins. The new square is not far from this street, from whence you go to the town-house, which is a large structure with four wings, before the front of which is the statue of Charles V. in bronze, with a globe in one hand and a sword in the other. The imperial eagle is raised over a large bason, and spouts out water by both his beaks; and there is also a fountain adorned with the figure of a naked woman, with water springing out at her nipples. The university, which was dissolved at the revolution, was re-established as a lyceum and college in 1801. The population in 1815 was 28,200. E. Long. 6. 10. N. Lat. 47. 26.

BESANT, or BEZANT, a coin of pure gold, of an uncertain value, struck at Byzantium, in the time of the Christian emperors; from hence the gold offered by the king at the altar is called *besant* or *bisant*.

BESANTED, or BEZANTED. This word means *full of besants;* and is used to denote a field, ordinary, or charge, covered with above eight besants; for if there be but eight or fewer, their number must be particularly mentioned.

BESELEEL *and* OOLIAH, architects, sculptors, and painters, supposed to have made all the ornaments in brass, silver, &c. of the first tabernacle in the wilderness, 1490 B. C.

BESIERS, or BEZIERS, an ancient town of France, in Lower Languedoc, now the department of Herault, formerly a bishop's see, and containing 12,500 inhabitants in 1815. It has a delightful situation; and the country in which it stands is fertile in corn and oil, and produces excellent wine. It is seated on a hill near the river Orbe, in E. Long. 3. 23. N. Lat. 43. 21.

BESISTAN, or BERSTEIN: Thus, at Constantinople, Adrianople, and in some other towns within the Grand Signior's dominions, they call those places where the merchants have their shops, and expose their merchandises to sale. Each sort of merchants have their particular besistan, which must also be understood of the workmen, all those of the same trade working in the same place. These besistans are commonly large galleries, vaulted over, whose gates are shut every night. Sometimes the wardens and keepers of the besistans will answer for the merchandises, on paying them a very moderate perquisite for every shop.

BESLERIA. See BOTANY *Index*.

BESORCH, a coin of tin, or some alloyed metal, current at Ormus at the rate of $\frac{7}{17}$ parts of a farthing sterling.

BESOZZI, or BEZUTIUS, AMBROGIO, a painter of considerable eminence, was born at Milan in 1648. He worked some time under Gioseffo Danedi, called *Montalti:* he afterwards went to Rome, where he studied from the antiques and the pictures of the greatest masters; and at last perfected himself in the school of Ciro Ferri. His great excellency consisted in painting architecture, friezes, imitations of bass-relieves, and other decorations. He died at Milan in 1706, aged 58 years.

BESSARABIA, a territory lying between Moldavia, the Danube, and the Black sea, formerly belonging to Turkey, but ceded by that power to Russia in 1812. It is inhabited chiefly by Tartars, who maintain themselves by their cattle and husbandry. Their religion, manners, and customs, are the same with those of the Crim Tartars. The whole country contains about 8800 square miles, is level and fertile, but the inhabitants apply more to grazing than tillage. Although a number of small rivers traverse the country, both water and wood are scarce.

BESSARION, titular patriarch of Constantinople and archbishop of Nice, and one of those illustrious persons who contributed to the resurrection of letters in the 15th century, was born at Trebisond. He was very zealous to reunite the Greek with the Latin church, and engaged the emperor John Paleologus to interest himself in bringing this great work about. He passed into Italy, appeared at the council of Florence, harangued the fathers, and made himself admired as well by his modesty as by his uncommon abilities. The Greek schismatics conceived so great an aversion to him, that he was obliged to remain in Italy; where Pope Eugenius IV. honoured him with the purple in 1439. He fixed his abode at Rome, and would have been raised to the papal chair, if Cardinal Alain had not opposed it, as injurious to the Latin church, to choose a Greek however illustrious. He was employed in several embassies, but that to France proved fatal to him. When legate at this court, he happened to visit the duke of Burgundy, before he saw Louis XI. which so displeased the capricious haughty monarch, as to occasion him a very ungracious reception. Nay, the king even took the cardinal legate by his most magnificent beard, saying in his fine Latin, *Barbara Græca genus retinent quod habere solebant:* and this affront so chagrined the cardinal, as to occasion his death at Ravenna upon his return in 1472. This at least is what Matthieu relates in his History of Louis XI. Bessarion loved the literati, and protected them. Argyropilus, Theodore of Gaza, Poggius, Laurentius Valla, &c. formed in his house a kind of academy. His library was large and curious; and the senate of Venice, to whom he gave it, preserve it to this day with attention.

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attention and regard. He left some works, which rank among those that helped to revive letters; as, *Defensio Doctrinæ Platonicæ*, &c.; Translations of some Pieces of Aristotle; Orations; Epistles, &c.

BESSICA, in *Ancient Geography*, a district of Thrace towards Mount Hæmus, to the south of the Hebrus. It was inhabited by a fierce and barbarous people noted for their robberies. Their chief city Uscudama is now know by the name of *Adrianople*. They lived under their own kings till the consulate of M. Licinius Lucullus and C. Cassius Varus; when the consul Lucullus invaded their country, and having gained a great victory over them, took their metropolis, and subjected the whole nation to the Roman laws. The Romans, notwithstanding they had subdued them by force of arms, still suffered them to live under their own kings; for Piso, while he governed Macedon in quality of proconsul, having treacherously seized Rabocentus, whom Suetonius calls *prince of the Bessi*, caused him to be publicly beheaded. This affront so exasperated the whole nation that they revolted; but were overthrown in a great battle by Octavius the father of Augustus. During the civil wars of Rome they attempted anew to recover their liberty, but were again defeated by the famous M. Brutus. In the reign of Augustus one Vologesus, a native of the country, and priest of Bacchus, having, under pretence of religion, drawn together great crowds of people, made himself master of the whole country; and, entering the Chersonesus, committed there the most dreadful ravages. He was at last, however, overcome by L. Piso; who obliged the savage inhabitants to lay down their arms, and submit to such conditions as he was pleased to impose upon them. From this time the Bessi continued subject to the Romans, without attempting any more to regain their liberty.

BESSIS. See Bes.

BESTAIL, or Bestial, in ancient statutes, all kinds of beasts or cattle, especially those purveyed for the king's provision.

BESTIARII, in Roman antiquity, such as fought against beasts, or those who were exposed to them by sentence of the law. There were four kinds of bestiarii: the first were those who made a trade of it, and fought for money; the second were such young men as, to show their strength and dexterity in managing their arms, fought against beasts; the third kind was, where several bestiarii were let loose at once, well armed, against a number of beasts; and the fourth kind were those condemned to the beasts, consisting either of enemies taken prisoners in war, or as being slaves, and guilty of some enormous crime; these were all exposed naked, and without defence.

BESTRICIA, a town of Transylvania, remarkable for the gold mines in its neighbourhood. E. Long. 22. 5. N. Lat. 48. 0.

BETA, the Beet. See Botany and Agriculture *Index*.

BETANZOS, a town of Gallicia in Spain, seated on the Mandeo, and a bay of the sea, in W. Long. 7. 50. N. Lat. 43. 21.

BETEL, or Betle, in *Botany*, an Indian plant (a species of Piper), in great esteem in the east, where it makes a considerable article of commerce. See Piper. See also Betel, Supplement.

BETELFAGUI, a town of Asia, in Arabia Felix, famous for the vast quantity of coffee bought and sold there; being the mart where the country people bring their coffee to sell; and where the Europeans come, or send their factors or brokers, to purchase it. E. Long. 57. 20. N. Lat. 15. 40.

BETHABARA, in *Ancient Geography*, a term denoting *a passage*; and therefore by many referred to the passage at Jericho, where the Israelites passed over dry-shod; by Lightfoot, to the passage at Scythopolis: but Cellarius refers it to the midway between both; because there were doubtless several middle passages or fords on the Jordan. Here John is said to have baptized on the other side Jordan, (Evangelists).

BETHAGLA, or Beth-hagla, in *Ancient Geography*, a town of the tribe of Benjamin (Joshua xviii. 21.). In Jerome's time there was a village called *Agla*, ten miles from Eleutheropolis, towards Gaza, and supposed to be Bethagla.

BETHANY, in *Ancient Geography*, a village at the foot of Mount Olivet, on the side, about two miles to the east of Jerusalem, (John, Jerome); where Lazarus dwelt and was raised from the dead; and where happened the ascension of our Saviour.

BETHARAMPHTHA, in *Ancient Geography*, a town of Galilee, (Ptolemy) of the Peræa, (Josephus); which being walled round by Herod Antipas, was called *Julias*, after Julia, the daughter of Augustus, and consort of Tiberius: it stood to the north of the lake of Genesareth, at the influx of the Jordan into that lake; and here Dr Wells places Bethsaida.

BETHARAN, in *Ancient Geography*, a town of the Peræa, or on the other side Jordan. Said to be called *Livias*, or *Libias*, in the Greek manner, by Herod in honour of Livia, (Eusebius, Jerome); and of the same latitude almost with Jerusalem, (Ptolemy); called *Julius* by Josephus, who always calls the Livia of Augustus *Julia*.

BETHAVEN, in *Ancient Geography*, a town in the tribe of Ephraim, and a name given Bethel by Hosea, after the establishment of the idolatry of Jeroboam there; meaning it to have become the house of iniquity, from being the house of God; but Bethaven was a distinct town (Joshua vii. 2.) to the south-east of Bethel.

BETHEL, in *Ancient Geography*, a city of Samaria, on the borders of the tribe of Benjamin, anciently called *Luz*, (Moses); but they seem to be distinguished, (Joshua xvi. 2.). They were, however, contiguous places. Bethel was properly the place of Jacob's vision; and Luz, or Lus, an adjoining town, afterwards called *Bethel*, the former name being lost in that of *Bethel*. It was twelve miles to the north-east of Jerusalem (Jerome); and called *Bethaven* (Hosea).

BETHESDA, (called in the Greek, κολυμβηθρα προβατικη, and thence in the Vulgate, *Piscina Probatica*; because, according to some, the sheep were washed in it, which were appointed for sacrifices), was the Hebrew name for a pool or public bath, which had five porticos, piazzas, or covered walks, around it. This bath, for its singular usefulness, was called Bethesda, בית חסדה, or *Beth Chesda*, or the *house of Mercy*, because, as Pool in his Annotations observes, the erecting of baths was an act of great kindness to the common people, whose indispositions in hot countries required

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quired frequent bathing. However, some will have the word Bethesda to be ביתאשדה or the *sink-house*, or *drain*, because the waters which came from the temple, and the place where the victims were washed, flowed thither. From the Greek word κολυμβηθρα being used by Josephus (*Antiq.* xv. 3.) to denote the baths at Jericho, Dr Macknight, in his Harmony of the Gospels, concludes that their opinion seems to be without a proper foundation who affirm, that this pool served for washing the sheep designed for sacrifice before they were driven into the temple, and for washing the entrails of the beasts sacrificed there: besides, he thinks it inconsistent with the situation of Bethesda, *near the sheep-gate* (or *market*, as our English translators have rendered the Greek επι τη προβατικη κολυμβηθρα, though some copies have it, Εν τη, &c.) in the south-east wall of the city; or, according to the compilers of the Universal History, in that which was on the north-east, a great way from the temple. However this may be, we are told (John v. 2, 3, &c.) that in the porticos of this bath, at the time of a certain feast (which is generally supposed to have been the passover), there lay a multitude of impotent folk, such as the blind, halt, and withered, waiting for the moving of the water: for an angel went down at a certain period into the pool, and troubled the water; that is, moved it in a sensible manner. Whosoever then first, after the troubling of the water, stepped into it, was made whole of whatever disease he had. Some writers confine the miracle of the pool of Bethesda to the season of this particular feast mentioned in verse 1. of this chapter, because they understand κατα καιρον *by times* (verse 4), which our translators render *a certain season*, meant *at that season*; that is, the season mentioned verse 1.; and since the evangelist does not say that the waters of Bethesda had their sanative quality at any other feast, we are at liberty to make what supposition seems most convenient. Perhaps the silence of Philo and Josephus upon this miracle may induce some to think that it happened only at one passover; for though many infirm people lay in Bethesda, if the angel, as is probable, descended frequently during that solemnity, the miracle would be no sooner known, than multitudes would come and wait at the pool to be cured by the moving of the waters: however, if the number of the sick who gathered on this occasion, and the phrase κατα καιρον, shall incline any person to believe that the waters of Bethesda had an healing quality at other passovers also, Dr Macknight observes, that the silence of the writers before mentioned needs not be much regarded; it being well known that they have omitted greater transactions which they had an opportunity to know, viz. that multitude and variety of miracles which our Lord performed in the course of his ministry. That the waters of Bethesda should at this time have obtained a miraculous healing quality was, without doubt, as that writer remarks, in honour of the personal appearance of the Son of God on earth. Perhaps it was intended to show that Ezekiel's (xlvii.) vision of waters issuing out of the sanctuary was about to be fulfilled, of which waters it is said (ib. verse 9.) "They shall be healed, and every thing shall live whither the river cometh." But it must be observed, that the fourth verse of this chapter of St John is not in the Cambridge MSS. which formerly was Beza's, nor in one or two more of great authority. See Dr Mill's judgment of it in that part of his *Prolegomena* to which he refers the reader in his note on the text. But though it should be rejected, the difficulty for which some would have it cancelled, Dr Macknight observes, remains still: because the seventh verse implies that cures were performed in this pool, and that only one at a time was cured, and consequently that these cures were miraculous. If so, it is as easy to conceive that an angel moved the water, and gave it its healing quality, as to fancy those cures were performed miraculously any other way. Grotius thinks, that the angel is said to have descended, not because he was ever seen to do so, but because the Jews were persuaded that God brought such things to pass by the ministration of angels; so that from that violent motion of the water, and the cure following it, the presence of an angel was with reason supposed. Dr Hammond supposes, that the waters became medicinal by being impregnated with a healing warmth from the blood and entrails of the sacrificed beasts that were washed there; and that the αγγελος, *angel*, or *messenger*, in the text, is not to be understood of those celestial beings that are usually distinguished by that name, but only of a common messenger, viz. an officer or servant of the priest, who at a proper season was sent by him to stir the pool.

BETHLEHEM, a town of Palestine, famous for the birth of Jesus Christ. It was once a flourishing town, but is now only a poor village. It is situated two leagues south-east of Jerusalem, on an eminence, in a country full of hills and valleys, and might be rendered very agreeable. The soil is the best in all these districts: fruits, vines, olives, and sesamum succeed here extremely well; but cultivation is wanting. They reckon about 600 men in this village capable of bearing arms upon occasion; and this often occurs, sometimes to resist the pacha, sometimes to make war with the adjoining villages, and sometimes in consequence of intestine dissensions. Of these 600 men, about 100 are Latin Christians, who have a vicar dependent on the great convent of Jerusalem. Formerly their whole trade consisted in the manufacture of beads; but the reverend fathers not being able to find a sale for all they could furnish, they have resumed the cultivation of their lands. They make a white wine, which justifies the former celebrity of the wines of Judea, but it has the bad property of being very heady. The necessity of uniting for their common defence prevails over their religious differences, and makes the Christians live here in tolerable harmony with the Mahometans, their fellow-citizens. Both are of the party *Yamani*, which, in opposition to that called *Kaisi*, divides all Palestine into two factions, perpetually at variance. The courage of these peasants, which has been frequently tried, has rendered them formidable through all that country. Here is a church built by St Helena, in the form of a cross, which is very large; and from its top may be seen all the country round about. The roof is lofty, flat, and composed of cedar on the inside, and leaded without. Both sides of the nave are supported by two rows of marble pillars, each made of one piece, and eleven in a row, insomuch that they make as it were five naves, separated from each other by these rows of pillars, in each of which is the picture of some saint. On the wall over the pillars there

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is a very beautiful mosaic work, on a gold ground. The walls were formerly overlaid with fine marble, but the Turks have taken it to adorn their mosques. The three upper ends of the cross terminate in three semicircles, having in each an altar. Over the chancel there is a stately cupola, covered with lead on the outside, and within adorned with mosaic work. Close to the church is the monastery of the Franciscans; which is large, but indifferently built. The gardens are defended with strong walls, and at the north-west of them stands a tower now almost in ruins. Their chapel is better taken care of. Through this there is a passage to a square cave, where they say the Innocents were buried. Beyond this there are passages to the tombs of St Jerome, St Paula, Eustochium, and Eusebius of Cremona. Beyond these there is a grot or cell, which they say was the lodging place of St Jerome when he translated the Bible. Another entrance leads to a vault or chapel, 12 feet wide and 40 long, whose floor is paved, and sides lined with white marble, and the roof is adorned with mosaic work, now much decayed. At the end of this there is an arched concavity, with an altar, over which is a picture of the nativity, and under it a vault, the middle of which is a star made with stones of various colours, to mark the place where they say our Saviour was born; and near this is the manger where they pretend he was laid; it is hewn out of a rock, and is now flagged with white marble.

Bethlehem, a town of the Netherlands, in the province of Brabant, subject to the house of Austria. E. Long. 4. 40. N. Lat. 51. 2.

BETHLEHEMITES, or Bethlemites, in church history, a sort of monks introduced into England in the year 1257, habited like the Dominicans, except that, on their breast, they wore a star with five rays, in memory of the star or comet which appeared over Bethlehem at the nativity of our Saviour. They were celled at Cambridge, and had only one house in England.

There is also an order of Bethlehemites still subsisting in Peru, who have convents at Lima; one called of the Incurables, the other of our Lady of Mount Carmel. These Bethlehemites came originally from the city of Guatimala in Mexico, where they were instituted by the venerable Peter Joseph of Betaneur, for the service of the poor. Innocent XI. in 1687, approved the institute. They have already nine convents in Peru.

The Bethlehemites, though outwardly of great simplicity, pass for the most refined politicians; insomuch as to be called the quintessence of the Carmelites and Jesuits. They are all friars. For their almoner they choose a secular priest, whom they hire, and who has no vote in the chapter.

BETHORON, in *Ancient Geography*, a town of Samaria; Upper and Nether, and both in the tribe of Ephraim, built by Shera grand-daughter of Ephraim, 1 Chron. viii. 24. both which were restored by Solomon, after falling to decay, 1 Kings ix. 17. and 2 Chron. viii. 5. Their distance was almost the whole breadth of the tribe of Ephraim, the Upper being in the north, the Nether in the south, of that tribe, Joshua xvi. We know more of the Nether than of the Upper; it was situated on a mountain, and therefore Josephus and Jerome mention going up or ascending; and it stood on the public road to Lydda and Cæsarea, distant an hundred stadia, or twelve miles, from Jerusalem: and on account of this vicinity, some allot it to the tribe of Benjamin.

BETH-PEOR, in *Ancient Geography*, a town of the Reubenites, on the other side Jordan, at Mount Fogor, over against Jericho, six miles above Livias. It had a temple sacred to the idol Baal-Peor, Numbers xxv. 3. called Beel-Phegor by the Vulgate, interpreted Priapus by Jerome.

BETHPHAGE, in *Ancient Geography*, a place at the west descent or declivity of Mount Olivet, Matthew xxi. 1. From which it may be gathered, that the whole of that declivity, with a part of the valley, and the extreme skirts of the city, went under the common name of Bethphage.

BETHSAIDA. See Betharamphtha.

BETHSAN, or Bethsean, in *Ancient Geography*, a town of Samaria, in the half tribe of Manasseh, on the borders of Galilee, about half a league from Jordan, on this side, having half of its territory in the Peræa: it was afterwards called *Scythopolis*: it was distant from Tiberias, situated on the lake Genesareth, 120 stadia, or 15 miles, to the south; and from Jerusalem to the north, 600 stadia, or 75 miles. As to the origin of the appellation Scythopolis, there scarce appears any thing in history that has a relation to it, but the irruption of the Scythians in the time of the Medes, when they overran all Asia. It was the greatest city of all the Decapolis, (Josephus). It is called Baeson by Stephanus.

BETHUNE, Maximilian de, duke of Sully, grand-master of the artillery, and marshal of France, sovereign prince of Enrichemont and Bois-Bell, marquis of Rosny, and one of the ablest and most upright ministers France ever had, was descended from an illustrious house, and was born in 1560. He entered very young into the service of Henry of Bourbon then king of Navarre, afterwards Henry IV. of France, who was only seven years older than Sully. He was bred in the reformed religion, and continued in the profession of it to the end of his life, though from political motives he advised his master to abjure it, as the only method of putting an end to the miseries of France. After Henry had gained possession of the kingdom, Sully performed all the duties of a great and good minister, while his master exercised all the offices of a great and good king. He had been at the battles of Coutras, Arques, and Ivry; at the sieges of Paris, Noyon, Rouen, and Laon; and signalized himself on every important occasion. In 1597 he was made chief overseer of the highways of France; and the following year was raised to the post of superintendant of the finances. Though he was then but 40 years of age, and had hitherto signalized himself only in the army, he put the king's finances in such order, that he paid his debts, which amounted to two hundred millions of livres, and laid up great sums in the king's treasury. In 1601 he was made grand-master of the artillery, the next year governor of the Bastile, and afterwards superintendant of the fortifications. He was then sent into England as ambassador extraordinary; and had, at his return, the government of Poictou. At last Henry IV. in 1606, erected in his favour the territory of Sully on the Loire into a duchy and peerage, and

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made him grand-master of the ports and havens. After the murder of that great prince in 1610, the duke of Sully, who had served him with the greatest zeal and fidelity, was obliged to retire to one of his houses, where he enjoyed a private life; but in 1634 he was made marshal of France, upon which he resigned the post of grand-master of the artillery. He died in his castle of Villebon on the 21st of December 1641, at 82 years of age. His memoirs are ranked among the best books of French history: they contain a most particular account of whatever passed from the peace of 1570 to the death of Henry IV. in 1610: and acquire additional value from the many curious personal anecdotes preserved in them. They were translated into English by Mrs Lennox in 1757.

Bethune, a town of France, in the department of the Straits of Calais, containing upwards of 5000 inhabitants. There is an entrance into this city through four gates, and it is surrounded with walls and fortified. The city and the castle taken together are of a triangular figure, but the castle itself is a very irregular building. The houses are very indifferent, and the streets ill paved; however, there is a large handsome square and several churches. In the marshy lands near the city there are several canals cut for the conveniency of whitening linen. It is seated on a rock by the river Belfe. E. Long. 2. 48. N. Lat. 50. 32.

BETIS, governor of Gaza under Darius, famous for his valour and loyalty. He defended a place of consequence with a few men against Alexander, who was there shot through the shoulder. Betis thinking him slain, returned triumphantly to the city; but in a second assault he was wounded and brought to Alexander, who cruelly ordered him to be put to death.

BETLEY, a town of Staffordshire in England. It is seated on the confines of the county, next to Cheshire, in a barren sandy soil. W. Long. 2. 15. N. Lat. 53. 0.

BETLIS, a strong town of Armenia or Turcomania, belonging to a bey or prince of the country, who is very powerful, and is subject to neither the grand signior nor king of Persia. It lies on the road from Tauris to Aleppo, and the prince can stop caravans whenever he pleases; for the passage between the mountains is so narrow, that ten men can defend it against 1000. The town is seated between two mountains about a cannon-shot from each other, and the castle is on an eminence exactly in the middle. This eminence is in the shape of a sugar-loaf; and is so steep on all sides, that it is impossible to get up but by winding round about it. The people in and about the town are shepherds, but are ready to take up arms at the command of their prince. E. Long. 42. 40. N. Lat. 37. 20.

BETON, a name given by the French engineers to a kind of mortar, which they use in raising the foundations of masonry under water. It consists of twelve parts of pozzolana or Dutch tarrass, six of good sand, nine of unslaked lime, thirteen of stone splinters about the size of an egg, and three of tile-dust or cinders, or scales of iron out of a forge; this being well worked together, is left to stand for about 24 hours, or till it becomes so hard as not to be separated without a pickaxe.

BETONICA, Betony. See Botany *Index*.

Betonica Aquatica. See Scrophularia, Botany *Index*.

Betonica Pauli. See Veronica, Botany *Index*.

BETONY. See Betonica, Botany *Index*.

BETROTHMENT, a mutual promise or compact between two parties for a future marriage. The word imports as much as giving one's troth; that is, true faith, or promise. Betrothment amounts to the same with what is called by civilians and canonists *sponsalia*, or "espousals;" sometimes *desponsation*, and by the French *fiancailles*.

BETTERTON, Thomas, the celebrated actor, was the son of Mr Betterton, under-cook to King Charles I. and was born in Tothil-street Westminster in the year 1635. Having received the first rudiments of a genteel education, his fondness for reading induced him to request of his parents that they would bind him an apprentice to a bookseller, which was readily complied with, fixing on one Mr Rhodes near Charing-cross for his master. This gentleman, who had been wardrobe-keeper to the theatre in Blackfriars before the troubles, obtained a license in 1659, from the powers then in being, to set up a company of players in the Cockpit in Drury-Lane, in which company Mr Betterton entered himself, and, though not much above 20 years of age, immediately gave proof of the most capital genius and merit.

Soon after the Restoration, two distinct theatres were established by royal authority: the one in Drury-Lane in consequence of a patent granted to Henry Killigrew, Esq. which was called the *King's Company*: the other in Lincoln's-Inn-Fields, who styled themselves the *Duke of York's Servants*, the patentee of which was the ingenious Sir William Davenant; which last-mentioned gentleman having long had a close intimacy with and warm friendship for Mr Rhodes, engaged Mr Betterton, and all who had acted under Mr Rhodes, into his company; which opened in 1662 with a new play of Sir William's, in two parts, called the *Siege of Rhodes*. In this piece, as well as in the subsequent characters which Mr Betterton performed, he increased his reputation and esteem with the public, and indeed became so much in favour with King Charles II. that by his majesty's special command he went over to Paris to take a view of the French stage, that he might the better judge what would contribute to the improvement of our own; and it was upon this occasion, as is generally supposed, that moving scenes were first introduced upon the English theatre, which before had been only hung with tapestry.

In the year 1670 he married one Mrs Sanderson, a female performer on the same stage; who, both as an actress and a woman, was every thing that human perfection was capable of arriving at, and with whom he through the whole course of his remaining life possessed every degree of happiness that a perfect union of hearts can bestow.

When the duke's company removed to Dorset-Gardens, he still continued with them; and on the coalition of the two companies in 1684, he acceded to the treaty, and remained among them; Mrs Betterton maintaining the same foremost figure among the women that her husband supported among the male performers. And so great was the estimation that they were both held in, that in the year 1675, when a pastoral

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Betterton. storal called *Calista*, or the *Chaste Nymph*, written by Mr Crown, at the desire of Queen Catharine consort to Charles II. was to be performed at court by persons of the greatest distinction, our English Roscius was employed to instruct the gentlemen, and Mrs Betterton honoured with the tutorage of the ladies, among whom were the two princesses Mary and Anne, daughters of the duke of York, both of whom succeeded to the crown of these realms. In grateful remembrance of which, the latter of them,' when queen, settled a pension of 100l. per annum on her old instructress.

In 1693, Mr Betterton having sounded the inclinations of a select number of the actors whom he found ready to join with him, obtained, through the influence of the earl of Dorset, the royal license for acting in a separate theatre; and was very soon enabled, by the voluntary subscriptions of many persons of quality, to erect a new playhouse within the walls of the Tennis Court in Lincoln's-Inn-Fields. To this step Mr Betterton is said to have been induced, partly by ill treatment from the managers, and partly with a view to repair, by the more enlarged profits of a manager, the loss of his whole fortune (upwards of 2000l.), which he had undergone in the year 1692, by adventuring it in a commercial scheme to the East Indies. Be this, however, as it will, the new theatre opened in 1695 with Mr Congreve's Love for Love, the success of which was amazingly great. Yet, in a few years, it appeared that the profits arising from this theatre, opposed as it was by all the strength of Cibber's and Vanbrugh's writings at the other house, were very insignificant; and Mr Betterton growing now into the infirmities of age, and labouring under violent attacks of the gout, he gladly quitted at once the fatigues of management and the hurry of the stage.

The public, however, who retained a grateful sense of the pleasure they had frequently received from this theatrical veteran, and sensible of the narrowness of his circumstances, resolved to continue the marks of their esteem to him by giving him a benefit. On the 7th of April 1709 the comedy of Love for Love was performed for this purpose, in which this gentleman himself, though then upwards of 70 years of age, acted the youthful part of Valentine; as in the September following he did that of Hamlet, his performance of which the author of the Tatler has taken particular notice of. On the former occasion, those very eminent performers, Mrs Barry, Mrs Bracegirdle, and Mr Dogget, who had all quitted the stage some years before, in gratitude to one whom they had had so many obligations to, acted the parts of Angelica, Mrs Frail, and Ben; and Mr Rowe wrote an epilogue for that night, which was spoken by the two ladies, supporting between them this once powerful supporter of the English stage. The profits of this night are said to have amounted to upwards of 500l. the prices having been raised to the same that the operas and oratorios are at present; and when the curtain drew up, almost as large an audience appearing behind as before it.

The next winter Mr Betterton was prevailed on by Mr Owen M'Swinney, then manager of the opera-house in the Hay-market (at which plays were acted four times a week) to continue performing, though but seldom. In consequence of which, in the ensuing spring, viz. on the 25th of April 1710, another play was given out for this gentleman's benefit, viz. The Maid's Tragedy of Beaumont and Fletcher, in which he himself performed his celebrated part of Melanthus. This, however, was the last time of his appearing upon the stage. For having been suddenly seized with the gout, and being impatient at the thoughts of disappointing his friends, he made use of outward applications to reduce the swellings of his feet, which enabled him to walk on the stage, though obliged to have his foot in a slipper. But although he acted that day with unusual spirit and briskness, and met with universal applause, yet he paid very dear for this tribute he had paid to the public; for the fomentations he had made use of occasioning a revulsion of the gouty humour to the nobler parts, threw the distemper up into his head, and terminated his life on the 28th of that month. On the 2d of May his body was interred with much ceremony in the cloister of Westminster, and great honour paid to his memory by his friend the Tatler, who has related in a very pathetic, and at the same time the most dignified manner, the process of the ceremonial. As an author, Mr Betterton had a considerable degree of merit. His dramatic works are, 1. Amorous Widow, a comedy. 2. Dioclesian, a dramatic opera. 3. Masque in the Opera of the Prophetess. 4. Revenge, a comedy. 5. Unjust Judge, a tragedy. 6. Woman made a justice, a comedy. As an actor, he was certainly one of the greatest of either his own or any other age; but those who are desirous of having him painted out in the most lively colours to their imagination, we must refer to the description given of him by his cotemporary and friend Colley Cibber, in the Apology for his own life.

Betterton | Bevelling.

BETTINELLI, Xavier, a late Italian writer. See Supplement.

BETUE, or Betaw, a territory of the Low Countries in the duchy of Guelderland, between the rivers Rhine and Leck.

BETULA, the Birch-tree. See Botany *Index*.

BETULEIUS, Sixtus, an able grammarian, a good Latin poet and philosopher, born at Memmingen in the year 1500; his true name was *Birck*. He taught the belles lettres and philosophy with reputation; and became principal of the college of Augsburg, where he died on the 16th of June 1554. He published several works in prose; and his dramatic pieces of Joseph, Susannah, and Judith, are esteemed.

BEVECUM, a town of the Netherlands, in the province of Brabant. E. Long. 4. 50. N. Lat. 50. 45.

BEVEL, among masons, carpenters, &c. a kind of square, one leg whereof is frequently crooked, according to the sweep of an arch or vault. It is moveable on a centre, and so may be set to any angle.

Bevel-Angle, any other angle besides those of 90 or 45 degrees.

BEVELAND, North and South, two islands in the province of Zealand, between the eastern and western branches of the river Scheldt, making part of the United Provinces.

BEVELLING, in ship-building, the art of hewing a timber with a proper and regular curve, according to a mould which is laid on one side of its surface. "In order to hew any piece of timber to its proper bevel,

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bevel, it will be necessary, first, to make one side *fair* and *out of winding*; a term used to signify that the side of a timber should be a plane. If this side be uppermost, and placed horizontally, or upon a level, it is plain, if the timber is to be hewed square, it may be done by a plummet and line; but if the timber is not hewed square, the line will not touch both the upper and lower edge of the piece; or if a square be applied to it, there will be wood wanting either at the upper or lower side. This is called *within* or *without* a square. When the wood is deficient at the under side, it is called *under-bevelling*; and when it is deficient on the upper side, it is called *standing-bevelling*; and this deficiency will be more or less according to the depth of the piece; so that, before the proper bevellings of the timbers are found, it will be sometimes very convenient to assign the breadth of the timbers; nay, in most cases it will be absolutely necessary, especially afore and abaft: though the breadth of two timbers, or the timber and room, which includes the two timbers and the space between them, may be taken without any sensible error, as far as the square body goes. For as one line represents the moulding side of two timbers, the foreside of the one being supposed to unite with the aft-side of the other; the two may be considered as one entire piece of timber." *Murray's Ship-Building.*

BEVERAGE, in a general sense, signifies a *drink*: hence nectar is said to be the beverage of the gods. In writers of the middle age, beverage, *beveragium*, or *biberagium*, denotes money to give to an artificer, or other person, to drink, over and above his hire or wages.

BEVERIDGE, William, a learned English bishop, in the beginning of the 18th century, was born in the year 1638, and educated in St John's college Cambridge, where he distinguished himself very early by his extensive learning, and particularly by his knowledge of the oriental languages. Upon the deprivation of Dr Thomas Ken, bishop of Bath and Wells, for not taking the oaths to the government in 1691, he refused the offer of that see, though he was then chaplain to King William and Queen Mary. In 1704 he was consecrated to the bishopric of St Asaph; in which high function he so behaved himself all along, and discharged it in so exemplary a manner, that he approved himself a truly primitive prelate. He died at his lodgings in the Cloisters in Westminster-abbey in 1707; aged 69. As his whole life was spent in acts of piety and charity, so he gave remarkable instances of both at his death, leaving the bulk of his estate for the propagation of the gospel, and promoting of Christian knowledge, at home as well as abroad. His Private Thoughts upon a Christian Life is a very popular, though in many points a very exceptionable, book. He wrote several other works on various subjects, particularly on the oriental tongues.

BEVERLAND, Hadrian, a man of excellent genius in the end of the 17th century, but who prostituted it in the study and composition of books of a very obnoxious kind. He was a perfect master of Ovid, Catullus, Petronius, and authors of that stamp. He is famous for his book on Original Sin, in which he maintained, that Adam's sin consisted in his commerce with his wife, and that original sin is nothing else but the inclination of the sexes to each other: it was condemned to be burnt. He led a scandalous life, but seems to have repented of his wicked manners and lewd writings; for he published a treatise in the end of his life, *De Fornicatione Cavenda*, in 1698. It is said he died mad.

BEVERLEY, a town of Yorkshire, governed by a mayor, a recorder, 12 aldermen, &c. and sends two members to parliament. The minster here is a very fair and neat structure, and the roof is an arch of stone. In it are several monuments of the Percies, earls of Northumberland, who had added a little chapel to the choir, in the windows whereof there are several pictures of that family painted on glass. At the upper end of the choir, at the right of the altar-place, stands the freed stool, made of one entire stone, to which every one that fled had a right of protection. At the upper end of the body of the church, next the choir, hangs an ancient table, with the picture of King Athelstane, who founded the church. Between them is this inscription:

Als free make I thee,
As heart can wish, or egh can see.

Hence the inhabitants pay no toll in any town or port in England. In the body of the church stands an ancient monument, called the *Virgins Tomb*, because two virgin-sisters lie buried there, who gave the town a piece of land, into which any free man may put three milk-cows from Lady-day to Michaelmas. At the lower end of the body of the church is a large font of agate stone.

Near the minster, on the south side of it, is a place called *Hall-Garth*, wherein they keep a court of record, called *Provost's Court*. In this, causes arising within the liberties may be tried for any sum. The liberties contain above 100 towns and parts of towns, in Holdernesse and other parts of the east riding belonging to it. The town is a mile in length, having pleasant springs running quite through it. It is beautified with two stately churches; and has a free-school, with two fellowships, six scholarships, and three exhibitions in St John's college, Cambridge, belonging to it; besides six alms-houses, where none are admitted but those that give bond to leave their effects to the poor when they die. The principal trade of this town is making malt, oatmeal, and tanned leather; and the poor people chiefly support themselves by making bone-lace. About a mile east from the town, there is a mineral water, which cures eruptions of the skin, and is beneficial in the king's evil. Population 6035 in 1811. E. Long. 0. 9. N. Lat. 53. 50.

BEVERLY, a sea-port of Massachusets in North America, separated from Salem by a bridge. It is 20 miles north of Boston, in N. Lat. 42. 31. W. Long. 70. 50.

Beverly, *John of*, in Latin *Joannes Beverlacius*, archbishop of York in the eighth century, was born of a noble family at Harpham in Northumberland, and was justly esteemed one of the best scholars of his time. He was first a monk, and afterwards abbot of the monastery of St Hilda, when his merit recommended him to the favour of Alfred king of Northumberland, who in the year 685 advanced him to the see of Hagustald or Hexham, and in 687 translated him to the archbishopric of York. This prelate was tutor to the famous Bede; and lived in the strictest

strictest friendship with Acca and other Anglo-Saxon doctors, several of whom he engaged to write comments on the Holy Scriptures. In 704, he founded a college at Beverly for secular priests; and after he had governed the see of York 34 years, being tired of the tumults and confusions that prevailed in the church, divested himself of his episcopal character, and retired to Beverly; where he died four years after, on the 7th of May 721.—Bede and other monkish writers ascribe several miracles to him. Between 300 and 400 years after his death, his body was taken up by Alfric archbishop of York, and placed in a shrine richly adorned with silver, gold, and precious stones; and in 1416, the day of his death was, by a synod held at London, appointed a festival. We are told that William the Conqueror, when he ravaged Northumberland with a numerous army, spared Beverly alone, out of a religious veneration for St John of that place. This prelate wrote some pieces which are mentioned by Bale and Pits, viz. 1. *Pro Luca exponenda.* 2. *Homiliæ in Evangelica.* 3. *Epistolæ ad Hildum Abbatissam.* 4. *Epistolæ ad Herebaldum, Andenum et Bertinum.*

BEVERUNGEN, a town of Germany, in the diocese of Paderborn, seated at the confluence of the rivers Beve and Weser, in E. Long. 9. 30. N. Lat. 51. 40.

BEVILE, in *Heraldry*, a thing broken or opening like a carpenter's rule: Thus we say, he beareth argent, a chief bevile, vert, by the name of *Beverlis.*

BEVIN, Elway, a musician eminently skilled in the knowledge of practical composition, flourished towards the end of Queen Elizabeth's reign. He was of Welsh extraction, and had been educated under Tallis, upon whose recommendation it was that in 1589 he was sworn in gentleman extraordinary of the chapel; from whence he was expelled in 1637, it being discovered that he adhered to the Romish communion. He was also organist of Bristol cathedral, but forfeited that employment at the same time with his place in the chapel. Child, afterwards Doctor, was his scholar. He has composed sundry services, and a few anthems. Before Bevin's time the precepts for the composition of canon were known to few. Tallis, Bird, Waterhouse, and Farmer, were eminently skilled in this most abstruse part of musical practice. Every canon, as given to the public, was a kind of enigma. Compositions of this kind were sometimes exhibited in the form of a cross, sometimes in that of a circle; there is now extant one resembling a horizontal sun-dial: and the *resolution* (as it was called) of a canon, which was the resolving it into its elements and reducing it into score, was deemed a work of almost as great difficulty as the original composition. But Bevin, with a view to the improvement of students, generously communicated the result of many years study and experience, in a treatise which is highly commended by all who have taken occasion to speak of it. This book was published in 4to, in 1631, and dedicated to Goodman bishop of Gloucester, with the following title: 'A briefe and short instruction of the art of music, to teach how to make discant of all proportions that are in use: very necessary for all such as are desirous to attain to knowledge in the art; and may by practice, if they can sing, soon be able to compose three, four, and five parts, and also to compose all sorts of canons that are usual, by these directions of two or three parts in one upon the plain song.' The rules contained in this book, for composition, in general are very brief; but for the composition of canon there are in it a great variety of examples of almost all the possible forms in which it is capable of being constructed, even to the extent of 60 parts.

Hawkins's Hist. of Music.

BEWDLY, a town of Worcestershire in England, seated on the bank of the river Severn, in W. Long. 2. 20. N. Lat. 52. 25. It has its name *Bewdley, Beawley,* or *Beaulieu,* from its pleasant situation on the declivity of a hill overlooking the river, and commanding a fine prospect of the country, and formerly of the forest of Wyre, remarkable for its tall stately oaks and other trees, which have since been either blown or cut down. It was formerly accounted so delightful a place, that Henry VII. built a house here for Prince Arthur, which he called *Tiken-hall.* Bewdley sent burgesses to parliament very early, and had charters and great privileges from Edward IV. and Henry VII. which were confirmed with the addition of others, by Henry VIII. in whose time it was annexed to the county of Worcester. King James I. granted it a charter; of which a surrender was procured in Charles II.'s time, and the corporation was new-modelled. King James II. compelled it to accept of a new charter; but the former surrender, upon a trial, was held void, and a new charter was obtained of Queen Anne. In consequence of this it is governed by a bailiff and burgesses, recorder, steward, town-clerk, &c. The town is neat and well built; and carries on a considerable trade, by means of the Severn, in salt, glass, iron-ware, and Manchester goods; but its chief manufacture is in caps, commonly called *Monmouth Caps.* Bewdly contained 3454 inhabitants in 1811.

BEWITS, in falconry, pieces of leather, to which a hawk's bells are fastened, and buttoned to his legs.

BEY, among the Turks, signifies a governor of a country or town. The Turks write it *begh* or *bek,* but pronounce it *bey.*

The word is particularly applied to a lord of a banner, whom, in the same language, they call *sangiac beg* or *bey.* Every province in Turkey is divided into seven sangiacs, or banners, each of which qualifies a bey; and these are all commanded by the governor of the province, whom they also call *beglerbeg,* that is, lord of all the beghs or beys of the province: these beys are much the same as banners were formerly in England.

Bey of Tunis, denotes a prince or king thereof; answering to what at Algiers is called the *dey.* In the kingdom of Algiers, each province is governed by a bey, or viceroy, who is appointed and removed at pleasure by the dey; but has a despotic power within his jurisdiction.

BEYKANEER, or Bicanere, a principality of Hindostan. See Supplement.

BEYS, Giles, a celebrated printer at Paris, in the 16th century, and the first introducer of the consonants j and v.

BEZA, Theodore, one of the principal pillars of the reformed church, was born at Vezelai, in Burgundy, June 24th, 1519. He was brought up by his uncle

uncle Nicholas de Beza, counsellor of the parliament of Paris, till the month of December 1528, when he sent him to study at Orleans, and afterwards at Bourges, where he was under the care of Melchior Wolmar, under whom he made an extraordinary progress in polite learning, and from him imbibed the principles of Calvinism. His uncle intended him for the bar; but the law not suiting his disposition, he spent most of his time in reading the Greek and Latin authors, and in composing verses. In 1539, he took up his licentiate's degree, and went to Paris. He fell into snares in his youth, and wrote some licentious things. Sickness awakened him; and he pursued a vow, he had formerly made, of entering into the reformed religion. According to this resolution, he went to Geneva and made public profession of the reformed religion. In 1549, he accepted of the Greek professorship at Lausanne, where he also read lectures in French on the New Testament to the refugees of both sexes who dwelt in that city. Having settled at Geneva, he adhered to Calvin in the strictest manner, and became in a little time his colleague in the church and in the university. He was sent to Nerac, at the solicitation of some great men of the kingdom, to convert the king of Navarre, and to confer with him upon affairs of importance. This was when the Guises had got the authority under the reign of Francis II. to the prejudice of the princes of the blood. The king of Navarre having testified, both by letters and deputies, that he desired that Beza might assist at the conference of Poissi, the senate of Geneva consented. The assembly hearkened attentively to his harangue, till, speaking of the real presence, he said, that the body of Jesus Christ was as distant from the bread and wine, as the highest heaven is from the earth. This made a murmur: some cried out, *Blasphemavit!* others got up to go away. Cardinal de Tournon, who sat in the first place, desired the king and queen either to silence Beza, or to permit him and his company to withdraw. The king did not stir, nor any of the princes; and leave was given to go on. Throughout the whole conference he behaved himself with great ability. He often preached before the queen of Navarre, the prince of Condé, and in the suburbs of Paris. After the massacre of Vassi, he was deputed to the king to complain of this violence. The civil war followed soon after, during which the prince of Condé kept him with him; and while the prince was imprisoned, he lived with Admiral de Coligni, and did not return to Geneva till after the peace 1563. In 1571, he was chosen moderator at the national synod of Rochelle: and in the year after, assisted at that of Nismes; after this, he assisted at the conferences of Montbeliard, and at those of Bern. The infirmities of old age beginning to fall heavy upon him in 1597, he could seldom speak in public: and at last he left it off entirely in the beginning of the year 1600. However, in 1597, he wrote some animated verses against the Jesuits, on the occasion of the report that was made of his death, and of his having before he died made profession of the Roman faith. He lived till the 13th of October 1605. He was a man of extraordinary merit, and one who did great services to the Protestant cause. This, however, exposed him to innumerable slanders and calumnies; but he showed both to the Catholics and Lutherans, that he understood how to defend himself. He wrote, 1. A Translation of the New Testament; 2. Turned the Psalms into Latin verse; 3. Published a Treatise on the Sacraments; 4. Some Sermons on the Passion of Jesus Christ and on Solomon's Song; 5. A version of the Canticles, in lyric verse; 6. A French tragi-comedy, entitled, The Sacrifice of Abraham; and many other pieces.

BEZANS, cotton cloths, which come from Bengal: some are white, and others stripped with several colours.

BEZANTLER, the branch of a deer's horn next below the brow-antler.

BEZOAR, in *Natural History* and *Medicine*, a general name for certain animal substances supposed to be effectual in preventing the fatal consequences of poison. The word comes from the Persian *badzcher*, *bazcher*, or *pahazar*, which signifies an antidote.

The first mention made of bezoar is in Avenzoar, an Arabian physician, who gives a very romantic account of its origin. He describes it as generated of the tears or gum of the eyes of stags; who, after eating serpents, used to run into the water up to the nose, where they stood till their eyes began to ooze a humour, which, collecting under the eye-lids, gradually thickened and coagulated, till, being grown hard, it was thrown off by the animal in rubbing frequently. Other opinions no less fabulous obtained till the time of Garcias al Horto, physician to the Portuguese viceroy of the Indies, who gave the first genuine account of it. Kempfer afterwards gave a description of it, with some new particulars.

The bezoar is a calculous concretion found in the stomach of certain animals of the goat kind. See CAPRA. It is composed of concentrical coats surrounding one another, with a little cavity in the middle, containing a bit of wood, straw, hair, or the like substances.

There are two sorts of bezoar; one brought from Persia and the East Indies, the other from the Spanish West Indies. The first or best sort, called *oriental bezoar*, is of a shining dark-green or olive colour, and an even smooth surface; on removing the outward coat, that which lies underneath it appears likewise smooth and shining. The *occidental* has a rough surface, and less of a green colour then the foregoing; it is likewise much heavier, more brittle, and of a looser texture; the coats are thicker, and on breaking exhibit a number of striæ curiously interwoven. The oriental is generally less than a walnut; the occidental for the most part larger, and sometimes as big as a goose egg. The first is universally most esteemed, and is the only sort now retained by the London college; the Edinburgh, in the edition of their pharmacopœia preceding the present, directed both; but they now seem to allow them to be used promiscuously, retaining in their catalogue only the name *bezoar lapis*.

This stone is in high esteem among the Persians, and even of greater value than in Europe, which, with sundry other circumstances needless to relate here, has given occasion to many to suspect, that the true bezoar is never brought to us. Some authors relate with great confidence, that all the stones commonly sold under this name are artificial compositions. That some of them are so, is evident; hence the great differences in the accounts which different persons have given of their qualities:

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qualities: the stones examined by Slare as oriental bezoar did not dissolve in acids; those which Grew and Boyle made trial of, did; those employed by Geoffroy (in some experiments related in the French memoirs 1710) did not seem to be acted on by rectified spirits; whilst some of those examined by Neumann at Berlin almost totally dissolved therein. The common mark of the goodness of this stone, is its striking a deep green colour on white paper that has been rubbed with chalk.

Bezoar was not known to the ancient Greeks, and is first taken notice of by the Arabians (as above mentioned), who extol it in a great variety of disorders, particularly against poisons. Later writers also bestow extraordinary commendations on it as a sudorific and alexipharmac; virtues to which it certainly has no pretence. It has no smell or taste, is not digestible in the stomach of the animal in which it is found, and is scarce capable of being acted on by any of the juices of the human body. It cannot be considered in any other light than as an absorbent; and is much the weakest of all the common substances of that class. It has been given to half a dram, and sometimes a whole dram, without any sensible effect; though the general dose (on account of its great price) is only a few grains.

Bezoar, in a more extensive sense, includes all substances formed stratum super stratum in the stomachs or intestines of animals; in which sense pearls, the concretions called *crabs-eyes*, &c. belong to the class of bezoars. To this also belong the hippolithus, or *bezoar equinum*, a stone sometimes found in the stomach or intestines of a horse: the monkey-bezoar, a stone said to be found in the stomachs of certain monkeys in Brazil and the East Indies, harder than the oriental bezoar, of a dark green colour, and very costly on account of its scarcity.—*Bezoar bovinum*, is a yellowish stone found in the ox's gall-bladder.—*Human bezoars* are stony substances found in the intestines of several persons, formed from the stones of plums, or other fruits, retained in the cœcum or other guts, and growing coated over, of which we have an instance given by Dr Cole, Phil. Trans. N° 235.—*Bezoar microcosmicum* is the same with the human calculus; and is various in its degrees of hardness, as well as in its size and figure. It has been used in the place of the more costly sorts.—As to the *bezoar hystricis*, a concretion found in the gall-bladder of an Indian porcupine; and the German bezoar, or that found in mountain deer, especially on the Alps; these, not being stones, are more properly called by late writers *egagrophilæ;* the former consisting of woolly fibres, and a bitter friable matter, having neither laminæ nor membranes; the latter being a ball of hair or herbs, or perhaps roots, compacted in the stomach of the animal.—They are all, as medicines, unworthy of regard.—The bezoar bovinum, or ox bezoar, is used by miniature-painters in several casts of yellow.

Bezoar-Mineral. See Pharmacy *Index*.

Fossil Bezoar, is a kind of figured stone, formed like the animal bezoar, of several coats or strata ranged round some extraneous body which forms a nucleus, and supposed to have the same virtues. It is found chiefly in Sicily, in sand and clay pits. It is of a purple colour, with a rough surface, the size of a walnut, and light. When broken, it is found to be an irony crust, containing in its hollow a fine greenish white earth, resembling pale bezoar. The earth is used and not the shells. It seems to be of the nature of bole armeniac. It is called *Sicilian earth.*

BEZOARDIC, an appellation given to whatever partakes of the nature of bezoar; also compound medicines whereof bezoar makes an ingredient.

BIA, in *Commerce*, a name given by the Siamese to those small shells which are called *cowries* throughout almost all the other parts of the East Indies. See Cowries.

BIÆUM, βιαιον, in *Rhetoric*, denotes a kind of counter argument, whereby something alleged for the adversary is retorted against him, and made to conclude a different way: for instance, *Occidisti, quia adstitisti interfecto.*—βιαιον, *Immo quia adstiti interfecto, non occidi; nam si id esset, in fugam me conjecissem.* "You killed the person because you were found standing by his body. *Biæum*, Rather I did not kill him because I was found standing by his body; since, in the other case, I should have fled away."

Biæum, in the Grecian laws, was an action brought against those who ravished women, or used violence to any man's person.

BIAFAR, or Biafra, a kingdom of Africa, situated to the east of Benin, to the west of Medra, from which it is divided by a chain of mountains, and extending southward to the fourth degree of north latitude. The natives are the most of all negroes addicted to, and infatuated with, magic; imagining themselves capable of causing rain, thunder, and lightning: therefore they worship the devil with great zeal, and even sacrifice their children to him.

BIAFORA, in the customs of the middle age, a form of cry or alarm to arms; on the hearing whereof the inhabitants of towns or villages were to issue forth, and attend their prince. The word seems originally from Gascony; and the Italians even now on a sudden insurrection of the people, commonly cry, *Via-fora*, by an usual change of the letter B into V.

BIARCHUS, an officer in the court of the emperors of Constantinople, intrusted with the care and inspection of the provisions of the soldiery.

BIALOGOROD, or Akerman, a strong town of Bessarabia, in European Russia. It is seated on a lake called *Vidono*, near the sea-side, in E. Long. 22. 50. N. Lat. 46. 24.

BIANA, a town of Asia in Hindostan, 50 miles west from Agra, remarkable for its excellent indigo, and formerly for its copper mines. E. Long. 77. 0. N. Lat. 26. 20.

BIANCHI, Francesco, called *Il Frari*, an eminent painter, was born at Modena; and had the honour of being master to one of the most esteemed painters that ever appeared, Antonio Corregio. His colouring was delicately fine; his attitudes full of grace; and his invention extremely grand. His works had an astonishing beauty, and are prized as highly as even those of Corregio. He died in 1520.

BIANCHINI, Francis, one of the most learned men of his time, was born at Verona in 1662, of a noble and ancient family. His taste for natural philosophy and mathematics induced him to establish the academy at Aletofili, at Verona. He went to Rome in 1684;

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and was made librarian to Cardinal Ottoboni, who was afterwards pope under the name of Alexander VIII. He also became canon of St Mary de la Rotonda, and at length of St Lawrence in Damaso. He was esteemed by the learned; and was a member of many academies. He published several ingenious dissertations, &c. and died in 1729, aged 67.

BIAS, one of the seven sages of Greece, flourished about 608 before Christ. He was accustomed to say, "It was a sickness of the mind to wish for impossible things." During the siege of Priene, his native city, being asked why he was the only one who retired from the place without carrying any thing with him, he replied, That he carried his all with him; meaning, that his knowledge and virtue were the only blessings that were peculiarly his own, since they could not be taken from him. He expired while pleading for one of his friends.

BIAS, or *Biass*, in a general sense, the inclination or bent of a person's mind to one thing more than another.—It also signifies the lead or weight put into a bowl, that draws or turns the course of it any way to which the bias looks.

BIBERACH, formerly a free and imperial city of Suabia in Germany, but now included in the kingdom of Wirtemberg. It has a large manufacture in fustians, and is seated on the river Russ. E. Long. 10. 2. N. Lat. 48. 4.

BIBERSBERG, a town of Upper Hungary, situated in E. Long. 17. 25. N. Lat. 48. 35.

BIBIENA, FERDINAND GALLI, an excellent painter and architect, was born at Bologna in 1657; and was surnamed *Bibiena* from a territory of that name in Tuscany, in which his father was born. He acquired such reputation by his skill in architecture, the decorations of the theatre and perspective, that the duke of Parma invited him to his court, and made him his first painter and architect. Bibiena at length went to the emperor's court, where he had the same honours and advantages. He wrote two books of architecture; and died at Bologna, at above 80 years of age. His sons followed with success the same professions.

BIBLE (in Greek βιβλος, *the book*), a name applied by Christians by way of eminence or distinction to the collection of sacred writings, or the holy scriptures of the Old and New Testaments; known also by various other appellations, as, the Sacred Books, Holy Writ, Inspired Writings, Scriptures, &c. The Jews styled the Bible (that is the Old Testament) *mikra;* which signifies *Lesson* or *Lecture*.

This collection of the sacred writings containing those of the Old and New Testament, is justly looked upon as the foundation of the Jewish as well as the Christian religion. The Jews, it is true, acknowledged only the scriptures of the Old Testament, the correcting and publishing of which is unanimously ascribed, both by the Jews and Christians, to Ezra. Some of the ancient fathers, on no other foundation than that fabulous and apocryphal book, the second book of Esdras, pretend, that the scriptures were entirely lost and destroyed at the Babylonish captivity, and that Ezra restored them all again by divine revelation. What is certain is, that in the reign of Josiah there was no other book of the law extant besides that found in the temple by Hilkiah; from which original, by order of that pious king, copies were immediately written out, and search made for all the other parts of the scriptures, (2 Kings xxii.); by which means copies of the whole became multiplied among the people, who carried them with them into their captivity. After the return of the Jews from the Babylonish captivity, Ezra got together as many copies as he could of the sacred writings, and out of them all prepared a correct edition, disposing the several books in their proper order, and settling the canon of scripture for his time. These books he divided into three parts. 1. The Law, 2. The Prophets. 3. The Cetubim or Hagiographia. i. e. *The Holy Writings*.

I. The Law contains, 1. Genesis. 2. Exodus. 3. Leviticus. 4. Numbers. 5. Deuteronomy.

II. The writings of the prophets are, 1. Joshua. 2. Judges, with Ruth. 3. Samuel. 4. Kings. 5. Isaiah. 6. Jeremiah, with his Lamentations. 7. Ezekiel. 8. Daniel. 9. The twelve minor prophets. 10. Job. 11. Ezra. 12. Nehemiah. 13. Esther.

III. And the Hagiographia consists of, 1. The Psalms. 2. The Proverbs. 3. Ecclesiastes. 4. The Song of Solomon. This division was made for the sake of reducing the number of the sacred books to the number of the letters in their alphabet, which amount to 22. At present, the Jews reckon 24 books in their canon of Scripture, in disposing of which the law stands as it did in the former division, and the prophets are distributed into the former and latter prophets.

The former prophets are,
Joshua, Judges, Samuel, Kings.

The latter prophets are,
Isaiah, Jeremiah, Ezekiel, and the 12 minor prophets.

And the hagiographia consists of
The Psalms, the Proverbs, Job, the Song of Solomon, Ruth, the Lamentations, Ecclesiastes, Esther, Daniel, Ezra, the Chronicles.

Under the name of Ezra, they comprehend Nehemiah. It is true this order hath not always been observed, but the variations from it are of little or no moment.

The five books of the law are divided into 54 sections. This division many of the Jews hold to have been appointed by Moses himself; but others, with more probability, ascribe it to Ezra. The design of this division was, that one of these sections might be read in their synagogues every sabbath-day. The number was 54, because in their intercalated years a month being then added, there were 54 sabbaths. In other years, they reduced them to 52, by twice joining together two short sections. Till the persecution of Antiochus Epiphanes, they read only the law; but the reading of it being then prohibited, they substituted in the room of it 54 sections out of the prophets; and when the reading of the law was restored by the Maccabees, the section which was read every sabbath out of the law served for their first lesson, and the section out of the prophets for their second These sections were divided into verses; of which division, if Ezra was not the author, it was introduced not long after him, and seems to have been designed for the use of the Targumists or Chaldee interpreters: for after the return of the Jews from the Babylonish captivity, when the Hebrew language ceased to be their mother tongue, and the Chaldee grew into use instead of it, the custom was that the law should be first read in the original Hebrew,

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brew, and then interpreted to the people in the Chaldee language, for which purpose these shorter sections or periods were very convenient.

The division of the scriptures into chapters, as we at present have them, is of much later date. Some attribute it to Stephen Langton, archbishop of Canterbury, in the reigns of John and Henry III. But the true author of the invention was Hugo de Sancto Caro, commonly called *Hugo Cardinalis*, because he was the first Dominican that ever was raised to the degree of cardinal. This Hugo flourished about the year 1240. He wrote a comment on the scriptures, and projected the first concordance, which is that of the vulgar Latin Bible. The aim of this work being for the more easy finding out any word or passage in the scriptures, he found it necessary to divide the book into sections, and the sections into subdivisions: for till that time the vulgar Latin Bibles were without any division at all. These sections are the chapters into which the Bible has ever since been divided. But the subdivision of the chapters was not then into verses, as it is now. Hugo's method of subdividing them was by the letters A, B, C, D, E, F, G, placed on the margin at an equal distance from each other, according to the length of the chapters. The subdivision of the chapters into verses, as they now stand in our Bibles, had its original from a famous Jewish rabbi, named Mordecai Nathan, about the year 1445. This rabbi, in imitation of Hugo Cardinalis, drew up a concordance to the Hebrew Bible, for the use of the Jews. But though he followed Hugo in his division of the books into chapters, he refined upon his invention as to the subdivision, and contrived that by verses: this being found to be a much more convenient method, it has been ever since followed. And thus, as the Jews borrowed the division of the books of the Holy Scriptures into chapters from the Christians, in like manner the Christians borrowed that of the chapters into verses from the Jews.

The order and division of the books of the Bible, as well of the Old as of the New Testament, according to the disposition made by the council of Trent, by Decree I. session iv. are as follow: where we are to observe, that those books to which the asterisms are prefixed, are rejected by the Protestants as apocryphal.

Genesis,
Exodus,
Leviticus,
Numbers,
Deuteronomy,
Joshua,
Judges and Ruth,
1 Samuel, or 1 Kings,
2 Samuel, or 2 Kings,
1 Kings, otherwise called 3 Kings,
2 Kings, otherwise called 4 Kings,
1 Chronicles,
2 Chronicles,
1 Esdras (as the LXX and Vulgate call it), or the book of Ezra,
2 Esdras or (as we have it) the book of Nehemiah,
* Tobit,
* Judith,
Esther,
Job,
Psalms,
Proverbs,
Ecclesiastes,
Song of Solomon,
* The book of Wisdom,
* Ecclesiasticus,
Isaiah,
Jeremiah and *Baruch,
Ezekiel,
Daniel,
Hosea,
Joel,
Amos,
Obadiah,
Nahum, which we place immediately after Micah, before Habakkuk,
Jonah, which we place immediately after Obadiah,
Micah,
Habakkuk,
Zephaniah,
Haggai,
Zechariah,
Malachi,
* 1 Maccabees,
* 2 Maccabees.

The books of the New Testament are,

The Gospel of { St Matthew, St Mark, St Luke, St John.

The Acts of the Apostles.

The Epistle of St Paul to { the Romans, the Corinthians, I. the Corinthians, II. the Galatians, the Ephesians, the Philippians, the Colossians, the Thessalonians, I. the Thessalonians, II. Timothy, I. Timothy, II. Titus, Philemon, the Hebrews.

The general Epistle of { St James, St Peter, I. St Peter, II. St John, I. St John, II. St John, III. St Jude.

The Revelation of St John.

The apocryphal books of the Old Testament, according to the Romanists, are, the book of Enoch (see Jude 14.), the third and fourth books of Esdras, the third and fourth books of Maccabees, the prayer of Manasseh, the Testament of the twelve patriarchs, the Psalter of Solomon, and some other pieces of this nature.

The apocryphal books of the New Testament are, the epistle of St Barnabas, the pretended epistle of St Paul

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Paul to the Laodiceans, several spurious gospels, Acts of the Apostles, and Revelations; the book of Hermas, entitled the Shepherd, Jesus Christ's Letter to Abgarus, the epistles of St Paul to Seneca, and several other pieces of the like nature, as may be seen in the collection of the apocryphal writings of the New Testament made by Fabricius.

The books which are cited in the Old Testament, and now lost, are these; the book of the *Righteous*, or of Jasher, as our version of the Bible has it (Josh. x. 13. and 2 Sam. i. 18.); the book of the wars of the Lord, (Numb. xxi. 14.); the annals of the kings of Israel, so often cited in the books of the Kings and Chronicles. The authors of these annals were the prophets, who lived in the kingdoms of Judah and Israel. We have likewise but a part of Solomon's 3000 proverbs and his 1005 songs, (1 Kings iv. 32.); and we have entirely lost what he wrote upon plants, animals, birds, fishes, and reptiles.

Ezra, in the opinion of most learned men, published the Scriptures in the Chaldee character: for that language being grown wholly into use among the Jews, he thought proper to change the old Hebrew character for it, which hath since that time been retained only by the Samaritans, among whom it is preserved to this day.

Prideaux is of opinion that Ezra made additions in several parts of the Bible, where any thing appeared necessary for illustrating, connecting, or completing, the work; in which he appears to have been assisted by the same spirit in which they were first written. Among such additions are to be reckoned the last chapter of Deuteronomy, wherein Moses seems to give an account of his own death and burial, and the succession of Joshua after him. To the same cause, our learned author thinks, are to be attributed many other interpolations in the Bible, which created difficulties and objections to the authenticity of the sacred text, no ways to be solved without allowing them. Ezra changed the names of several places which were grown obsolete, and instead of them put their new names, by which they were then called, in the text. Thus it is that Abraham is said to have pursued the kings who carried Lot away captive, as far as Dan; whereas that place in Moses's time was called *Laish;* the name *Dan* being unknown till the Danites, long after the death of Moses, possessed themselves of it.

The Jewish canon of Scripture was then settled by Ezra, yet not so but that several variations have been made in it. Malachi, for instance, could not be put in the Bible by him, since that prophet is allowed to have lived after Ezra; nor could Nehemiah be there, since mention is made in that book, of Jaddus, as high-priest, and of Darius Codomannus, as king of Persia, who were at least 100 years later than Ezra. It may be added, that in the first book of Chronicles, the genealogy of the sons of Zerubbabel is carried down for so many generations as must necessarily bring it to the time of Alexander, and consequently this book could not be in the canon in Ezra's days. It is probable, the two books of Chronicles, Ezra, Nehemiah, Esther, and Malachi, were adopted into the Bible in the time of Simon the Just, the last of the men of the great synagogue.

The Jews, at first, were very reserved in communicating their Scripture to strangers: despising and shunning the Gentiles, they would not disclose to them any of the treasures concealed in the Bible. We may add, that the people bordering on the Jews, as the Egyptians, Phœnicians, Arabs, &c. were not very curious to know the laws or history of a people, whom in their turn they hated or despised. Their first acquaintance with these books was not till after the several captivities of the Jews, when the singularity of the Hebrew laws and ceremonies induced several to desire a more particular knowledge of them. Josephus seems surprised to find such slight footsteps of the Scripture-history interspersed in the Egyptian, Chaldean, Phœnician, and Grecian history; and accounts for it hence, that the sacred books were not as yet translated into Greek or other languages, and consequently not known to the writers of those nations.

The first version of the Bible was that of the SEPTUAGINT into Greek, in the time of Ptolemy Philadelphus; though some maintain that the whole was not then translated, but only the Pentateuch; between which and the other books in the version called of the Seventy, the critics find a great diversity in point of style and expression, as well as of accuracy.

Hebrew BIBLES are either manuscript or printed. The best manuscript Bibles are those copied by the Jews of Spain. Those copied by the Jews of Germany are less exact, but more common. The two kinds are easily distinguished from each other; the former being in beautiful characters, like the Hebrew Bibles of Bomberg, Stephens, and Plantin: the latter in characters like those of Munster and Gryphius. F. Simon observes, that the oldest manuscript Hebrew Bibles are not above six or seven hundred years old; nor does Rabbi Menaham, who quotes a vast number of them, pretend that any of them exceed six hundred years.

Dr Kennicot, in his Dissertatio Generalis prefixed to his Hebrew Bible, p. 21. observes, that the most ancient manuscripts were written between the years 900 and 1100: but though those that are the most ancient are not more than 800 or 900 years old, they were transcribed from others of a much more ancient date. The manuscript preserved in the Bodleian library is not less than 800 years old. Another manuscript, not less ancient, is preserved in the Cæsarean library at Vienna.

The most ancient printed Hebrew Bibles are those published by the Jews of Italy, especially of Pelaro and Bresse. Those of Portugal also printed some parts of the Bible at Lisbon, before their expulsion.—This may be observed in the general, that the best Hebrew Bibles are those printed under the inspection of the Jews; there being so many *minutiæ* to be observed, that it is scarce possible for any other to succeed in it.

In the beginning of the 16th century Dan. Bomberg printed several Hebrew Bibles in folio and quarto at Venice, most of which are esteemed both by the Jews and Christians: the first in 1517, which is the least exact, and generally goes by the name of Felix Pratensis, the person who revised it. This edition contains the Hebrew text, the targum, and the commentaries of several rabbins. In 1528, the same Bomberg

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berg printed the folio Bible of Rabbi Benchajim, with his preface, the masoretical divisions, a preface of Aben Ezra, a double *masora*, and several various readings. The third edition was printed in 1618; it is the same with the second, but much more correct. From the former editions it was, that Buxtorf the father, printed his rabbinical Hebrew Bible at Basil in 1618; which, though there are many faults in it, is more correct than any of the former. In 1623 appeared at Venice a new edition of the rabbinical Bible by Leo of Modena, a rabbin of that city, who pretended to have corrected a great number of faults in the former edition; but, besides that it is much inferior to the other Hebrew Bibles of Venice, with regard to paper and print, it has passed through the hands of the inquisitors, who have altered many passages in the commentaries of the rabbins.

As to Hebrew Bibles in 4to, that of R. Stephens is esteemed for the beauty of the characters; but it is very incorrect. Plantin also printed several beautiful Hebrew Bibles at Antwerp: one, in eight columns, with a preface by Arias Montanus in 1571, which far exceeds the Complutensian in paper and print, and contents; this is called the Royal Bible, because it was printed at the expence of Philip II. of Spain: another at Geneva in 1619; besides many more of different sizes, with and without points. Manasseh Ben Israel, a learned Portuguese Jew, published two editions of the Hebrew Bible at Amsterdam; the one in 4to in 1635; the other in 8vo in 1639: the first has two columns, and for that reason is commodious for the reader. In 1639, R. Jac. Lombroso published a new edition in 4to at Venice, with small literal notes at the bottom of each page, where he explains the Hebrew words by Spanish words. This bible is much esteemed by the Jews at Constantinople: in the text they have distinguished between words where the point *camets* is to be read with a *camets-katuph*, that is, by *o*, and not an *a*.

Of all the editions of the Hebrew Bible in 8vo, the most beautiful and correct are the two of Jo. Athias, a Jew of Amsterdam. The first, of 1661, is the best paper; but that of 1667 is the most exact; that, however, published since at Amsterdam by Vander Hooght, in 1705, is preferable to any of them.

After Athias, three Hebraizing Protestants, engaged in revising and publishing the Hebrew Bible, viz. Clodius, Jablonski, and Opitius. Clodius's edition was published at Franckfort in 1677, in 4to. At the bottom of the page it has the various readings of the former editions; but the author does not appear sufficiently versed in the accenting, especially in the poetical books; besides, as it was not published under his eye, many faults have crept in. That of Jablonski in 1699, in 4to, at Berlin, is very beautiful as to letter and print: but, though the editor pretends he made use of the editions of Athias and Clodius, some critics find it scarce in any thing different from the 4to edition of Bomberg. That of Opitius is also in 4to at Keil, in 1709; the character is large and good, but the paper bad: it is done with a great deal of care; but the editor made use of no manuscripts but those of the German libraries; neglecting the French ones, which is an omission common to all three. They have this advantage, however, that besides the divisions used by the Jews, both general and particular, into *paraskes* and *pesukim*, they have also those of the Christians, or of the Latin Bibles, into chapters and verses; the *keir ketib*, or various readings, Latin summaries, &c. which made them of considerable use, with respect to the Latin edition and the concordances.

The little Bible of R. Stephens, in 16to, is very much prized for the beauty of the character. Care, however, must be taken, there being another edition of Geneva exceedingly like it, excepting that the print is worse, and the text less correct. To these may be added some other Hebrew Bibles without points, in 8vo and 24to, which are much coveted by the Jews; not that they are more exact, but more portable than the rest, and are used in their synagogues and schools: of these there are two beautiful editions, the one of Plantin, in 8vo, with two columns, and the other in 24to reprinted by Raphalengius at Leyden, in 1610. There is also an edition of them by Laurence at Amsterdam in 1631, in a large character; and another in 12mo, at Franckfort, in 1694, full of faults, with a preface of M. Leusden at the head of it.

Houbigant published an elegant edition of the Hebrew Bible at Paris, in 1753, contained in four vols. folio. The text is that of Van der Hooght, without points, to which he has added marginal notes, supplying the variations of the Samaritan copy. Dr Kennicott, after almost 20 years laborious collation of near 700 copies, manuscript and printed, either of the whole or of particular parts of the Bible, did, in 1776, publish the first volume of the Hebrew Bible in folio. The text is that of Everand Van der Hooght, already mentioned, differing from it only in the disposition of the poetical parts, which Dr Kennicott has printed in hemistichs, into which they naturally divide themselves; however, the words follow one another in the same order as they do in the edition of Van der Hooght. This edition is printed on an excellent type; the Samaritan text, according to the copy in the London Polyglot, is exhibited in a column parallel with the Hebrew text; those parts of it only being introduced in which it differs from the Hebrew. The numerous variations both of the Samaritan manuscripts from the printed copy of the Samaritan text, and of the Hebrew manuscripts from the printed text of Van der Hooght, are placed separately at the bottom of the page, and marked with numbers referring to the copies from which they are taken. The editor regrets, that the dissertatio generalis, which would help to enrich this article, is not to be published till the second volume is ready.

Greek Bibles. There is a great number of editions of the Bible in Greek; but they may be all reduced to three or four principal ones, viz. that of Complutum, or Alcala de Henares, that of Venice, that of Rome, and that of Oxford. The first was published in 1515, by Cardinal Ximenes, and inserted in the Polyglot Bible, usually called the *Complutensian Bible*: this edition is not just, the Greek of the Seventy being altered in many places according to the Hebrew text. It has, however, been reprinted in the Polyglot Bible of Antwerp, in that of Paris, and in the 4to Bible, commonly called *Vatablus's Bible*.

The second Greek Bible is that of Venice, printed by

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by Aldus in 1518. Here the Greek text of the Septuagint is reprinted just as it stood in the manuscript, full of faults of the copyists, but easily amended. This edition was reprinted at Strasburg in 1526, at Basil in 1545, at Frankfort in 1597, and other places, with some alterations to bring it nearer the Hebrew. The most commodious is that of Frankfort; there being added to this little *scholia*, which show the different interpretations of the old Greek translators: the author of this collection has not added his name, but it is commonly ascribed to Junius.

The third Greek Bible is that of Rome, or the Vatican, in 1587, with Greek *scholia* collected from the manuscripts in the Roman libraries by Pet. Morin. It was first set on foot by Cardinal Montalbo, afterwards Pope Sixtus Quintus. This fine edition has been reprinted at Paris 1628 by J. Morin, priest of the oratory, who has added the Latin translation, which in the Roman was printed separately with *scholia*. The Greek edition of Rome has been printed in the Polygot Bible of London; to which are added, at bottom, the various readings of the Alexandrian manuscript. This has been also reprinted in England in 4to and 12mo, with some alterations. It has been again published at Franeker in 1709 by Bos, who has added all the various readings he could find.

The fourth Greek Bible is that done from the Alexandrian manuscript, begun at Oxford by Dr Grabe in 1707. In this the Alexandrian manuscript is not printed such as it is, but such as it was thought it should be; i. e. it is altered wherever there appeared any fault of the copyists, or any word inserted from any particular dialect: this some think an excellence, but others a fault; urging that the manuscript should have been given absolutely and entirely of itself, and all conjectures as to the readings should have been thrown into the notes.

Latin Bibles, how numerous soever, may be all reduced to three classes; the ancient vulgate, called also *Italica*, translated from the Greek Septuagint; the modern vulgate, the greatest part of which is done from the Hebrew text; and the new Latin translations, done also from the Hebrew text, in the 16th century. We have nothing remaining of the ancient vulgate, used in the primitive times in the western churches, but the Psalms, Wisdom, and Ecclesiastes. Nobilius has endeavoured to retrieve it from the works of the ancient Latin fathers; but it was impossible to do it exactly, because most of the fathers did not keep close to it in their citations.

As to the modern vulgate, there is a vast number of editions very different from each other. Cardinal Ximenes has inserted one in the Bible of Complutum, corrected and altered in many places. R. Stephens and the doctors of Louvain have taken great pains in correcting the modern vulgate.

The best edition of Stephens's Latin Bible is that of 1540, reprinted in 1545, in which are added on the margin the various readings of several Latin manuscripts which he had consulted. The doctors of Louvain revised the modern vulgate after R. Stephens; and added the various readings of several Latin manuscripts. The best of the Louvain editions are those at the end of which are added the critical notes of Francis Lucas of Bruges.

All these reformations of the Latin Bible were made before the time of Pope Sixtus V. and Clement VIII. since which people have not dared to make any alterations, excepting in comments and separate notes. The correction of Clement VIII. in 1592, is now the standard throughout all the Romish churches: that pontiff made two reformations; but it is the first of them that is followed. From this the Bibles of Plantin were done, and from those of Plantin all the rest; so that the common Bibles have none of the after corrections of the same Clement VIII. It is a heavy charge that lies on the editions of Pope Clement, viz. that they have some new texts added, and many old ones altered, to countenance and confirm what they call the Catholic doctrine; witness that celebrated passage of St John, *tres sunt*, &c. There are a great number of Latin Bibles of the third class, comprehending the versions from the originals of the sacred books made within these 200 years. The first is that of Santes Pagninus, a Dominican, under the patronage of Pope Leo X. printed at Lyons, in 4to, in 1527, much esteemed by the Jews. This the author improved in a second edition. In 1542, there was a beautiful edition of the same at Lyons, in folio, with *scholia*, published under the name of *Michael Villanovanus*, i. e. Michael Servetus, author of the *scholia*. Those of Zurich have likewise published an edition of Pagninus's Bible in 4to; and R. Stephens reprinted it in folio, with the vulgate, in 1557, pretending to give it more correct than in the former editions. There is also another edition of 1586, in four columns, under the name of *Vatablus*: and we find it again in the Hamburgh edition of the Bible in four languages.

In the number of Latin Bibles is also usually ranked the version of the same Pagninus corrected, or rather rendered literal, by Arias Montanus; which correction being approved of by the doctors of Louvain, &c. was inserted in the Polyglot Bible of Philip II. and since in that of London. There have been various editions of this in folio, 4to, and 8vo; to which have been added the Hebrew text of the Old Testament, and the Greek of the New. The best of them all is the first, which is in folio, 1571.

Since the Reformation there have been several Latin versions of the Bible from the originals by Protestants. The most esteemed are those of Munster, Leo Juda, Castalio, and Tremellius; the three last whereof have been reprinted various times. Munster published his version at Basil in 1534, which he afterwards revised; he published a correct edition in 1546. Castalio's fine Latin pleases most people; but there are some who think it too much affected; the best edition thereof is that in 1573. Leo Juda's version, altered a little by the divines of Salamanca, was added to the ancient Latin edition, as published by R. Stephens, with notes, under the name of *Vatablus's Bible*, in 1545. It was condemned by the Parisian divines, but printed with some alterations by the Spanish divines of Salamanca. That of Junius and Tremellius is preferred, especially by the Calvinists, and has undergone a great number of editions.

One may add a fourth class of Latin Bibles, comprehending the vulgate edition corrected from the originals. The Bible of Isidorus Clarus is of this number: that author, not being contented with restoring the ancient

Bible.

ancient Latin copy, has corrected the translator in a great number of places, which he thought ill rendered. Some Protestants have followed the same method; and among others, Andrew and Luke Osiander, who have each published a new edition of the vulgate, corrected from the originals.

Oriental Bibles.—At the head of the Oriental versions of the Bible must be placed the Samaritan; as being the most ancient of all, though neither its age nor author have been yet ascertained, and admitting no more for holy scripture but the Pentateuch, or five books of Moses. This translation is made from the Samaritan Hebrew text, which is a little different from the Hebrew text of the Jews. This version has never been printed alone; nor anywhere but in the Polyglots of London and Paris.

Chaldee Bibles, are only the glosses or expositions made by the Jews in the time when they spake the Chaldee tongue. These they call by the name of *Targumim*, or *paraphrases*, as not being any strict versions of the Scripture. They have been inserted entire in the large Hebrew Bibles of Venice and Basil; but are read more commodiously in the Polyglots, being there attended with a Latin translation.

Syriac Bibles.—There are extant two versions of the Old Testament in the Syriac language: one from the Septuagint, which is ancient, and made probably about the time of Constantine; the other called *antiqua et simplex*, made from the Hebrew, as some suppose, about the time of the apostles. This version is printed in the Polyglots of London and Paris.

In the year 1562, Widmanstadius printed the whole New Testament in Syriac, at Vienna, in a beautiful character: after him there were several other editions; and it was inserted in the Bible of Philip II. with a Latin translation. Gabriel Sionita also published a beautiful Syriac edition of the Psalms, at Paris, in 1525, with a Latin interpretation.

Arabic Bibles.—In the year 1516, Aug. Justinian, bishop of Nebio, printed at Genoa an Arabic version of the Psalter, with the Hebrew text and Chaldee paraphrase, adding Latin interpretations. There are also Arabic versions of the whole Scriptures in the Polyglots of London and Paris; and we have an edition of the Old Testament entire, printed at Rome in 1671, by order of the congregation *de propaganda fide;* but it is of little esteem, as having been altered agreeably to the vulgate edition. The Arabic Bibles among us are not the same with those used with the Christians in the east. Some learned men take the Arabic version of the Old Testament, printed in the Polyglots, to be that of Saadias, who lived about the year 900; at least in the main. Their reason is, that Aben Ezra, a great antagonist of Saadias, quotes some passages of his version, which are the same with those in the Arabic version of the Polyglots; yet others are of opinion, that Saadias's version is not extant. In 1622, Erpenius printed an Arabic Pentateuch, called also the Pentateuch of Mauritania, as being made by the Jews of Barbary, and for their use. This version is very literal, and esteemed very exact. The four Evangelists have also been published in Arabic, with a Latin version, at Rome, in 1591, folio. These have been since reprinted in the Polyglots of London and Paris, with some little alterations of Gabriel Sionita. Erpenius published an Arabic New Testament entire, as he found it in his manuscript copy, at Leyden, in 1616.

There are some other Arabic versions of late date mentioned by Walton in his Prolegomena; particularly a version of the Psalms preserved in Sion College, London, and another of the Prophets at Oxford: neither of which have been published.

Cophtic Bibles.—There are several manuscript copies of the Cophtic Bible in some of the great libraries, especially in that of the French king. Dr Wilkins published the Cophtic New Testament in 4to in the year 1716, and the Pentateuch also in 4to in 1731, with Latin translations. He reckons these versions to have been made in the end of the second, or the beginning of the third century.

Ethiopic Bibles.—The Ethiopians have also translated the Bible into their language. There have been printed separately, the Psalms, Canticles, some chapters of Genesis, Ruth, Joel, Jonah, Zephaniah, Malachi, and the New Testament; all which have been since reprinted in the Polyglot of London. As to the Ethiopic New Testament, which was first printed at Rome in 1548, it is a very inaccurate work, and is reprinted in the English Polyglot with all its faults.

Armenian Bibles.—There is a very ancient Armenian version of the whole Bible, done from the Greek of the Seventy, by some of their doctors about the time of Chrysostom. This was first printed entire in 1664, by one of their bishops at Amsterdam, in 4to; with the New Testament in 8vo.

Persian Bibles.—Some of the fathers seem to say, that all the Scripture was formerly translated into the language of the Persians; but we have nothing now remaining of the ancient version, which was certainly done from the Septuagint. The Persian Pentateuch printed in the London Polyglot is, without doubt, the work of Rabbi Jacob, a Persian Jew. It was published by the Jews at Constantinople, in the year 1551. In the same Polyglot we have likewise the four Evangelists in Persian, with a Latin translation; but this appears very modern, incorrect, and of little use. Wilton says this version was written above 400 years ago. Another version of the Gospels was published at Cambridge by Wheloc in the last century: there are also two Persian versions of the Psalms made in the last century from the vulgar Latin.

Gothic Bibles.—It is generally said that Ulphilas, a Gothic bishop, who lived in the fourth century, made a version of the whole Bible, excepting the book of Kings, for the use of his countrymen. That book he omitted, because of the frequent mention of the wars therein; as fearing to inspire too much of the military genius into that people. We have nothing remaining of this version but the four Evangelists, printed in 4to, at Dort, in 1665, from a very ancient MS.

Whilst the Roman empire subsisted in Europe, the reading of the Scriptures in the Latin tongue, which was the universal language of that empire, prevailed everywhere. But since the face of affairs in Europe has been changed, and so many different monarchies erected upon the ruins of the Roman empire, the Latin tongue has by degrees grown into disuse: whence has arisen a necessity of translating the Bible into the respective languages of each people; and this has produced

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ced as many different versions of the Scriptures in the modern languages, as there are different nations professing the Christian religion. Hence we meet with French, Italian, Spanish, German, Flemish, Danish, Sclavonian, Polish, Bohemian, and Russian or Muscovite Bibles; besides the Anglo-Saxon, and modern English and Irish Bibles.

French Bibles. The oldest French Bible we hear of is the version of Peter de Vaux, chief of the Waldenses, who lived about the year 1160. Raoul de Presle translated the Bible into French in the reign of Charles V. king of France, about the year 1380. Besides these, there are several old French translations of particular parts of the Scripture. The doctors of Louvain published the Bible in French at Louvain, by order of the emperor Charles V. in 1550. There is a version by Isaac le Maitre de Sacy, published in 1672, with explanations of the literal and spiritual meaning of the text, which was received with wonderful applause, and has been often reprinted, As to the New Testaments in French, which have been printed separately, one of the most remarkable is that of F. Amelotte of the oratory, composed by the direction of some French prelates, and printed with annotations in the years 1666, 1667, and 1670. The author pretends he had been at the pains to search all the libraries in Europe, and collate the oldest manuscripts. But, in examining his work, it appears that he has produced no considerable various readings, which had not before been taken notice of either in the London Polyglot or elsewhere. The New Testament of Mons, printed in 1665, with the archbishop of Cambray's permission, and the king of Spain's license, made a great noise in the world. It was condemned by Pope Clement IX. in 1668, and by Pope Innocent XI. in 1679, and in several bishoprics of France at several times. The New Testament published at Trevoux in 1702, by M. Simon, with literal and critical annotations upon difficult passages, was condemned by the bishops of Paris and Meaux in 1702. F. Bohours, a Jesuit, with the assistance of F. F. Michael Tellier and Peter Bernier, Jesuits likewise, published a translation of the New Testament in 1697: but this translation is, for the most part, harsh and obscure, which was owing to the author's keeping too strictly to the Latin text from which he translated,

There are likewise French translations published by Protestant authors; one by Robert Peter Olivetan, printed at Geneva in 1535, and since often reprinted with the corrections of John Calvin and others; another by Sebastian Castalio, remarkable for particular ways of expression never used by good judges of the language. John Diodati likewise published a French Bible at Geneva in 1644; but some find fault with his method, in that he rather paraphrases the text than translates it. Faber Stapalensis translated the New Testament into French, which was revised and accommodated to the use of the reformed churches in Piedmont, and printed in 1534. Lastly, M. John le Clerc published a New Testament in French at Amsterdam in 1703, with annotations taken chiefly from Grotius and Hammond; but the use of this version was prohibited in Holland by order of the States-General, as tending to revive the errors of Sabellius and Socinus.

Italian Bibles. The first Italian Bible published by the Romanists is that of Nicholas Malerme, a Benedictine monk, printed at Venice in 1471. It was translated from the Vulgate. The version of Anthony Brucioli, published at Venice in 1532, was prohibited by the Council of Trent. The Calvinists likewise have their Italian Bibles. There is one of John Diodati in 1607 and 1641, and another of Maximus Theophilus in 1551, dedicated to Francis de Medicis duke of Tuscany. The Jews of Italy have no entire version of the Bible in Italian; the inquisition constantly refusing to allow them the liberty of printing one.

Spanish Bibles. The first Spanish Bible that we hear of is that mentioned by Cyprian de Valera, which he says was published about the year 1500. The Epistles and Gospels were published in that language by Ambrose de Montesin in 1512; the whole Bible by Cassiodore de Reyna, a Calvinist, in 1569; and the New Testament, dedicated to the emperor Charles V. by Francis Enzinas, otherwise called *Driander*, in 1543. The first Bible which was printed in Spanish for the use of the Jews was that printed at Ferrara in 1553, in Gothic characters, and dedicated to Hercules d'Est duke of Ferrara. This version is very ancient, and was probably in use among the Jews of Spain before Ferdinand and Isabella expelled them out of their dominions in 1492.

German Bibles. The first and most ancient translation of the Bible in the German language is that of Ulphilas bishop of the Goths, about the year 360. This bishop left out the book of Kings, which treats chiefly of war, lest it should too much encourage the martial humour of the Goths. An imperfect manuscript of this version was found in the abbey of Verden near Cologne, written in letters of silver, for which reason it is called *Codex Argenteus;* and it was published by Francis Junius in 1665. The oldest German printed Bible extant is that of Nuremberg, printed in 1447; but who the author of it was is uncertain. John Emzer, chaplain to George duke of Saxony, published a version of the New Testament in opposition to Luther. There is a German Bible of John Eckius in 1537, with Emzer's New Testament added to it; and one by Ulembergius of Westphalia, procured by Ferdinand duke of Bavaria, and printed in 1630. Martin Luther having employed eleven years in translating the Old and New Testament, published the Pentateuch in 1552, the historical books and the Psalms in 1524, the books of Solomon in 1527; Isaiah in 1529, the Prophets in 1531, and the other books in 1530: he published the New Testament in 1522. The learned agree, that his language is pure, and the version clear and free from intricacies: it was revised by several persons of quality, who were masters of all the delicacies of the German language. The German Bibles which have been printed in Saxony, Switzerland, and elsewhere, are for the most part the same with that of Luther, with very little variation. In 1604 John Piscator published a version of the Bible in German, taken from that of Junius and Tremellius: but his turn of expression is purely Latin, and not at all agreeable to the genius of the German language: the Anabaptists have a German Bible printed at Worms in 1529. John Crellius published his version of the New Testament at Racovia in 1630; and Felbinger his at Amsterdam in 1660.

Flemish Bibles. The Flemish Bibles of the Romanists are very numerous, and for the most part have no author's, author's name prefixed to them, till that of Nicolas Vinck, printed at Louvain in 1548. The Flemish versions made use of by the Calvinists till the year 1637, were copied principally from that of Luther. But the synod of Dort having in 1618 appointed a new translation of the bible into Flemish, deputies were named for the work, which was not finished till the year 1637.

Danish BIBLES. The first Danish Bible was published by Peter Palladius, Olaus Chrysostom, John Syningius, and John Maccabæus, in 1550, in which they followed Luther's first German version. There are two other versions, the one by John Paul Resenius bishop of Zealand, in 1605; the other, being the New Testament only, by John Michel, in 1524.

Swedish BIBLE. In 1534 Olaus and Laurence published a Swedish Bible from the German version of Martin Luther. It was revised in 1617, by order of King Gustavus Adolphus, and was afterwards almost universally received.

Bohemian, Polish, Russian or Muscovite, and Sclavonian BIBLES. The Bohemians have a Bible translated by eight of their doctors, whom they had sent to the schools of Wirtemberg and Basil, on purpose to study the original languages. It was printed in Moravia in the year 1539. The first Polish version of the Bible, it is said, was that composed by Hadewich wife of Jagellon duke of Lithuania, who embraced Christianity in the year 1390. In 1599 there was a Polish translation of the Bible published at Cracow, which was the work of several divines of that nation, and in which James Wieck, a Jesuit, had a principal share. The Protestants, in 1596, published a Polish Bible from Luther's German version, and dedicated it to Uladislaus IV. king of Poland. The Russians or Muscovites published the Bible in their language in 1581. It was translated from the Greek by St Cyril, the apostle of the Sclavonians; but this old version being too obscure, Ernest Gluk, who had been carried prisoner to Moscow after the taking of Narva, undertook a new translation of the Bible into Sclavonian; who dying in 1705, the Czar Peter appointed some particular divines to finish the translation: but whether it was ever printed, we cannot say.

English Saxon BIBLES. If we inquire into the versions of the Bible of our own country, we shall find that Adelm bishop of Shireborn, who lived in 709, made an English Saxon version of the Psalms; and that Eadfrid, or Ecbert, bishop of Lindisferne, who lived about the year 730, translated several of the books of Scripture into the same language. It is said likewise, that Venerable Bede, who died in 785, translated the whole Bible into Saxon. But Cuthbert, Bede's disciple, in the enumeration of his master's works, speaks only of his translation of the Gospels; and says nothing of the rest of the Bible. Some pretend, that King Alfred, who lived in 890, translated a great part of the Scriptures. We find an old version in the Anglo-Saxon of several books of the Bible, made by Elfric abbot of Malmesbury: it was published at Oxford in 1699. There is an old Anglo-Saxon version of the four Gospels, published by Matthew Parker archbishop of Canterbury in 1571, the author whereof is unknown. Dr Mill observes, that this version was made from a Latin copy of the old Vulgate.

Saxon BIBLES. The whole Scripture is said by some to have been translated into the Anglo-Saxon by Bede about the year 701, though others contend he only translated the Gospels.

We have certain books or parts of the Bible by several other translators; as, 1. The Psalms, by Adelm bishop of Shireborn, contemporary with Bede; though by others this version is attributed to King Alfred, who lived 200 years after. Another version of the Psalms in Anglo-Saxon was published by Spelman in 1640. 2. The Evangelists, still extant, done from the ancient vulgate, before it was revised by St Jerome, by an author unknown, and published by Matth. Parker in 1571. An old Saxon version of several books of the Bible, made by Elfric abbot of Malmesbury, several fragments of which were published by Will. Lilly in 1638, the genuine copy by Edm. Thwaites in 1699, at Oxford.

Indian BIBLE. A translation of the Bible into the North American Indian language, by Elliot, was published in 4to at Cambridge in 1685.

English BIBLES. The first English Bible we read of was that translated by J. Wickliffe about the year 1360; but never printed, though there are MS. copies of it in several of the public libraries. J. de Trevisa, who died about the year 1398, is also said to have translated the whole Bible; but whether any copies of it are remaining, does not appear.

Tindal's. The first printed Bible in our language was that translated by Wil. Tindal, assisted by Miles Coverdale, printed abroad in 1526; but most of the copies were bought up and burnt by Bishop Tunstal and Sir Thomas More. It only contained the New Testament, and was revised and republished by the same person in 1530. The prologues and prefaces added to it reflect on the bishops and clergy; but this edition was also suppressed, and the copies burnt. In 1532, Tindal and his associates finished the whole Bible except the Apocrypha, and printed it abroad: but while he was afterwards preparing for a second edition, he was taken up and burnt for heresy in Flanders.

Matthews's. On Tindal's death, his work was carried on by Coverdale, and John Rogers superintendant of an English church in Germany, and the first martyr in the reign of Queen Mary, who translated the Apocrypha, and revised Tindal's translation, comparing it with the Hebrew, Greek, Latin, and German, and adding prefaces and notes from Luther's Bible. He dedicated the whole to Henry VIII. in 1537, under the borrowed name of Thomas Matthews; whence this has been usually called *Matthews's Bible.* It was printed at Hamburgh, and license obtained for publishing it in England by the favour of Archbishop Cranmer and the bishops Latimer and Shaxton.

Cranmer's. The first Bible printed by authority in England, and publicly set up in churches, was the same Tindal's version, revised, compared with the Hebrew, and in many places amended, by Miles Coverdale afterwards bishop of Exeter; and examined after him by Archbishop Cranmer, who added a preface to it: whence this was called *Cranmer's Bible.* It was printed by Grafton, of the largest volume, and published in 1540; and, by a royal proclamation, every parish was obliged to set one of the copies in their church, under the penalty of 40s. a-month; yet, two years

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Bibles.

years after, the Popish bishops obtained its suppression of the king. It was restored under Edward VI. suppressed again under Queen Mary, and restored again in the first year of Queen Elizabeth, and a new edition of it given in 1562.

Geneva.—Some English exiles at Geneva in Queen Mary's reign, Coverdale, Goodman, Gilbie, Sampson, Cole, Whittingham, and Knox, made a new translation, printed there in 1560, the New Testament having been printed in 1557; hence called the *Geneva Bible;* containing the variations of readings, marginal annotations, &c. on account of which it was much valued by the puritan party in that and the following reigns.

Bishops.—Archbishop Parker resolved on a new translation for the public use of the church, and engaged the bishops and other learned men to take each a share or portion. These being afterwards joined together, and printed with short annotations in 1568, in a large folio, made what was afterwards called the *Great English Bible*, and commonly the *Bishops Bible.* The following year it was also published in 8vo, in a small but fine black letter: and here the chapters were divided into verses: but without any breaks for them, in which the method of the Geneva Bible was followed, which was the first English Bible where any distinction of verses was made. It was afterwards printed in large folio, with corrections, and several prolegomena, in 1572: this is called *Matthew Parker's Bible.* The initial letters of each translator's name were put at the end of his part: e. gr. at the end of the Pentateuch, W. E. for William Exon; that is, William bishop of Exeter, whose allotment ended there; at the end of Samuel, R. M. for Richard Menevensis, or bishop of St David's, to whom the second allotment fell: and the like of the rest. The archbishop oversaw, directed, examined, and finished the whole. This translation was used in the churches for 40 years, though the Geneva Bible was more read in private houses, being printed above 30 times in as many years. King James bore it an inveterate hatred on account of the notes; which at the Hampton-court conference he charged as partial, untrue, seditious, &c. The Bishops Bible too had its faults. The king frankly owned he had yet seen no good translation of the Bible in English; but he thought that of Geneva the worst of all.

Rhemish.—After the translation of the Bible by the bishops, two other private versions had been made of the New Testament: The first by Laur. Thomson, made from Beza's Latin edition, together with the notes of Beza, published in 1582 in 4to, and afterwards in 1589, varying very little from the Geneva Bible; the second by the Papists at Rheims in 1584, called the *Rhemish Bible*, or *Rhemish Translation.* These finding it impossible to keep the people from having the Scriptures in the vulgar tongue, resolved to give a version of their own as favourable to their cause as might be. It was printed on a large paper, with a fair letter and margin. One complaint against it was its retaining a multitude of Hebrew and Greek words untranslated, for want, as the editors express it, of proper and adequate terms in the English to render them by; as the words *azymes*, *tunike*, *rational*, *holocaust*, *prepuce*, *pasche*, &c. However, many of the copies were seized by the queen's searchers, and confiscated; and Th. Cartwright was solicited by Secretary Walsingham to refute it: but after a good progress made therein, Archbishop Whitgift prohibited his further proceeding thereing, as judging it improper the doctrine of the church of England should be committed to the defence of a puritan, and appointed Dr Fulke in his place, who refuted the Rhemists with great spirit and learning. Cartwright's refutation was also afterwards published in 1618, under Archbishop Abbot. About 30 years after their New Testament, the Roman Catholics published a translation of the Old at Doway, in 1609 and 1610, from the vulgate, with annotations; so that the English Roman Catholics have now the whole Bible in their mother-tongue; though it is to be observed, they are forbidden to read it without a license from their superiors.

King James's.—The last English Bible was that which proceeded from the Hampton-court conference in 1603, where many exceptions being made to the Bishops Bible, King James gave orders for a new one; not, as the preface expresses it, for a translation altogether new, nor yet to make of a bad one a good one, but to make a good one better, or of many good ones one best. Fifty-four learned persons were appointed for this office by the king, as appears by his letter to the archbishop, dated in 1604; which being three years before the translation was entered upon, it is probable seven of them were either dead or had declined the task, since Fuller's list of the translators makes but 47; who being ranged under six divisions, entered on their province in 1607. It was published in 1613, with a dedication to James, and a learned preface, and is commonly called *King James's Bible.* After this, all the other versions dropped and fell into disuse, except the Epistles and Gospels in the Common Prayer Book, which were still continued according to the Bishops translation till the alteration of the liturgy in 1661, and the Psalms and Hymns, which are to this day continued as in the old version.

The judicious Selden in his Table Talk, speaking of the Bible, says, "The English translation of the Bible is the best translation in the world, and renders the sense of the original best, taking in for the English translation the Bishops Bible, as well as King James's. The translators in King James's time took an excellent way. That part of the Bible was given to him who was most excellent in such a tongue (as the Apocrypha to Andrew Downs), and then they met together, and one read the translation, the rest holding in their hands some Bible either of the learned tongues, or French, Spanish, Italian, &c. If they found any fault, they spoke; if not, he read on."

King James's Bible is that now read by authority in all the churches in Britain.

Welch Bibles.—There was a Welch translation of the Bible made from the original in the time of Queen Elizabeth, in consequence of a bill brought into the house of commons for this purpose in 1563. It was printed in folio in 1588. Another version, which is the standard translation for that language, was printed in 1620. It is called *Parry's Bible.* An impression of this was printed in 1690, called *Bishop Lloyd's Bible.* These were in folio. The first 8vo impression of the Welch Bible was made in 1630.

Irish Bible.—Towards the middle of the 16th century,

tury, Bedell, bishop of Kilmore, set on foot a translation of the Old Testament into the Irish language; the New Testament and the Liturgy having been before translated into that language. The bishop appointed one King to execute this work, who not understanding the oriental languages, was obliged to translate it from the English. This work was revised by Bedell, who, after having compared the Irish translation with the English, compared the latter with the Hebrew, the LXX. and the Italian version of Diodati. When this work was finished, the bishop would have been himself at the charge of the impression, but his design was stopped upon advice given to the lord lieutenant and the archbishop of Canterbury, that it would prove a shameful thing for a nation to publish a Bible translated by such a despicable hand as King. However, the manuscript was not lost, for it went to press in the year 1685.

Erse Bible.—There is also (lately finished at Edinburgh) a version of the Bible in the Gaelic or Erse language.

BIBLIANDER, Theodore, professor of divinity at Zurich in the 16th century. As he understood the oriental languages, he set about a new edition of the Koran; the text of which he corrected, by collating the Arabic and Latin copies. To this edition he subjoined the life of Mahomet and his successors; and prefixed an apology by way of preface, which has been loudly exclaimed against.

BIBLIOGRAPHIA, a branch of archæographia, employed in the judging and perusing of ancient manuscripts, whether written in books, on paper or parchment.

The sense of it is now extended; and it signifies a work intended to give information concerning the first or best editions of books, and the ways of selecting and distinguishing them properly. In short, it is used for a *notitia* or description of printed books, either in the order of the alphabet, of the times when printed, or of the subject matters. In which sense it is nearly the same as biliotheca. See Bibliography, Supplement.

Literary journals afford also a kind of bibliographia.

BIBLIOMANCY, a kind of divination performed by means of the Bible. This amounts to much the same with what is otherwise called *sortes biblicæ* or *sortes sanctorum*. It consisted in taking passages of Scripture at hazard, and drawing indications thence concerning things future; as in Augustine's *tolle et lege*. It was much used at the consecration of bishops.—F. J. Davidius, a Jesuit, has published a bibliomancy under the borrowed name of *Veridicus Christianus*.

BIBLIOTHECA, in its original and proper sense, denotes a library or place for depositing books.

Bibliotheca, in matters of literature, denotes a treatise giving an account of all the writers on a certain subject: thus we have bibliothecas of theology, law, philosophy, &c.

There are likewise universal bibliothecas, which treat indifferently of all kinds of books; also select bibliothecas, which give account of none but authors of reputation.

Many of the bibliothecas agree, in most respects, with what are otherwise called memoirs or journals of literature, except that these last are confined to new books; but there are other bibliothecas, that differ in nothing from catalogues of the writers on certain subjects.

BIBLISTS. So the Roman Catholics call those Christians who make Scripture the sole rule of faith, in which sense, all Protestants either are or ought to be biblists.

BIBLUS, βιβλος, in *Botany*, an aquatic plant in Egypt, called also *papyrus;* of the skin whereof the ancient Egyptians made their paper. See Papyrus.

BIBRACTE, in *Ancient Geography*, a citadel of the Ædui, according to Strabo; but Cæsar describes it as a town well fortified, very large and populous, and of the greatest authority among that nation: Now *Beuvect*, or Bevray; a desolate place four miles to the north-west of Autun.

BIBROCI, in *Ancient Geography*, an ancient people of Britain: Now the *Hundred of Bray* in Berks.

BICANER, a city of Asia, on the river Ganges, in the northern part of Hindostan. E. Long. 87. 20. N. Lat. 28. 40.

BICE, or Bise, among painters, a blue colour prepared from the lapis armenus.

Bice bears the best body of all bright blues used in common work, as house-painting, &c. but it is the palest in colour. It works indifferently well, but inclines a little to sandy, and therefore requires good grinding.

BICEPS, the name of several muscles: as the biceps humeri, or cubiti; biceps tibiæ; &c. See Anatomy, *Table of the Muscles*.

BICESTER, a straggling town of Oxfordshire in England, seated on the road between Oxford and Buckingham.

BICHAT, Marie Francois Xavier, an eminent French physiologist. See Supplement.

BICHET, a quantity or measure of corn, which differs according to the places where it is used. The bichet is not a wooden measure, as the minot at Paris, or the bushel at London; but it is compounded of several certain measures. It is used in many parts of France, &c.

BICLINIUM, in Romany antiquity, a chamber with two beds in it: or when two beds only were round a table.

BICORNES, an order of plants in the *fragmenta methodi naturalis* of Linnæus, so termed from the antheræ having in appearance two horns. See Botany.

BIDACHE, a town of France, in the department of the Lower Pyrenees, seated on the river Bidouse. W. Long. 1. 9. N. Lat. 41. 31.

BIDAL, or Bidale, in our ancient customs, denotes the invitation of friends to drink ale at some poor man's house, who in consideration hereof expects some contribution for his relief. This custom still obtains in the west of England, and is mentioned in some of our ancient statutes.

BIDDEL, John, one of the most eminent English writers among the Socinians, was born at Wotton-under-Edge in Gloucestershire, and educated in the free-school of that place. Being a hopeful youth, he was taken notice of; particularly by Lord George Berkeley, who allowed him an exhibition of ten pounds a-year. This caused him vigorously to apply

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ply himself to his studies; and he was, while at school, author of a translation of Virgil's Bucolics, and of the two first satires of Juvenal. He continued at school till he was 13 years of age. However, having manifested in that early period a singular piety and contempt of secular affairs, he was sent to the university of Oxford, and entered a student in Magdalen hall. In 1641, the magistrates of Gloucester chose him master of the free school of that city; and he was much esteemed: but falling into some opinions concerning the Trinity different from those commonly received, and expressing his thoughts with too much freedom, he suffered various persecutions and imprisonments in the time of the commonwealth. During one of these confinements, which lasted for several years, being reduced to great indigence, he was employed by Roger Daniel of London to correct the impression of the Greek Septuagint Bible, which that printer was about to publish with great accuracy. In 1651, the parliament published a general act of oblivion, which restored him to his full liberty. He was afterwards imprisoned on account of his tenets; and at last the Protector banished him for life to St Mary's castle in the isle of Scilly, and sent him thither in October 1655. Soon after, he was allowed 100 crowns a year for subsistence. In 1658, he was set at full liberty. After the restoration of King Charles II. he was fined in 100l. and each of his hearers in 20l. to lie in prison till paid; which being put in execution, the want of fresh air and exercise made him contract a disease, of which he died on the 22d of September 1662, in the 47th year of his age. His life was published in Latin in 1682, by Mr Farrington of the Inner Temple, who represents him as possessed of extraordinary piety, charity, and humility. He would not discourse of those points in which he differed from others, with those that did not appear religious according to their knowledge; and was a strict observer himself, and a severe exactor in others, of reverence in speaking of God and Christ. He had so happy a memory, that he retained word for word the whole New Testament, not only in English, but in Greek, as far as the fourth chapter of the Revelation of St John.

BIDDIFORD, a town of Devonshire, seated on the river Toridge, over which there is a fine stone-bridge with 24 arches. It contains 3244 inhabitants, and carries on a considerable trade. W. Long. 4. 10. N. Lat. 51. 10.

BIDDING, or OFFERING, denotes the raising the price of a thing at a sale or auction. The French call this *enchirer*. It answers to what the Romans called *licitari*: they used to bid by holding up the hand or finger.

BIDDING is also used for proclaiming or notifying. In which sense we meet with *bidding of the* BANNS, the same with what is otherwise called *asking*.

BIDDING Prayer. It was one part of the office of the deacons in the primitive Christian church, to be a sort of monitors and directors of the people in the exercise of their public devotions in the church. To which end they made use of certain known forms of words, to give notice when each part of the service began. This was called by the Greeks κηρυττειν, and by the Latins *prædicare*: which therefore does not ordinarily signify to *preach*, as some mistake it, but to perform the office of a crier (κηρυξ, or *præco*) in the assembly: whence Synesius and others call the deacons ἱεροκηρυκες, the *holy criers* of the church, appointed to bid or exhort the congregation to pray and join in the several parts of the service of the church. Agreeable to this ancient practice is the form *Let us pray*, repeated before several of the prayers in the English liturgy.

BIDDING of the Beads, a charge or warning which the parish-priest gave to his parishioners at certain special times, to say so many pater-nosters, &c. on their beads.

BIDENS, WATER HEMP-AGRIMONY. See BOTANY *Index*.

BIDENTAL, in Roman antiquity, a place blasted with lightning; which was immediately consecrated by an haruspex, with the sacrifice of a bidens. This place was afterwards accounted sacred, and it was unlawful to enter it or to tread upon it; for which reason it was commonly surrounded with a ditch, wall, hedge, ropes, &c. See next article.

BIDENTALES, in Roman antiquity, priests instituted to perform certain ceremonies and expiations when thunder fell on any place. Their principal office was the sacrificing a sheep of two years old, which in Latin is called *bidens*; from whence the place struck with thunder got the name of *bidental*.

BIDENTES, in middle-age writers, denotes two-yearlings, or sheep of the second year. The wool of these bidentes, or two years old sheep, being the first sheering, was sometimes claimed as a heriot to the king, on the death of an abbot. Among the ancient Romans, the word was extended further to any sorts of beasts used for victims, especially those of that age: whence we meet with *sues bidentes*.

BIDET, a nag or little horse, formerly allowed each trooper and dragoon, for his baggage and other occasions. Bidets are grown into disuse, on account of the expences thereof, and the disorders frequently arising from those who attended on them, &c.

BIDIS, in *Ancient Geography*, a small city of Sicily, not far from Syracuse, whose ruins are still to be seen in the territory of Syracuse, about 15 miles to the south-west, with a church called *S. Giovanni di Bidini*.

BIDLOO, GODFREY, author of several treatises on anatomy, was born at Amsterdam, March 12. 1649. In 1688, he was professor of anatomy at the Hague; and, in 1694, at Leyden; when King William III. of England appointed him his physician; which he would not accept but on condition of holding his professorship, which was readily granted him. He published, in Latin, 1. The Anatomy of the Human Body, demonstrated in 105 cuts, explained by the discoveries of the ancient and modern writers. 2. An Oration upon the Antiquity of Anatomy. 3. A Letter to Anthony Leeuwenhoeck on the animals sometimes found in the liver of sheep and other animals. 4. Two Decades of dissertations in Anatomy and Chirurgery; and other pieces. He died at Leyden, in April, 1713.

BIDON, a liquid measure, containing about five pints of Paris, that is, about five quarts English wine-measure. It is seldom used but among ships crews.

BIE, ADRIAN DE, an eminent painter, was born at Liere in 1594. After learning the rudiments of the art from different masters, he travelled to Rome, where he spent six years in studying the works of the best masters. His industry was then rewarded with proportionable success; for he found encouragement among the

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the most honourable persons at Rome, and in every part of Italy through which he travelled, from persons of the first distinction. His penciling was so exceedingly neat, and his touch and colouring so very delicate, that he was frequently employed to paint on jasper, agate, porphyry, and other precious materials.

BIEEZ, a town of Poland, in the palatinate of Cracovia, remarkable for its mines of vitriol. It is seated on the river Weseloke, in E. Long. 2. 21. N. Lat. 49. 50.

BIEL. See BIENNA.

BIELA, a town of Russia, and capital of a province of the same name, seated on the river Opschaw, in E. Long. 34. 55. N. Lat. 55. 0.

BIELA OSERO, or BELOZERO, a town of the Russian empire, capital of a duchy, and situated on a lake of the same name, at the mouth of the river Consa, in E. Long. 39. 10. N. Lat. 58. 55.

BIELA, a town of Piedmont in Italy, and capital of the Bellese, near the river Cerva, in E. Long. 8. 3. N. Lat. 45. 22.

BIELSKI, a town of Poland, in the palatinate of Polachia, near one of the sources of the river Narew. E. Long. 22. 55. N. Lat. 53. 50.

BIELSKOI, a town of Russia, in the province of Smolensko. E. Long. 35. 5. N. Lat. 56. 40.

BIENNA, a town of Switzerland, seated on a lake of the same name. The inhabitants are Protestants, and in alliance with those of Bern, Soleure, and Friburg. E. Long. 7. 14. N. Lat. 47. 11.

BIENNIAL PLANTS; plants, as the title *biennial* imports, that are only of two years duration. Numerous plants are of this tribe, which being raised one year from seed, generally attain perfection either the same, or in about the period of a twelvemonth, or a little less or more, and the following spring or summer shoot up stalks, flower, and perfect seeds; soon after which they commonly perish; or if any particular sorts survive another year, they assume a dwindling and straggling growth, and gradually die off; so that biennials are always in their prime the first or second summer. Biennials consist both of esculents and flower plants. Of the esculent kinds, the cabbage, savoy, carrot, parsnip, beet, onion, leek, &c. are biennials. Of the flowery tribe, the Canterbury-bell, French honeysuckle, wall-flower, stock-july-flower, sweet-william, China-pink, common-pink, matted-pink, carnation, scabious, holly-hock, tree-mallow, vervain-mallow, tree-primrose, honesty or moonwort, &c. are all of the biennial tribe; all of which being sown in March, April, or May, rise the same year, and in spring following shoot up into stalks, flower, and perfect seeds in autumn; after which most of them dwindle: though sometimes the wall-flowers, hollyhocks, carnations, and pinks, will survive and flower the following year; but the plants become straggling, the flowers small and badly coloured: it is therefore eligible to raise a supply annually from seed; although wall-flowers, carnations, and pinks, may be continued by slips and layers.

BIER, a wooden machine for carrying the bodies of the dead to be buried. The word comes from the French *bierre*, which signifies the same. It is called in Latin *feretrum*, *à ferendo*. Among the Romans the common bier, whereon the poorer sort were carried, was called *sandapila*; that used for the richer sort *lectica*, *lectica funebris*, sometimes *lectus*. The former was only a sort of wooden chest, *vilis arca*, which was burnt with the body; the latter was enriched and gilded for pomp. It was carried bare, or uncovered, when the person died a natural and easy death; when he was much disfigured or distorted, it was veiled or covered over.

BIER is more particularly used for that whereon the bodies of saints are placed in the church to rest, and exposed to the veneration of the devout. This is also called, in middle-age writers, *lectus*, *feretrum*, *lectica*, and *loculus*; and was usually enriched with gold, silver, and precious stones, which was the cause that the bier of St Benedict was pillaged, and all its ornaments carried off.

BIEROLIET, a town of the Netherlands, in Dutch Flanders, where William Bruckfield, or *Beukelings*, who invented the method of pickling herrings, died in 1397. E. Long. 3. 42. N. Lat. 51. 25.

BIFFERÆ, plants that flower twice a-year, in spring and autumn, as is common between the tropics.

BIFRONS, a person double-fronted, or two-faced.

BIFRONS is more peculiarly an appellation of Janus, who was represented by the ancients with two faces, as being supposed to look both backwards and forwards: though other reasons for it are recited by Plutarch. Sometimes he was painted with four faces, *quadrifrons*, as respecting the four seasons.

BIGA, in antiquity, a chariot drawn by two horses abreast. Chariot-races, with two horses, were introduced into the Olympic games in the 93d Olympiad: but the invention was much more ancient; as we find that the heroes in the Iliad fight from chariots of that kind. The moon, night, and the morning, are by mythologists supposed to be carried in *bigæ*, the sun in *quadrigæ*. Statues in *bigæ* were at first only allowed to the gods, then to conquerors in the Grecian games; under the Roman emperors, the like statues, with *bigæ*, were decreed and granted to great and well-deserving men, as a kind of half triumph, being erected in most public places of the city. Figures of *bigæ* were also struck on their coins. The drivers of *bigæ* were called *bigarii*; a marble bust of one Florus a *bigarius* is still seen at Rome.

BIGAMY, properly signifies being *twice married*; but with us is used as synonymous with polygamy, or having a plurality of wives at once. Such second marriage, the former husband or wife living, is simply void, and a mere nullity, by the ecclesiastical law of England; and yet the legislature has thought it just to make it felony, by reason of its being so great a violation of the public economy and decency of a well-ordered state. For polygamy can never be endured under any rational civil establishment, whatever specious reasons may be urged for it by the eastern nations, the fallaciousness of which has been fully proved by many sensible writers: but in northern countries the very nature of the climate seems to reclaim against it; it never having obtained in this part of the world, even from the time of our German ancestors, who, as Tacitus informs us, "*prope soli barbarorum singulis uxoribus contenti sunt*. It is therefore punished by the laws both of ancient and modern Sweden with death. And in Britain it is enacted by statute 1 Jac. I. c. 11. that if

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if any person being married, do afterwards marry again, the former husband or wife being alive, it is felony; but within the benefit of clergy. The first wife in this case shall not be admitted as an evidence against her husband, because she is the true wife; but the second may, for she indeed is no wife at all: and so, *vice versa*, of a second husband. This act makes an exception to five cases, in which such second marriage, though in the three first it is void, is yet no felony. 1. Where either party hath been continually abroad for seven years, whether the party in England hath notice of the other's being alive or no. 2. Where either of the parties hath been absent from the other seven years within this kingdom, and the remaining party hath had no knowledge of the other's being alive within that time. 3. Where there is a divorce (or separation *à mensa et thoro*) by sentence in the ecclesiastical court. 4. Where the first marriage is declared absolutely void by any such sentence, and the parties loosed *à vinculo*. Or, 5. Where either of the parties was under the age of consent at the time of the first marriage; for in such case the first marriage was voidable by the disagreement of either party, which the second marriage very clearly amounts to. But, if at the age of consent the parties had agreed to the marriage, which completes the contract, and is indeed the real marriage; and afterwards one of them should marry again; Judge Blackstone apprehends that such second marriage would be within the reason and penalties of the act.

BIGATI, in antiquity, a kind of ancient Roman silver coins, on one side whereof was represented a *biga*, or chariot drawn by two horses. The *bigatus* was properly the Roman denarius, whose impression, during the times of the commonwealth, was a chariot driven by Victory, and drawn either by two horses or four; according to which it was either denominated *bigatus* or *quadrigatus*.

BIGGAR, a town and parish in Lanarkshire, Scotland, containing 1376 inhabitants in 1811. Here are the ruins of a collegiate church which was founded in 1545.

BIGGLESWADE, a town in Bedfordshire, in England, seated on the river Ivel, over which there is a handsome bridge. It lies on the principal road from London to York, and with the adjoining hamlets of Home and Stratton, contained 1895 inhabitants in 1811. W. Long. 0. 15. N. Lat. 52. 5.

BIGHT, among seamen, denotes one roll or round of a cable or rope, when coiled up.

BIGNON, Jerome, a French writer, was born at Paris in 1590. He gained an uncommon knowledge, under the care of his father, in philosophy, mathematics, history, civil law, and divinity, in a very short time; and was almost at the end of his studies at an age when it is usual to send children to school. At ten years of age he gave the public a specimen of his learning, in a Description of the Holy Land; and two years after, he published a Discourse concerning the principal antiquities and curiosities of Rome: and a summary Treatise concerning the election of Popes. Henry IV. desired to see him, and appointed him page to the dauphin, who was afterwards Louis XIII. He appeared at court with all the politeness of manners imaginable. He wrote at that time a treatise of the precedency of the kings of France, which he dedicated to Henry IV. who gave him an express order to continue his researches on that subject; but the death of that prince interrupted his design. He published, in 1613, the Formulæ of Marculphus. He was in 1620 made advocate-general in the grand council; and discharged that post with such reputation, that the king nominated him some time after counsellor of state, and at last advocate-general in the parliament. He resigned his offices in 1641; and the year following was appointed chief library-keeper of the king's library. He was obliged to resume his office of advocate-general, and held it till his death. He was employed in the most important affairs of state. At last this great man, who had always made religion the basis of his other virtues, died with the most exemplary devotion in 1656.

BIGNONIA, Trumpet-flower, or Scarlet Jasmine. See Botany *Index*.

BIGORRE, a territory or county of France, in the province of Gascony, which is now included in the department of the Upper Pyrenees. It is bounded on the east by the valley of Aure, the viscounty of Neboussa, Riviere Verdun, and Pardiac; by Bearne on the west; on the south, by the valleys of Brotou and Penticouse in Arragon; and on the north, by the county Riviere-Bas incorporated with Armagnac. It is 40 miles long from north to south, and 30 in breadth from east to west. It is divided into three parts, the mountains, the plains, and the Rustan. The mountains are enclosed between those of the valley of Aure on the east, those of Arragon on the south, and of Bearne on the west. This part contains two principal valleys, Lavedan and Barege. The valley of Bigorre is of an oval form, and has the hills of Rustan on the east. The remarkable towns are Tarbes the capital, Bagneres, Lourd, &c. The mountains are a barrier between France and Spain, and there are four different passages which the inhabitants are obliged to guard. Bigorre yields marble, jasper, stone, and slate; there are also mines of several sorts, but they are not worked. The rivers are the Adour, the Elches, the Arroset, and the Gave of Lavedan; there are also three lakes.

BIGOT, a person obstinately and perversely wedded to some opinion or practice, particularly of a religious nature. Camden, perhaps, has hit upon the true original of the word. He relates, that when Rollo, duke of Normandy, received Gisla, the daughter of Charles *the Foolish*, in marriage, together with the investiture of that dukedom, he would not submit to kiss Charles's foot: and when his friends urged him by all means to comply with that ceremony, he made answer in the English tongue, Ne se by God, i. e. *Not so by God*. Upon which, the king and his courtiers deriding him, and corruptly repeating his answer, called him *bigot*; from whence the Normans were called *bigodi*, or *bigots*.

Bigot, in Italian *bigontia*, is used to denote a Venetian liquid measure, containing the fourth part of the amphora, or half the boot.

BIHAEZ, a strong town of Croatia in Hungary, seated in an isle formed by the river Anna, in E. Long. 16. 2. N. Lat. 44. 35.

BILANDER, in *Navigation*, a small merchant ship with two masts, distinguished from other vessels of the same kind by the form of the main-sail. Few vessels are

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are now rigged in the manner of bilanders; the name has been variously applied in different countries.

BILBILIS, in *Ancient Geography*, a town of Hispania Citerior, the birth-place of Martial; now supposed to be Calatajud in Arragon, on the Xalon.

BILBOA, a large, handsome, and rich town of Spain, capital of Biscay, containing 15,000 inhabitants, with a well-frequented harbour. The inhabitants have always preserved themselves from a mixture with the Jews and Moors; and therefore will admit no family to settle among them but who can prove themselves to be of Christian extraction. The number of ships great and small that visit the harbour yearly is from 500 to 600. The exports are wool and sword-blades, with some other manufactures of iron and steel. The town is seated at the mouth of the river Ibaicabal, in W. Long. 4. 20. N. Lat. 43. 23.

BILBOWS, a punishment at sea, answering to the stocks at land. The offender is laid in irons, or stocks, which are more or less ponderous according to the quality of the offence of which he is guilty.

BILDESTON, a town of Suffolk in England, seated on a creek on the river Breton. The principal manufacture is of woollen goods, especially blankets. E. Long. 0. 45. N. Lat. 52. 20.

BILDGE of a ship, the bottom of her floor, or the breadth of the place the ship rests on when she is aground. Therefore, *bildge-water* is that which lies on her floor, and cannot go to the well of the pump: And *bildge-pumps*, or burr-pumps, are those that carry off the bildge-water. They likewise say the ship is *bildged*, when she has some of her timber struck off on a rock or anchor, and springs a leak.

BILE, a yellow, bitter juice, separated from the blood in the liver, collected in the porus biliarius and gall-bladder, and thence discharged by the common duct into the duodenum. See ANATOMY *Index*.

BILEDULGERID, or BELAD AL JERID, the *Country of Dates*, a kingdom of Africa. It is almost of a square form, extending itself more than 80 leagues every way, from 28. 30. to 32. 50. north latitude, and from 6 to 12 degrees of west longitude. It is bounded on the north by the kingdom of Tunis, on the east by a ridge of lofty mountains which divide it from Tripoli and part of Guadamis, on the west by the countries of Zeb and Mezeb, and on the south by the province of Verghela. The whole country is barren, sandy, and mountainous, producing little or nothing besides dates, which grow here in such profusion, that the face of half the kingdom is covered over with date-trees, and from hence the whole country takes its name. The climate is hot and unhealthy; the people lean, swarthy, and shrivelled in their complexions; with their eyes inflamed, owing to the reflection of the sunbeams from the white hard soil; and the showers of dust and sand, driven by the high winds that blow here at certain seasons, are frequently so violent as to bury men and cattle under them. Another inconvenience with which the inhabitants are afflicted, for which no other reason is given besides their constant living on dates, is an inveterate scurvy in their gums, whence all their teeth drop out; though it frequently spreads over their whole bodies, and then they become the most unhappy and loathsome objects. They are almost entirely free

from other diseases: so that when not afflicted with this, they live to a good old age; though it is observable that they discover a furrowed countenance, shrivelled skin, hoary locks, and other symptoms of old age, very early in life, and before decrepitude, infirmity, or any decay of their faculties, appear. The plague is not known in Biledulgerid, though so frequent in Barbary, and though a constant intercourse is kept up between the two countries; whence it would seem, that in certain cases this terrible distemper is not so infectious as it is usually thought to be. The same may be said of the smallpox, a disease little less contagious and fatal in hot countries than the plague itself. The natives are represented as a lewd, treacherous, thievish, and savage people, who delight in murder and robbery. They are mostly a mixture of Africans and wild Arabs who mingled themselves with them. The former live with some regularity and civil order in a kind of villages composed of a number of little huts; the latter in tents, ranging from place to place in quest of food and plunder. The Arabs, who pride themselves in their superiority of birth and talents above the primitive inhabitants, are wholly independent and free, frequently hiring themselves in the service of the neighbouring princes at war; from which policy arise the most valuable branches of their public revenue, if any thing can be called common or public in a nation of lawless robbers. The rest pursue no other occupation besides hunting and plundering; the first of which is their common employment, especially hunting of ostriches, which are said to be of a prodigious stature in this country, and as high as a man mounted on a tall horse. The inhabitants eat the flesh of these animals; barter their feathers for corn, pulse, and other things they want; use their hearts in their necromantic and religious rites, their fat as a medicine of sovereign virtue, their talons for ear-pendants and other ornaments, and their skins they convert into pouches and knapsacks, so that not a part of the animal but is employed in some useful purpose. Besides dates and ostriches, the Arabs live likewise on the flesh of goats and camels; drinking either the liquor or broth in which that flesh is boiled, or the milk of their camels. In the whole country there is scarcely a town of any note, or even a stream of water that deserves notice, or that is not dried up half the year.

BILEVELT, a town of Germany in the circle of Westphalia and county of Ravensburg, subject to the king of Prussia, in E. Long. 8. 20. N. Lat. 52. 0.

BILFINGER, GEORGE BERNARD, a German philosopher and statesman. See SUPPLEMENT.

BILINGUIS, in a general sense, signifies one that speaks two languages; but in law, is used for a jury that passes in any case between an Englishman and a foreigner, whereof part ought to be English and part strangers.

BILIOUS, in general, denotes something belonging to, or partaking of, the nature of bile. Hence,

BILIOUS Fevers are those occasioned by the over copiousness or bad qualities of the bile.

BILL, in *Mechanics*, an instrument made of iron, edged in the form of a crescent, and adapted to a handle. It is used by plumbers, to perform several parts of their work; by basket-makers, to cut the largest pieces of chesnut-trees and other wood; and by gardeners,

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gardeners, to prune trees. When short, it is called a *hand-bill;* and when long, a *hedge-bill.*

Bill, in *Law*, a declaration in writing, expressing either some wrong the complainant has suffered from the defendant, or a fault committed by the person complained of against some law or statute.—This bill is sometimes exhibited to justices at the general assizes, by way of indictment, or referred to others having jurisdiction; but it is more generally addressed to the lord chancellor. It contains the fact complained of, the damage sustained, and a petition or process against the defendant for redress; and is used both in criminal and civil cases. In the former, the words *billa vera* are indorsed by the grand jury upon a presentment, implying that they find the same founded on probable evidence, and therefore worthy of further consideration.

In Scots law, every summary application in writing, by way of petition to the court of session, is called a *bill.*

Bill of Attainder. See Attainder.

Bill of Appeal. See Appeal.

Bill signifies also a paper, either written or printed, in very large characters, which is posted up in some open and public place, to give notice of the sale of any merchandise or ship, or of the sailing of any vessel into foreign parts.

Bill, in trade, both wholesale and retail, as also among workmen, signifies an account of merchandises or goods delivered to a person, or of work done for one.

Bill, in *Commerce*, denotes a security for money under the hand and sometimes seal of the debtor, without any condition or forfeiture in case of non-performance; in which it is distinguished from a bond or obligation. It has been usually defined, a writing wherein one man is bound to another to pay a sum of money, on a day that is future, or presently on demand, according to the agreement of the parties at the time when it is drawn; on which, in case of failure, diligence or execution may be immediately done to force payment. These bills must be on stamped paper: if under 50l. the stamp to be 6d.; if for 50l. or upwards 1s.

Bank-Bill is a note or obligation signed on behalf of the company of the bank, by one of their cashiers, for value received. Or it is an obligation to pay on demand either to the bearer or to order; in Scotland, it is understood to be to order.

Bill of Entry, an account of the goods entered at the custom-house, both inwards and outwards. In this bill must be expressed, the merchant exporting or importing; the quantity of merchandise, and the divers species thereof; and whither transported, or from whence.

Bill of Exchange, is a security, originally invented among merchants in different countries, for the more easy remittance of money from the one to the other, which has since spread itself into almost all pecuniary transactions. It is an open letter of request from one man to another, desiring him to pay a sum named therein to a third person on his account; by which means a man at the most distant part of the world may have money remitted to him from any trading country. If A lives in Jamaica, and owes B who lives in England 1000l.; now if C be going from England to Jamaica, he may pay B this 1000l. and take a bill of exchange drawn by B in England upon A in Jamaica, and receive it when he comes thither. Thus does B receive his debt, at any distance of place, by transferring it to C; who carries over his money in paper credit, without danger of robbery or loss. This method is said to have been brought into general use by the Jews and Lombards, when banished for their usury and other vices; in order the more easily to draw their effects out of France and England into those countries in which they had chosen to reside. But the invention of it was a little earlier; for the Jews were banished out of Guienne in 1287, and out of England in 1290, and in 1236 the use of paper-credit was introduced into the Mogul empire in China.—In common speech, such a bill is frequently called a *draught;* but a bill of exchange is the more legal as well as mercantile expression. The person, however, who writes this letter, is called, in law, the *drawer;* and he to whom it is written, the *drawee;* and the third person or negociator to whom it is payable (whether specially named or the bearer generally) is called the *payee.*

These bills are either foreign or inland; foreign, when drawn by a merchant residing abroad upon his correspondent in England, or *vice versâ;* and inland, when both the drawer and the drawee reside within the kingdom. Formerly foreign bills of exchange were much more regarded in the eye of the law than inland ones, as being thought of more public concern in the advancement of trade and commerce. But now by two statutes, the one 9 and 10 W. III. c. 17. the other 3 and 4 Ann. c. 9. inland bills of exchange are put upon the same footing as foreign ones: what was the law and customs of merchants with regard to the one, and taken notice of merely as such, being by those statutes expressly enacted with regard to the other. So that there is now in law no manner of difference between them. In drawing foreign bills of exchange, it is customary to give two or three of the same date and tenor to be sent by different conveyances, that in case of accidents the person to whom they are sent may not be disappointed; in which case it is mentioned in the body of the bill, that it is the 1st, 2d, or 3d bill of exchange; so that when one is paid it discharges all the rest. Inland bills for any sum must be on 6d. stamped paper.

Bill of Lading, an acknowledgement signed by the master of a ship, and given to a merchant, &c. containing an account of the goods which the master has received on board from that merchant, &c. with a promise to deliver them at an intended place for a certain salary. Each bill of lading must be treble, one for the merchant who loads the goods, another to be sent to the person to whom they are consigned, and the third to remain in the hands of the master of the ship. It must be observed, however, that a bill of lading is used only when the goods sent on board a ship are but part of the cargo: for when a merchant loads a whole vessel for his own personal account, the deed passed between him and the master of the ship is called *charter-party.* See *Charter-Party.*

Bills of Mortality, are accounts of the numbers of births and burials within a certain district, every week, month, quarter, or year. In this sense we say *weekly bills,* Bill. *bills, monthly bills, quarterly bills, yearly bills.* The London *bills of mortality*, which were the first, are composed by the parish-clerks, and express the number of christenings of each sex, and of deaths from each disease. See BILLS OF MORTALITY, SUPPLEMENT.

BILL of Parcels, an account given by the seller to the buyer, containing the particulars of all the sorts and prices of goods bought.

BILL of Sale, is when a person wanting a sum of money delivers goods as a security to the lender, to whom he gives his bill, empowering him to sell the goods, in case the sum borrowed is not repaid, with interest, at the appointed time.

BILL of Stores, a license granted at the custom-house to merchants, by which they have liberty to carry, custom-free, all such stores and provisions as they may have occasion for during the voyage.

BILL of Sufferance, a license granted to a merchant, at the custom-house, suffering him to trade from one English port to another without paying custom.

Lombard BILLS, are instruments of an uncommon kind and figure, used in Italy and Flanders, and of late also in France; consisting of a piece of parchment, cut to an acute angle, about an inch broad at top, and, terminating in a point at bottom: chiefly given where private persons are concerned in the fitting out a ship on any long voyage. The manner is thus: The party, who is desirous to be concerned in the cargo or venture, carries his money to the merchant who fits out the ship, where it is entered down in a register; at the same time the merchant writes down on a piece of parchment, upwards of an inch broad, and seven or eight inches long, the name of the lender and the sum lent; which being cut diagonal-wise, or from corner to corner, each party retains his half. On the return of the vessel, the lender brings his moiety to the merchant; which being compared with the other, he receives his dividend accordingly. Much the same is practised in Holland by those who lend money on pledges; the name of the borrower and the sum are written on a like slip of parchment, which is cut into two, and half given to the borrower, and the other half stitched to the pledge; that, upon comparing them together again, the borrower may receive his goods on paying the money stipulated.

BILL in Parliament, a paper containing propositions, offered to the houses to be passed by them, and then presented to the king to pass into a law.

To bring a bill into the house, if the relief sought by it is of a private nature, it is first necessary to prefer a petition; which must be presented by a member, and usually sets forth the grievance desired to be remedied. This petition (when founded on facts that may be in their nature disputed) is referred to a committee of members, who examine the matter alleged, and accordingly report it to the house; and then (or, otherwise, upon the mere petition) leave is given to bring in the bill. In public matters, the bill is brought in upon motion made to the house, without any petition at all. Formerly all bills were drawn in the form of petitions, which were entered upon the parliament rolls, with the king's answer thereunto subjoined; not in any settled form of words, but as the circumstances of the case required, and at the end of each parliament the judges drew them into the form of a statute, which was entered on the statute-rolls. In the reign of Henry V. to prevent mistakes and abuses, the statutes were drawn up by the judges before the end of the parliament; and in the reign of Henry VI. bills in the form of acts according to the modern custom, were first introduced.

The persons directed to bring in the bill, present it in a competent time to the house, drawn out on paper, with a multitude of blanks, or void spaces, where any thing occurs that is dubious, or necessary to be settled by the parliament itself, such especially as the precise date of times, the nature and quantity of penalties, or of any sums of money to be raised; being indeed only the skeleton of the bill. In the house of lords, if the bill begins there, it is, (when of a private nature) referred to two of the judges, who examine and report the state of the facts alleged, to see that all necessary parties consent, and to settle all points of technical propriety. This is read a first time, and at a convenient distance a second time; and after each reading, the speaker opens to the house the substance of the bill, and puts the question, Whether it shall proceed any farther? The introduction of the bill may be originally opposed, as the bill itself may at either of the readings; and, if the opposition succeeds, the bill must be dropped for that session; as it must also, if opposed with success in any of the subsequent stages.

After the second reading, it is committed; that is, referred to a committee: which is either selected by the house in matters of small importance; or else, upon a bill of consequence, the house resolves itself into a committee of the whole house. A committee of the whole house is composed of every member; and, to form it, the speaker quits the chair (another member being appointed chairman), and may sit and debate as a private member. In these committees the bill is debated clause by clause, amendments made, the blanks filled up, and sometimes the bill entirely new-modelled. After it has gone through the committee, the chairman reports it to the house with such amendments as the committee have made; and then the house considers the whole bill again, and the question is repeatedly put upon every clause and amendment. When the house hath agreed or disagreed to the amendments of the committee, and sometimes added new amendments of its own, the bill is then ordered to be engrossed, or written in a strong gross hand, on one or more long rolls (or presses) of parchment sewed together. When this is finished, it is read a third time, and amendments are sometimes then made to it; and if a new clause be added, it is done by tacking a separate piece of parchment on the bill, which is called a *ryder*. The speaker then again opens the contents; and, in holding it up in his hands, puts the question, Whether the bill shall pass? If this is agreed to, the title to it is then settled; which used to be a general one for all the acts passed in the session, till in the fifth year of Hen. VIII. distinct titles were introduced for each chapter. After this, one of the members is directed to carry it to the lords and desire their concurrence; who, attended by several more, carries it to the bar of the house of peers, and there delivers it to their speaker, who comes down from his woolsack to receive it.

It there passes through the same forms as in the other house (except engrossing, which is already done); and, if

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if rejected, no more notice is taken, but it passes *sub silentio*, to prevent unbecoming altercations. But if it is agreed to, the lords send a message by two masters in chancery (or sometimes two of the judges) that they have agreed to the same: and the bill remains with the lords, if they have made no amendments to it. But if any amendments are made, such amendments are sent down with the bill to receive the concurrence of the commons. If the commons disagree to the amendments, a conference usually follows between members deputed from each house; who for the most part settle and adjust the difference: but if both houses remain inflexible, the bill is dropped. If the commons agree to amendments, the bill is sent back to the lords by one of the members, with a message to acquaint them therewith. The same forms are observed, *mutatis mutandis*, when the bill begins in the house of lords. But when an act of grace or pardon is passed, it is first signed by his majesty, and then read once only in each of the houses, without any new engrossing or amendment. And when both houses have done with any bill, it always is deposited in the house of peers, to wait the royal assent; except in the case of a bill of supply, which after receiving the concurrence of the lords is sent back to the house of commons.

The royal assent may be given two ways: 1. In person; when the king comes to the house of peers, in his crown and royal robes, and sending for the commons to the bar, the titles of all the bills that have passed both houses are read; and the king's answer is declared by the clerk of the parliament in Norman-French: a badge it must be owned (now the only one remaining), of conquest; and which one could wish to see fall into total oblivion; unless it be reserved as a solemn memento to remind us that our liberties are mortal, having been once destroyed by a foreign force. If the king consents to a public bill, the clerk usually declares, *Le roy le veut*, "The king wills it so to be;" if to a private bill, *Soit fait comme il est desiré*, "Be it as it is desired." If the king refuses his assent, it is in the gentle language of *Le roy s'avisera*, "The king will advise upon it." When a bill of supply is passed, it is carried up and presented to the king by the speaker of the house of commons; and the royal assent is thus expressed, *Le roy remercie ses loyal subjects, accepte leur benevolence, et aussi le veut;* "The king thanks his loyal subjects, accepts their benevolence, and wills it so to be." In case of an act of grace, which originally proceeds from the crown and has the royal assent in the first stage of it, the clerk of the parliament thus pronounces the gratitude of the subject: *Les prelats, seigneurs, et commons, en ce present parliament assemblees, au nom de touts vous autres subjects, remercient tres humblement votre majeste, et prient à Dieu vous donner en santé bone vie et longue;* "The prelates, lords, and commons in this present parliament assembled, in the name of all your other subjects, most humbly thank your majesty, and pray to God to grant you in health and wealth long to live." 2. By the statute 33 Hen. VIII. c. 21. the king may give his assent by letters patent under his great seal, signed with his hand, and notified in his absence to both houses assembled together in the high house. And when the bill has received the royal assent in either of these ways, it is then, and not before, a statute or act of parliament.

This statute or act is placed among the records of the kingdom; there needing no formal promulgation to give it the force of a law, as was necessary by the civil law with regard to the emperor's edicts; because every man in Britain is, in judgment of law, party to the making of an edict of parliament, being present thereat by his representatives. However, a copy thereof is usually printed at the king's press for the information of the whole land. And formerly, before the invention of printing, it was used to be published by the sheriff of every county; the king's writ being sent to him at the end of every session, together with a transcript of all the acts made at that session, commanding him, *ut statuta illa, et omnes articulos in eisdem contentos, in singulis locis ubi expedire viderit, publicè proclamari, et firmiter teneri et observari faciat*. And the usage was to proclaim them at his county court, and there to keep them, that whoever would, might read or take copies thereof; which custom continued till the reign of Henry VII.

An act of parliament thus made is the exercise of the highest authority that this kingdom acknowledges upon earth. It hath power to bind every subject in the land, and the dominions thereunto belonging; nay, even the king himself, if particularly named therein. And it cannot be altered, amended, dispensed with, suspended, or repealed, but in the same forms and by the same authority of parliament: for it is a maxim in law, that it requires the same strength to dissolve as to create an obligation. It is true, it was formerly held that the king might in many cases dispense with penal statutes; but now by statute 1 Will. and M. stat. 2. c. 2. it is declared, that the suspending or dispensing with laws by regal authority, without consent of parliament, is illegal.

Bill of Rights. See the article LIBERTY.

BILLERICAY, a town of Essex in England, seated on a hill, in E. Long. 0. 25. N. Lat. 51. 35.

BILLET, in *Heraldry*, a bearing in form of a long square. They are supposed to represent pieces of cloth of gold or silver; but Guillem thinks they represent a letter sealed up, and other authors take them for bricks. *Billeté* signifies that the escutcheon is all over strewed with billets, the number not ascertained.

Billet-Wood, small wood for fuel, cut three feet and four inches long, and seven inches and a half in compass; the size of which is to be inquired of by justices.

BILLETING, in military affairs, is the quartering of soldiers in the houses of a town or village.—And, among fox-hunters, it signifies the ordure and dung of a fox.

BILLIARDS, an ingenious kind of game, played on a rectangular table, with little ivory balls, which are driven into hazards or holes, according to certain rules of the game.

This game was invented by the French, when it was played in a different manner from what it is at present, by having a pass or iron fixed on the table, through which the balls at particular periods of the game used to be played; but now this method is quite laid aside.

Soon after the French, the Germans, the Dutch, and Italians, brought this game into vogue throughout most parts of Europe, at which they became great proficients; and in a few years afterwards it became a favourite

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Billiards. vourite diversion in many parts of England, particularly with persons of the first rank. Since that time, indeed, it has been in a great measure prostituted by designing and vulgar sorts of people: notwithstanding, it will never be out of fashion, being of itself very entertaining, and attended with that kind of moderate exercise which renders it the more agreeable.

The table on which the game is played is generally about twelve feet long and six feet wide, or rather in the exact form of an oblong; it is covered with fine green cloth, and surrounded with cushions to prevent the balls running off, and to make them rebound. There are six holes, nets, or pockets: these are fixed at the four corners, and in the middle, opposite to each other, to receive the balls, which when put into these holes or pockets are called hazards. The making of a hazard, that is, putting the adversary's ball in, at the usual game reckons for two in favour of the player.

The game is played with sticks called *maces*, or with cues; the first consists of a long straight stick, with a head at the end, and is the most powerful instrument of the two: the cue is a thick stick diminishing gradually to a point of about half an inch diameter; this instrument is played over the left hand, and supported by the fore-finger and thumb. It is the only instrument in vogue abroad, and is played with amazing address by the Italians and some of the Dutch; but in England the mace is the prevailing instrument, which the foreigners hold in contempt, as it requires not near so much address to play the game with, as when the cue is made use of; but the mace is preferred for its peculiar advantage, which some professed players have artfully introduced, under the name of *trailing*, that is, following the ball with the mace to such a convenient distance from the other ball as to make it an easy hazard. The degrees of trailing are various, and undergo different denominations amongst the connoisseurs at this game; namely, the shove, the sweep, the long stroke, the trail, and the dead trail or turn up, all which secure an advantage to a good player according to their various gradations: even the butt end of the cue becomes very powerful, when it is made use of by a good trailer.

Rules generally observed at the common or usual game.—1. For the lead, the balls must be put at one end, and the player must strike them against the farthermost cushion, in order to see which will be nearest the cushion that is next to them. 2. The nearest to the cushion is to lead and choose the ball if he pleases. 3. The leader is to place his ball at the nail, and not to pass the middle pocket; and if he holes himself in leading, he loses the lead. 4. He who follows the leader must stand within the corner of the table, and not place his ball beyond the nail. 5. He who plays upon the running ball loses one. 6. He who touches the ball twice and moves it, loses one. But these two rules are seldom or ever enforced, especially in England. 7. He who does not hit his adversary's ball, loses one. 8. He who touches both balls at the same time, makes a foul stroke, in which case if he should hole his adversary, nothing is gained by the stroke; but if he should put himself in, he loses two. 9. He who holes both balls, loses two. 10. He who strikes upon his adversary's ball, and holes himself, loses two. 11. He who plays at the ball without striking it, and holes himself, loses three. 12. He who strikes both balls over the table, loses two. 13. He who strikes his ball over the table, and does not hit his adversary's ball, loses three. 14. He who retains the end of his adversary's stick when playing, or endeavours to baulk his stroke, loses one. 15. He who plays another's ball or stroke without leave, loses one. 16. He who takes up his ball, or his adversary's without leave, loses one. 17. He who stops either ball when running, loses one; and being near the hole, loses two. 18. He who blows upon the ball when running loses one, and, if near the hole, loses two. 19. He who shakes the table when the ball is running, loses one. 20. He who strikes the table with the stick, or plays before his turn, loses one. 21. He who strikes his stick upon the table, and hits the ball, loses one. 22. If the ball stands upon the edge of the hole, and after being challenged it falls in, it is nothing, but must be put up where it was before. 23. If any person, not being one of the players, stops a ball, the ball must stand in the place where it was stopped. 24. He who plays without a foot upon the floor, and holes his adversary's ball, gets nothing for it, but loses the lead. 25. He who leaves the game before it is ended, loses it. 26. Any person may change his stick in play. 27. If any difference arise between players, he who marks the game or the majority of the company must decide it. 28. Those who do not play must stand from the table, and make room for the players. 29. If any person lays any wager, and does not play, he shall not give advice to the players upon the game.

Different kinds of games played at billiards.—Besides the common winning game, which is twelve up, there are several other kinds of games, viz. the losing game, the winning and losing, choice of balls, bricole, carambole, Russian carambole, the bar-hole, the one-hole, the four-game, and hazards.

The *losing-game*, is the common game nearly reversed; that is to say, except hitting the balls, which is absolutely necessary, the player gains by losing. By putting himself in, he wins two; by putting his adversary in, he loses two; but if he pockets both balls, he gets four. The game depends greatly upon particular strengths, and is therefore very necessary to be known to play the winning game well.

The *winning and losing game*, is a combination of both games; that is to say, all balls that are put in by striking first the adversary's ball, reckon towards game; and holing both balls reckons four. At this game and the losing, knocking over or forcing the balls over the cushion, goes for nothing, the striker only loses the lead.

Choice of the balls, is choosing each time which ball the player pleases, which is doubtless a great advantage, and is generally played against losing and winning.

Bricole, is being obliged to hit a cushion, and make the ball rebound or return to hit the adversary's ball, otherwise the player loses a point. This is a great disadvantage, and is reckoned between even players to be equal to receiving about eight or nine points.

Carambole, is a game newly introduced from France. It is played with three balls, one being red, which is neutral, and is placed upon a spot on a line with the stringing

stringing nail (i. e. that part of the table from whence the player strikes his ball at first setting off, and which is generally marked with two brass nails). Each antagonist at the first stroke of a hazard, plays from a mark which is upon a line with it at the other end of the table. The chief object at this game is, for the player to hit with his own ball the two other balls, which is called a *carambole*, and by which the player wins two. If he puts in the red ball he gets three, and when he holes his adversary's ball he gets two; so that seven may be made at one stroke, by caramboling and putting in both balls. This game resembles the losing, depending chiefly upon particular strengths, and is generally played with the cue. The game is sixteen up; nevertheless it is reckoned to be sooner over than the common game. The next object of this game, after making what we have distinguished by the *carambole*, is the *baulk;* that is, making the white ball, and bringing the player's own ball and the red one below the stringing nail, from whence the adversary's begin. By this means the opponent is obliged to play bricole from the opposite cushion; and it often happens that the game is determined by this situation.

The *Russian carambole* is a game that has still more lately been introduced from abroad, and is played in the following manner: The red ball is placed as usual on the spot made for that purpose; but the player when he begins, or after having been holed, never places his ball on any particular place or spot; he being at liberty to put it where he pleases. When he begins to play, instead of striking at the red ball, he leads his own gently behind it, and his antagonist is to play at which he thinks proper; if he plays at the red ball and holes it, he scores three as usual towards the game, which is twenty-four instead of sixteen points; and the red ball is put upon the spot again, at which he may strike again, or take his choice which of the two balls to push at, always following his stroke till both balls are off the table. He is entitled to two points each time that he caramboles, the same as at the other game; but if he caramboles and puts his own ball into any hole, he loses as many as he might have got had he not holed himself: for example, if he strikes at the red ball which he holes, at the same time caramboles and holes himself, he loses five points; and if he holes both balls when he caramboles, and likewise his own, he loses seven, which he would have got, if he had not holed his own ball. In other respects it is played like the common carambole game.

The *bar-hole*, is so called from the hole being barred which the ball should be played for, and the player striking for another hole; when this game is played against the common game, the advantage for the latter, between equal players, is reckoned to be about six.

The player at the *one-hole*, though it seems to those who are not judges of the game to be a great disadvantage, has in fact the best of it; for as all balls that go into the one hole reckon, the player endeavours to lay his ball constantly before the hole, and his antagonist frequently finds it very difficult to keep one or other ball out, particularly on the leads, when the one-hole player lays his ball (which he does as often as he can) on the brink of the hole; leading for that purpose from the opposite end, which in reality he has no right to do; for, the lead should be given from the end of the table at which the hazard is made; but when a person happens to be a novice, this advantage is often taken.

The *four-game*, consists of two partners on each side, at the common winning game; who play by succession after each hazard, or two points lost. The game is fifteen up; so that the point or hazard is an odd number, which makes a miss at this game of more consequence than it is at another; being as much at four, six, or eight, as it is at five, seven, or nine, at the single game.

Hazards are so called because they depend entirely upon the making of hazards, there being no account kept of any game. Any number of persons may play by having balls that are numbered; but the number seldom exceeds six, to avoid confusion. The person whose ball is put in, pays so much to the player according to what is agreed to be played for each hazard; and the person who misses, pays half the price of a hazard to him whose ball he played at. The only general rule is not to lay any ball a hazard for the next player, which may be in a great measure avoided, by always playing upon the next player, and either bringing him close to the cushion, or putting him at a distance from the rest of the balls. The table, when hazards are played, is always paid for by the hour.

BILLINGHAM, a town of Northumberland in England, seated in W. Long. 1. 35. N. Lat. 55. 20.

BILLON, in the history of coins, a composition of precious and base metals, where the latter predominates. Wherefore gold under twelve carats fine, is called *billon of gold;* and silver under six pennyweight, *billon of silver*. So little attention was paid formerly to the purity of gold and silver, that the term *billon of gold* was applied only to that which was under twenty-one carats, and *billon of silver* to that which was lower than ten pennyweight.

BILLON, a town of France, in the department of Puy de Dome, containing 5200 inhabitants. E. Long. 3. 30. N. Lat. 45. 36.

BILSDON, a small town of Leicestershire in England, situated in W. Long. 0. 15. N. Lat. 52. 40.

BILSEN, a town of the Netherlands, in the principality of Liege, seated on the river Demer, in E. Long. 5. 42. N. Lat. 50. 48.

BILSON, THOMAS, bishop of Winchester, in which city he was born and educated. In 1565, he was admitted perpetual fellow of New College, and in 1570 completed his degrees in arts. He was made bachelor of divinity in 1579, and doctor the year following. His first preferment was that of master of Winchester school; he was next made prebendary, and afterwards warden, of Winchester college. In 1596 he was consecrated bishop of Worcester; and about a year after, translated to the see of Winchester, and sworn of Queen Elizabeth's privy-council. He was one of the principal managers of the Hampton-court conference in 1604; and the English translation of the Bible in the reign of King James I. was finally corrected by this prelate, and Dr Miles Smith bishop of Gloucester. He died in the year 1616, and was buried in Westminster abbey, near the entrance of St Edmund's chapel, on the south side of the monument of King Richard II. The several authors who have mentioned

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Bishop Bilson, agree in giving him the character of a learned divine, an able civilian, and an upright man. His style is in general much more easy and harmonious than that of cotemporary ecclesiastics. His works are, 1. Several Latin poems and orations. Manuscript, in Ant. Wood's library. 2. The true difference between Christian subjection and unchristian rebellion. Oxf. 1585, 4to. Lond. 1586, 8vo. 3. The perpetual government of Christ's church. Lond. 1593, 4to, Black Letter. 4. The effect of certain sermons touching the full redemption of mankind by the death and blood of Christ, &c. Lond. 1599, 4to. 5. The survey of Christ's suffering for man's redemption, and of his descent to Hades or Hell. Lond. 1604, fol. 6. A sermon preached before King James I. and his queen, at their coronation. Lond. 1603, 8vo.

BIMEDIAL, in *Mathematics*. If two medial lines, as AB and BC, commensurable only in power, containing a rational rectangle, are compounded, the whole line AC will be irrational, and is called a *first bimedial line*.

A————————B————————C

See Euclid, lib. x. prop. 38.

BIMINI, one of the Bahama islands, near the north-west extremity of the Bahama bank. It is about eight miles in length, and as much in breadth, covered with trees, and inhabited by the native Americans. It is very difficult of access on account of the shoals, but is a very pleasant place. W. Long. 79. 30. N. Lat. 25. 0.

BIMLIPATAN, a village in Hindostan, in the northern circars, seated on the west side of the bay of Bengal. The Dutch had formerly a small factory here, designed for buying up the cloth manufactured by the inhabitants. E. Long. 83. 5. N. Lat. 18. 0.

BINACLE, a wooden case or box, which contains the compasses, log-glasses, watch-glasses, and lights to show the compass at night. As this is called *bittacle* in all the old sea-books, even by mariners, it appears evidently to be derived from the French term *habittacle* (a small habitation), which is now used for the same purpose by the seamen of that nation. The binacle (Plate LXXXVIII. fig. 4.) is furnished with three apartments, with sliding shutters: the two side ones, *a b*, have always a compass in each *d*, to direct the ship's way; while the middle division *c*, has a lamp or candle with a pane of glass on either side to throw a light upon the compass in the night, whereby the man who steers may observe it in the darkest weather, as it stands immediately before the helm on the quarter-deck. There are always two binacles on the deck of a ship of war, one being designed for the man who steers, and the other for the person who superintends the steerage, whose office is called *conning*.

BINAROS, a small town of Spain, in the kingdom of Valentia, remarkable for good wine. It is seated near the sea, in E. Long. 0. 15. N. Lat. 40. 24.

BINARY ARITHMETIC, that wherein unity or 1 and 0 are only used. This was the invention of M. Leibnitz, who shows it to be very expeditious in discovering the properties of numbers, and in constructing tables; and Mr Dangecourt, in the history of the royal academy of sciences, gives a specimen of it concerning arithmetical progressionals; where he shows,

that because in binary arithmetic only two characters are used, therefore the laws of progression may be more easily discovered by it than by common arithmetic. All the characters used in binary arithmetic are 0 and 1; and the cypher multiplies every thing by 2, as in the common arithmetic by 10. Thus 1 is one; 10, two; 11, three; 100, four; 101, five; 110, six; 111, seven; 1000, eight; 1001, nine; 1010, ten; which is built on the same principles with common arithmetic. Hence immediately appears the reason of the celebrated property of the duplicate geometrical proportion in whole numbers; viz. that one number of each degree being had, we may thence compose all the other whole numbers above the double of the highest degree. It being here, v. gr. as if one should say, 111 is the sum of 4, 2, and 1, which property may serve essayers to weigh all kinds of masses with a little weight; and may be used in coins, to give several values with small pieces. This method of expressing numbers once established, all the operations will be easy: in multiplication particularly, there will be no need for a table, or getting any thing by heart. The author, however, does not recommend this method for common use, because of the great number of figures required to express a number; adding, that if the common progression were from 12 to 12, or from 16 to 16, it would be still more expeditious; but its use is in discovering the properties of numbers, in constructing tables, &c. What makes the binary arithmetic the more remarkable is, that it appears to have been the same with that used 4000 years ago among the Chinese, and left in *ænigma* by Fohi, the founder of their empire as well as of their sciences.

100	4
10	2
1	1
111	7

BINARY Measure, in *Music*, is a measure which is beaten equally, or where the time of rising is equal to that of falling. This is usually called *common time*.

BINARY Number, that composed of two units.

BINCH, a small fortified town of the Low Countries, in the county of Hainault, subject to the house of Austria. E. Long. 3. 21. N. Lat. 50. 23.

BIND, a country word for a stalk of hops.

BIND of Eels, a quantity, consisting of 250, or 10 strikes, each containing 25 eels.

BIND-WEED, in *Botany*. See CONVOLVULUS, BOTANY *Index*.

BINDBROKE, a town of Lincolnshire in England, seated in E. Long. 0. 10. N. Lat. 53. 32.

BINDING-JOISTS, in *Architecture*, are those joists in a floor, into which the trimmers of staircases, or well-holes of the stairs, and chimney-ways, are framed: they ought to be stronger than common joists.

BINDING, in the art of defence, a method of securing or crossing the adversary's sword with a pressure, accompanied with a spring from the wrist. See BEATING.

Unless a man by some kind of cross, secure, as it were, or render his adversary's sword incapable to offend him during the time of his performing a lesson upon him, it is impossible for him to be certain but that he may receive from his adversary, either a fortuitous *contretemps*, or an exchanged thrust, before the recovery of his body, or going off after a thrust.—The great objection made by some people, particularly those time-catchers, against the frequent use of binding,

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ing, is, that when a man, in performing it, cleaves too much to his adversary's sword, he is liable to his adversary's slipping of him, and consequently of receiving either a plain thrust, or one from a feint.

BINDING is a term in falconry, which implies tiring, or when a hawk seizes.

BINDING of Books. See *Book-Binding*.

BING, in the alum-works, denotes a heap of alum thrown together in order to drain.

BINGAZI, a sea-port town of Africa, in the kingdom of Tripoli. E. Long. 19. 10. N. Lat. 32. 20.

BINGEN, an ancient and handsome town of Germany, in the grand duchy of Hesse, seated at the place where the river Nave falls into the Rhine. E. Long. 7. 48. N. Lat. 49. 55.

BINGHAM, JOSEPH, a learned divine, born at Wakefield in Yorkshire, in September 1668, educated at University college in Oxford, and afterwards presented by John Radcliffe, M. D. to the rectory of Headbournworthy, near Winchester. In this country retirement he began his learned and laborious work, *Origines Ecclesiasticæ:* or, The Antiquities of the Christian church; the first volume of which was published in 1708, and it was completed afterwards in nine volumes more. He published also several other books. But notwithstanding his great learning and merit, he had no other preferment than that of Headbournworthy till the year 1712, when he was collated to the rectory of Havant, near Portsmouth, by Sir Jonathan Trelawney bishop of Winchester, to whom he dedicated several of his books. He died August 17th, 1723, in the 55th year of his age.

BINGHAM, a town of Nottinghamshire in England, seated in the vale of Belvoir, and containing 1326 inhabitants in 1811. W. Long. 1. 10. N. Lat. 50. 3.

BINGIUM, in *Ancient Geography*, a village or town of the Vangiones in Gallia Belgica, seated at the confluence of the Nave and Rhine. Now BINGEN, which see.

BINGLEY, a town in the west riding of Yorkshire, seated on the river Aire. Population 4782, including Micklethwaite. W. Long. 1. 35. N. Lat. 53. 20.

BINN, *binna*, a sort of chest or cupboard, wherein to lock up bread, meat, or other provisions. The word is also used for a place boarded up to put corn in.

BINN, or BIN. The pease and oatmeal, used at sea, are apt to spoil in casks. Dr Hales proposes to prevent this, by putting them into large binns, with false bottoms of hair-cloths laid on bars, whereby fresh air may be blown upwards through them, at proper times, with small ventilators.

BINOCULAR TELESCOPE, a kind of dioptric telescope fitted with two tubes, joined in such a manner that one may see a distant object with both eyes at the same time. See OPTICS.

BINOMIAL, in *Algebra*, a root consisting of two members connected by the sign + or —. Thus $a+b$, and 8—3, are binomials, consisting of the sums and differences of these quantities. See ALGEBRA.

BINTAN, an island of Asia, in the East Indies, to the south of the peninsula of Malacca, situated in E. Long. 103. 50. N. Lat. 1. 0.

BIOGRAPHER, one who writes the lives of particular persons, as Plutarch, Suetonius, &c. See the next article.

BIOGRAPHY, a species of history which records the lives and characters of remarkable persons. This is at once the most entertaining and instructive kind of history. It admits of all the painting and passion of romance; but with this capital difference, that our passions are more keenly interested, because the characters and incidents are not only agreeable to nature, but strictly true. No books are so proper to be put into the hands of young people. See HISTORY.

BION, a bucolic poet, native of Smyrna, lived at the same time with Ptolemy Philadelphus, whose reign reached from the fourth year of the 123d Olympiad to the second year of the 133d. He was an incomparable poet, if we may believe the lamentations of his disciple Moschus. His few pieces which are left do not contradict this testimony. See MOSCHUS.

BION, surnamed *Borysthenites*, because he was of Borysthenes, was a philosopher of a great deal of wit, but of very little religion: he flourished about the 120th Olympiad; but, falling sick, he, like other profane persons, became superstitious.

BIORNBURG, a town of North Finland in Sweden, seated on the river Kune near its mouth in the gulf of Bothnia. E. Long. 22. 35. N. Lat. 62. 6.

BIOTHANATI, (from βια, *violence*, and θανατος, *death*), in some medical writers, denotes those who die a violent death. The word is also written, and with more propriety, *biathanati;* sometimes *biæothanti*.

In a more particular sense, it denotes those who kill themselves, more properly called *autothanati*. In this sense it is that the word is used both by Greek and Latin writers. By the ancient discipline of the church, they were punished by denying them burial, and refusing all commemoration of them in the prayers and offices of the church.

BIOTHANATI (supposed by some to be derived from βιος, *life*, and θανατος, *death*, and alluding to the belief of a future life after death) was also a name of reproach given by the Heathens to the primitive Christians, for their constancy and forwardness to lay down their lives in martyrdom.

BIOTHANATOS is also used, in some writers of the barbarous age, for wicked, damnable, or accursed.

BIOUAC, BIVOUAC, or BIOVAC, in the military art, a nightly guard performed by the whole army, when there is an apprehension of danger from the enemy. The word is formed by corruption from the German, *weywaght*, a *double watch* or *guard*.

BIPENNIS, a two-edged axe, used anciently by the Amazons in fight; as also by the seamen, to cut asunder the ropes and cordage of the enemy's vessels. The bipennis was a weapon chiefly of the oriental nations, made like a double axe, or two axes joined back to back, with a short handle. Modern writers usually compare it to our halbard or partizan; from which it differed in that it had no point, or that its shaft or handle was much shorter.

BIQUADRATE, or BIQUADRATIC, is the next power above the cube, or the square multiplied by itself.

BIQUADRATIC EQUATION, in *Algebra*, an equation raised to the fourth power, or where the unknown quantity of one of the terms has four dimensions: Thus $x^4+ax^3+bx^2+cx+d=0$ is a biquadratic equation. See ALGEBRA.

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Biquadratic Parabola, in *Geometry*, a curve line of the third order, having two infinite legs tending the same way. See Parabola.

Biquadratic Power of any number, is the fourth power or squared square of that number: Thus 16 is the biquadratic power of 2; for $2\times 2=4$, and $4\times 4=16$

Biquadratic Root of any number, is the square root of the square root of that number: Thus the biquadratic root of 81 is 3; for the square root of 81 is 9, and the square root of 9 is 3.

BIQUALAR, in the customs of the Algerines, a cook of the divan.—The janizaries, whom the Algerines call *oldachis*, after serving a certain term as common soldiers, are preferred to be biqualars, or cooks of the divan, which is the first step towards arriving at higher preferment. Biqualars have the care of furnishing the officers and commanders of the Algerine soldiery with meat and drink in the camp, in garrison, &c. From biqualars they are made odobachis; this is, corporals of companies, or commanders of squadrons.

BIQUINTILE, an aspect of the planets, when they are 144 degrees distant from each other. It is thus called, because they are distant from one another by twice the fifth part of 360 degrees.

BIR, or Berr, a town of the province of Diarbeck in Turkey in Asia, with a castle where the governor resides, seated on the eastern bank of the river Euphrates, near a high mountain, in a very pleasant and fertile country. E. Long. 38. 6. N. Lat. 36. 10.

BIRAGUE, Clement, a Milanese engraver, and the inventor of the art of cutting diamonds, flourished about the year 1580.

BIRCH-tree. See Betula, Botany *Index*.

Birch-Bark, being bituminous, and consequently warm and emollient, is used in fumigations to correct a distempered air. The inner silken bark was anciently used for writing-tables before the invention of paper; though Ray rather assigns the office of paper to the cuticle, or outer skin, which peels off yearly. And with the outward, thicker, and coarser part, are houses in Russia, Poland, and other northern tracts, covered instead of slates and tyle. The Indians make pinnaces with white cedar, which they cover with large flakes of birch-bark; sewing them with thread of spruce roots, and pitching them, as the ancient Britons did, with the willow. Pliny speaks of a bitumen actually procured from the birch tree.

Fungus of Birch, an excrescence growing on its trunk. It is astringent, and good against hemorrhagies. When boiled, beaten, and dried in an oven, it makes excellent spunk or touchwood.

Birch-Leaves are of use in the dropsy, itch, &c. either internally or externally applied.

Birch-Twigs serve to make rods and brooms: smeared with bird-lime, they are used by fowlers; to say nothing of the ancient fasces carried by lictors.

Birch-Wine is made by fermenting the vernal juice. Formerly it was in great repute against all nephritic disorders, but is left out in the modern London practice. The preparation of birch-wine is well and amply described in a book entitled *Vinetum Britannicum*.

Birch, *Dr Thomas*, an eminent historical and biographical writer, was born in London in 1705. His parents were both of them Quakers; and his father, Joseph Birch, was a coffee-mill maker by trade. Thomas being put to school, was indefatigable in his application, and stole many hours from sleep to increase his stock of knowledge. By this unremitting diligence, though he had not the happiness of an university education, he soon became qualified to take holy orders in the church of England, to the surprise of his acquaintance. In 1728 he married the daughter of the Rev. Mr Cox, to whom he was curate: but his felicity was of short duration, Mrs Birch dying of a puerperal fever in less than 12 months after their marriage; an event which he deplores in a very elegant and pathetic poem, preserved in Nichols's Collection. In 1732 he was recommended to the friendship and favour of the late lord high chancellor Hardwicke, then attorney general; to which noble peer, and to the present earl of Hardwicke, he was indebted for all his preferments. The first proof he experienced of his patron's regard was the living of Ulting in the county of Essex, in the gift of the crown, to which he was presented 1732. In 1734 he was appointed one of the domestic chaplains to the unfortunate earl of Kilmarnock, who was beheaded in 1746. Mr Birch was chosen a member of the Royal Society, Feb. 20. 1734-5; and of the Society of Antiquaries, Dec. 11. 1735, of which he afterwards became director till his death. Before this, the Marischal college of Aberdeen had conferred on him, by diploma, the degree of master of arts. In 1743, by the interest of Lord Hardwicke, he was presented by the crown to the sinecure rectory of Landewy Welfrey in the county of Pembroke; and in 1743-4 was preferred, in the same manner, to the rectory of Sidington in St Peter's, in the county and diocese of Gloucester. We find no traces of his having taken possession of this living; and indeed it is probable that he quitted it immediately for one more suitable to his inclinations and to his literary engagements, which required his almost constant residence in town; for on the 24th of February 1743-4, he was instituted to the united rectories of St Michael Woodstreet, and St Mary Staining; and in 1745-6, to the united rectories of St Margaret Pattens and St Gabriel, Fenchurch-street (by lord chancellor Hardwicke, in whose turn the presentation then was). In January 1752, he was elected one of the secretaries of the Royal Society, in the room of Dr Cromwell Mortimer, deceased. In January 1753, the Marischal college of Aberdeen created him doctor of divinity; and in that year the same degree was conferred on him by Archbishop Herring. He was one of the trustees of the British Museum; for which honour he was probably indebted to the present earl of Hardwicke, as he was for his last preferment, the rectory of Depden in Essex, to which he was inducted Feb. 26. 1761. In the latter part of his life he was chaplain to the Princess Amelia. In 1765 he resigned his office of secretary to the Royal Society, and was succeeded by Dr Morton. His health declining about this time, he was ordered to ride for the recovery of it; but being a bad horseman, and going out Jan. 9. 1766, he was unfortunately thrown from his horse, on the road betwixt London and Hampstead, and died on the spot, in the 61st year of his age, to the great regret of the doctor's numerous

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numerous literary friends; and was buried in St Margaret Pattens. Dr Birch had in his lifetime been very generous to his relations; and none that were nearly allied to him being living at his decease, he bequeathed his library of books and manuscripts, with his picture painted in 1735, and all his other pictures and prints not otherwise disposed of by his will, to the British Museum. He likewise left the remainder of his fortune, which amounted to not much more than 500l. to be laid out in government-securities, for the purpose of applying the interest to increase the stipend of the three assistant librarians; thus manifesting at his death, as he had done during his whole life, his respect for literature, and his desire to promote useful knowledge. To the Royal Society he bequeathed his picture painted by Wills in 1737, being the original of the mezzotinto print done by Fauber in 1741. His principal publications were, 1. The General Dictionary, Historical and Critical; including a new translation of Mr Bayle, and interspersed with several thousand new lives. Dr Birch's associates in this undertaking were, the Reverend John Peter Bernard, Mr John Lockman, and Mr George Sale. The whole design was completed in 10 volumes folio. 2. Dr Cudworth's Intellectual System (improved from the Latin edition of Mosheim), his Discourse on the true Notion of the Lord's Supper, and two Sermons, with an account of his Life and Writings, 2 vols. 4to, 1743. 3. The Life of the Honourable Robert Boyle, 1744; prefixed to an edition of that excellent philosopher's works, revised by Dr Birch. 4. The Lives of Illustrious Persons of Great Britain, annexed to the engravings of Houbraken and Vertue, 1747—1752. 5. An Inquiry into the Share which King Charles I. had in the Transactions of the earl of Glamorgan, 1747, 8vo. 6. An edition of Spenser's Fairy Queen, 1751, 3 vols. quarto, with prints from designs by Kent. 7. The Miscellaneous Works of Sir Walter Raleigh; to which was prefixed the Life of that great, unfortunate, and injured man, 1751, 2 vols. 8vo. 8. The Theological, Moral, Dramatic, and Poetical Works of Mrs Catharine Cockburn; with an Account of the Life of that very ingenious Lady, 1751, 2 vols. 8vo. 9. The Life of the Most Reverend Dr John Tillotson, Lord Archbishop of Canterbury. Compiled chiefly from his original Papers and Letters, 1752, 8vo. 10. Milton's Prose Works, 1753, 2 vols. 4to; with a New Life of that great poet and writer. 11. Memoirs of the Reign of Queen Elizabeth, from the year 1581 till her death. In which the secret intrigues of her court, and the conduct of her favourite Robert earl of Essex, both at home and abroad, are particularly illustrated. From the original papers of his intimate friend Anthony Bacon, Esq.; and other manuscripts never before published, 1754, 2 vols. 4to. 12. The History of the Royal Society of London for improving natural knowledge, from its first rise. In which the most considerable of those papers communicated to the Society, which have hitherto not been published, are inserted in their proper order as a supplement to the Philosophical Transactions, 1756 and 1757, 4 vols. 4to. 13. The Life of Henry Prince of Wales, eldest Son of King James I. Compiled chiefly from his own papers and other manuscripts, never before published, 1760, 8vo. His numerous communications to the Royal Society may be seen in the Philosophical Transactions; and his poetical talents are evident from the verses already referred to.

BIRD, William, an eminent musician and composer, was one of the children of the chapel in the reign of Edward VI. and, as it is asserted by Wood in the Ashmolean MS. was bred up under Tallis. It appears, that in 1575 Tallis and Bird were both gentlemen and also organists of the royal chapel; but the time of their appointment to this latter office cannot now be ascertained.

The compositions of Bird are many and various; those of his younger years were mostly for the service of the church. He composed a work entitled *Sacrarum Cantionum, quinque vocum*, printed in 1589; among which is that noble composition, *Civitas sancti tui*, which for many years past has been sung in the church, as an anthem, to the words "Bow thine ear, O Lord." He was also the author of a work entitled *Gradualia, ac Cantiones sacræ, quinis, quaternis, trinisque vocibus concinnatæ, lib. primus*. Of this there are two editions, the latter published in 1610. Although it appears by these his works that Bird was in the strictest sense a church musician, he occasionally gave to the world compositions of a secular kind: and he seems to be the first among English musicians that ever made an essay in the composition of that elegant species of vocal harmony, the madrigal: the *La Verginella* of Ariosto, which he set in that form for five voices, being the most ancient musical composition of the kind to be met with in the works of English authors. Of his compositions for private entertainment, there are extant, "Songs of sundry natures, some of gravitie, and others of myrth, fit for all companies and voyces, printed in 1589;" and two other collections of the same kind, the last of them printed in 1611. But the most permanent memorials of Bird's excellencies are his motets and anthems; to which may be added, a fine service in the key of D with the minor third, the first composition in Dr Boyce's Cathedral Music, vol. iii. and that well-known canon of his, *Non nobis Domine*.

Besides his salaries and other emoluments of his profession, it is to be supposed that Bird derived some advantages from the patent granted by Queen Elizabeth to Tallis and him, for the sole printing of music and music-paper: Dr Ward speaks of a book which he had seen with the letters T. E. for Thomas East, Est, or Este, who printed music under that patent. Tallis dying in 1585, the patent, by the terms of it, survived to Bird, who, no doubt for a valuable consideration, permitted East to exercise the right of printing under the protection of it; and he in the title-page of most of his publications styles himself the *assignee of William Byrd*. Bird died in 1623.

BIRD, in *Zoology*. See Anatomy, and Ornithology *Index*.

Beam-Bird, or *Petty-chaps*. See Motacilla.

Black-Bird.
Blue-Bird.
Canary-Bird.
Dung-Bird.
Humming-Bird.
Mocking-Bird.
Bird of Paradise.
} See Ornithology *Index*.

Bird-Call, a little stick, cleft at one end, in which is is put a leaf of some plant, wherewith to counterfeit the cry or call of several birds, and bring them to the net, or snare, or lime-twig, to be taken. A laurel-leaf fitted on the bird-call, counterfeits the voice of lapwings; a leek that of nightingales, &c.

Bird-Catching, the art of taking birds or wild-fowl, whether for food, for the pleasure of their song, or for their destruction as pernicious to the husbandman, &c. The methods are by bird-lime, nets, decoys, &c. See *Bird-Lime*, infra; and Decoy.

British Zoology, vol. ii. append. N° iv. by the Honourable Daines Barrington.

In the suburbs of London (and particularly about Shoreditch) are several weavers and other tradesmen, who, during the months of October and March, get their livelihood by an ingenious, and, we may say, a scientific method of *bird-catching*, which is totally unknown in other parts of Great Britain. The reason of this trade being confined to so small a compass, arises from there being no considerable sale for singing-birds except in the metropolis: as the apparatus for this purpose is also heavy, and at the same time must be carried on a man's back, it prevents the bird-catchers going to above three or four miles distance.

This method of bird-catching must have been long practised, as it is brought to a most systematical perfection, and is attended with a very considerable expence.

The nets are a most ingenious piece of mechanism; are generally twelve yards and a half long, and two yards and a half wide; and no one, on bare inspection, would imagine that a bird (which is so very quick in all its motions) could be catched by the nets flapping over each other, till he becomes eye-witness of the pullers seldom failing.

The wild birds *fly* (as the bird-catchers term it) chiefly during the month of October, and part of September and November; as the flight in March is much less considerable than that of Michaelmas. It is to be noted also, that the several species of birds of *flight* do not make their appearance precisely at the same time, during the months of September, October, and November. The pippet (A), for example, begins to fly about Michaelmas; and then the woodlark, linnet, goldfinch, chaffinch, greenfinch, and other birds of flight succeed; all of which are not easily to be caught, or in any numbers, at any other time, and more particularly the pippet and the woodlard.

These birds, during the Michaelmas and March flights, are chiefly on the wing from daybreak to noon, though there is afterwards a small flight from two till night; but this however is so inconsiderable, that the bird-catchers always take up their nets at noon.

It may well deserve the attention of the naturalist whence these periodical flights of certain birds can arise. As the ground, however, is ploughed during the months of October and March for sowing the winter and lent corn, it should seem that they are thus supplied with a great profusion both of seeds and insects, which they cannot so easily procure at any other season.

It may not be improper to mention another circumstance, to be observed during their flitting, viz. that they fly always against the wind: hence there is great contention amongst the bird-catchers who shall gain that point; if (for example) it is westerly, the bird-catcher who lays his nets most to the east, is sure almost of catching every thing, provided his call-birds are good: a gentle wind to the south-west generally produces the best sport.

The bird-catcher, who is a substantial man, and hath a proper apparatus for this purpose, generally carries with him five or six linnets, (of which more are caught than any singing bird), two goldfinches, two greenfinches, one woodlark, one redpoll, a yellow-hammer, titlark, and aberdavine, and perhaps a bullfinch; these are placed at small distances from the nets in little cages. He hath, besides, what are called *flur-birds*, which are placed within the nets, are raised upon the flur (B), and gently let down at the time the wild bird approaches them. These generally consist of the linnet, the goldfinch, and the greenfinch, which are secured to the flur by what is called a *brace* (C); a contrivance that secures the birds without doing any injury to their plumage.

It having been found that there is a superiority between bird and bird, from the one being more in song than the other; the bird-catchers contrive that their call-birds should moult before the usual time. They therefore, in June or July, put them into a close box under two or three folds of blankets, and leave their dung in the cage to raise a greater heat; in which state they continue, being perhaps examined but once a-week to have fresh water. As for food, the air is so putrid, that they eat little during the whole state of confinement, which lasts about a month. The birds frequently die under the operation; and hence the value of a stopped bird rises greatly. When the bird hath thus prematurely moulted, he is in song whilst the wild birds are out of song, and his note is louder and more piercing than that of a wild one; but it is not only in his note he receives an alteration, the plumage is equally improved. The black and yellow in the wings of the goldfinch, for example, become deeper and more vivid, together with a most beautiful gloss, which is not to be seen in the wild bird. The bill, which in the latter is likewise black at the end, in the stopped bird becomes white and more taper, as do its legs: in short, there is as much difference between a wild and a stopped bird, as there is between a horse which is kept in body-clothes and one at grass.

When the bird-catcher hath laid his nets, he disposes of his call-birds at proper intervals. It must be owned

(A) A small species of lark, but which is inferior to other birds of that genus in point of song.

(B) A moveable perch to which the bird is tied, and which the bird-catcher can raise at pleasure by means of a long string fastened to it.

(C) A sort of bandage, formed of a slender silken string that is fastened round the bird's body, and under the wings, in so artful a manner as to hinder the bird from being hurt, let it flutter ever so much in the raising.

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owned that there is most malicious joy in these call-birds to bring the wild ones into the same state of captivity: which may likewise be observed with regard to the decoy ducks. See DECOY.

Their sight and hearing infinitely excel that of the bird-catcher. The instant that the (D) wild birds are perceived, notice is given by one to the rest of the call-birds, (as it is by the first hound that hits on the scent to the rest of the pack); after which, follows the same sort of tumultuous ecstacy and joy. The call-birds, while the bird is at a distance, do not sing as a bird does in a chamber; they invite the wild ones by what the bird-catchers call *short jerks*, which, when the birds are good, may be heard at a great distance. The ascendency by this call or invitation is so great, that the wild bird is stopped in its course of flight; and, if not already acquainted with the nets (E), lights boldly within 20 yards of perhaps three or four bird-catchers, on a spot which otherwise it would not have taken the least notice of. Nay, it frequently happens, that if half a flock only are caught, the remaining half will immediately afterwards light in the nets, and share the same fate; and should only one bird escape, that bird will suffer itself to be pulled at till it is caught; such a fascinating power have the call-birds.

While we are on this subject of the jerking of birds, we cannot omit mentioning, that the bird-catchers frequently lay considerable wagers whose call-bird can jerk the longest, as that determines the superiority. They place them opposite to each other, by an inch of candle; and the bird who jerks the oftenest, before the candle is burnt out, wins the wager. We have been informed, that there have been instances of a bird's giving 170 jerks in a quarter of an hour; and we have known a linnet, in such a trial, persevere in its emulation till it swooned from the perch: thus, as Pliny says of the nightingale, *victa morte finit sæpe vitam, spiritu prius deficiente quam cantu* *. It may be here observed, that birds when near each other, and in sight, seldom jerk or sing. They either fight, or use short and wheeling calls; the jerking of these call-birds, therefore, face to face, is a most extraordinary instance of contention for superiority in song.

* Lib. x. c. 29.

To these we may add a few particulars that fell within our notice during our inquiries among the bird-catchers; such as, that they immediately kill the hens of every species of birds they take, being incapable of singing, as also being inferior in plumage; the pippets likewise are indiscriminately destroyed, as the cock does not sing well: they sell the dead birds for threepence or fourpence a dozen. These small birds are so good, that we are surprised the luxury of the age neglects so delicate an acquisition to the table. The modern Italians are fond of small birds, which they eat under the common name of *beccaficos*: and the dear rate a Roman tragedian paid for one dish of singing birds is well known; (see the article ÆSOP).

Another particular we learned, in conversation with a London bird-catcher, was the vast price that is sometimes given for a single song-bird, which had not learned to whistle tunes. The greatest sum we heard of, was five guineas for a chaffinch, that had a particular and uncommon note, under which it was intended to train others: and we also heard of five pounds ten shillings being given for a call-bird linnet.

A third singular circumstance, which confirms an observation of Linnæus, is, that the male chaffinches fly by themselves, and in the flight precede the females; but this is not peculiar to the chaffinches. When the titlarks are caught in the beginning of the season, it frequently happens, that forty are taken and not one female among them: and probably the same would be observed with regard to other birds (as has been done with relation to the wheat-ear), if they were attended to. An experienced and intelligent bird-catcher informed us, that such birds as breed twice a-year, generally have in their first brood a majority of males, and in their second, of females, which may in part account for the above observation.

We must not omit mention of the bullfinch, though it does not properly come under the title of a singing bird, or a bird of flight, as it does not often move farther than from hedge to hedge; yet, as the bird sells well on account of its learning to whistle tunes, and sometimes flies over the fields where the nets are laid, the bird-catchers have often a call-bird to ensnare it, though most of them can imitate the call with their mouths. It is remarkable with regard to this bird, that the female answers the purpose of a call-bird as well as the male, which is not experienced in any other bird taken by the London bird-catchers.

The nightingale is not a bird of flight, in the sense the bird-catchers use this term. Like the robin, wren, and many other singing birds, it only moves from hedge to hedge, and does not take the periodical flights in October and March. The persons, who catch these birds, make use of small trap-nets, without call-birds; and are considered as inferior in dignity to other bird-catchers, who will not rank with them. The arrival of the nightingale is expected by the trappers in the neighbourhood of London, the first week in April: at the beginning, none but cocks are taken; but in a few days the hens make their appearance, generally by themselves, though sometimes a few males come along with them. The latter are distinguished from the females not only by their superior size, but by a great swelling of their vent, which commences on the first arrival of the hens. They are caught in a net-trap, the bottom of which is surrounded with an iron-ring; the net itself is rather larger than a cabbage net. When the trappers hear or see them, they strew some fresh mould under the place, and bait the trap with a meal-worm from the baker's shop. Ten or a dozen nightingales have been thus caught in a day.

The common way of taking larks, of which so many are used at our tables, is in the night, with those

(D) It may be also observed, that the moment they see a hawk, they communicate the alarm to each other by a plaintive note; nor will they then jerk or call though the wild birds are near.

(E) A bird acquainted with the nets, is by the bird-catchers termed a *sharper*; which they endeavour to drive away, as they can have no sport whilst it continues near them.

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those nets which are called *trammels*. These are usually made of 36 yards in length, and about six yards over, with six ribs of pack-thread, which at the ends are put upon two poles of about 16 feet long, and made lesser at each end. These are to be drawn over the ground by two men, and every five or six steps the net is made to touch the ground, otherwise it will pass over the birds without touching them, and they will escape. When they are felt to fly up against the net, it is clapped down, and then all are safe that are under it. The darkest nights are properest for this sport; and the net will not only take larks, but all other birds that roost on the ground; among which are woodcocks, snipes, partridges, quails, fieldfares, and several others. In the depth of winter people sometimes take great numbers of larks by nooses of horse-hair. The method is this: Take 100 or 200 yards of pack-thread; fasten at every six inches a noose made of double horse-hair; at every 20 yards the line is to be pegged down to the ground, and so left ready to take them. The time to use this is when the ground is covered with snow, and the larks are to be allured to it by some white oats scattered all the way among the nooses. They must be taken away as soon as three or four are hung, otherwise the rest will be frighted; but though the others are scared away just where the sportsman comes, they will be feeding at the other end of the line, and the sport may be thus continued for a long time. Those caught in the day are taken in clap-nets of fifteen yards length, and two and a half in breadth; and are enticed within the reach by means of bits of looking-glass, fixed in a piece of wood, and placed in the middle of the nets, which are put in a quick whirling motion by a string the larker commands; he also makes use of a decoy lark. These nets are used only till the 14th November: for the larks will not *dare*, or frolic in the air, except in fine sunny weather; and of course cannot be inveigled into the snare. When the weather grows gloomy, the larker changes his engine, and makes use of a trammel net, twenty-seven or twenty-eight feet long, and five broad; which is put on two poles, eighteen feet long, and carried by men under each arm, who pass over the fields and quarter the ground as a setting dog: when they hear or feel a lark hit the net, they drop it down, and so the birds are taken.

Multitudes of the inhabitants of each cluster of the Orkney isles feed during the season on the eggs of the birds of the cliffs. The method of taking them is so very hazardous, as to satisfy one of the extremity to which the poor people are driven for want of food. Copinsha, Hunda, Hoy, Foula, and Noss-head, are the most celebrated rocks; and the neighbouring natives the most expert climbers and adventurers after the game of the precipice. The height of some is above fifty fathoms; their faces roughened with shelves or ledges sufficient only for the birds to rest and lay their eggs. To these the dauntless fowlers will ascend, pass intrepidly from the one to the other, collect the eggs and birds, and descend with the same indifference. In most places the attempt is made from above: they are lowered from the slope contiguous to the brink, by a rope, sometimes made of straw, sometimes of the bristles of the hog: they prefer the last even to ropes of hemp, as it is not so liable to be cut by the sharpness of the rocks; the former is apt to untwist. They trust themselves to a single assistant, who lets his companion down, and holds the rope, depending on his strength alone; which often fails, and the adventurer is sure to be dashed to pieces, or drowned in the subjacent sea. The rope is often shifted from place to place, with the impending weight of the fowler and his booty. The person above receives signals for the purpose, his associate being far out of sight, who, during the operation, by help of a staff, springs from the face of the rock, to avoid injury from the projecting parts.

But the most singular species of bird-catching is on the holm of Noss, a vast rock severed from the isle of Noss by some unknown convulsion, and only about sixteen fathoms distant. It is of the same stupendous height as the opposite precipice, with a raging sea between; so that the intervening chasm is of matchless horror. Some adventurous climber has reached the rock in a boat, gained the height, and fastened several stakes on the small portion of earth which is to be found on the top; correspondent stakes are placed on the edge of the correspondent cliffs. A rope is fixed to the stakes on both sides, along which a machine, called a cradle, is contrived to slide; and, by the help of a small parallel cord fastened in like manner, the adventurer wafts himself over, and returns with his booty.

The manner of bird-catching (see Plate XC. fig. 7.) in the Feroe islands is so very strange and hazardous, that the description should by no means be omitted. Necessity compels mankind to wonderful attempts. The cliffs which contain the object of their search are often two hundred fathoms in height, and are attempted from above and below. In the first case, the fowlers provide themselves with a rope 80 or 100 fathoms in length. The fowler fastens one end about his waist and between his legs, recommends himself to the protection of the Almighty, and is lowered down by six others, who place a piece of timber on the margin of the rock, to preserve the rope from wearing against the sharp edge. They have besides a small line fastened to the body of the adventurer, by which he gives signals that they may lower or raise him, or shift him from place to place. The last operation is attended with great danger, by the loosening of the stones, which often fall on his head, and would infallibly destroy him, was it not protected by a strong thick cap; but even that is found unequal to save him against the weight of the larger fragments of rock. The dexterity of the fowlers is amazing; they will place their feet against the front of the precipice, and dart themselves some fathoms from it, with a cool eye survey the places where the birds nestle, and again shoot into their haunts. In some places the birds lodge in deep recesses. The fowler will alight there, disengage himself from the rope, fix it to a stone, and at his leisure collect the booty, fasten it to his girdle, and resume his pendulous seat. At times he will again spring from the rock, and in that attitude, with a fowling-net placed at the end of a staff, catch the old birds which are flying to and from their retreats. When he hath finished his dreadful employ, he gives a signal to his friends above, who pull him up, and share the hard-earned profit. The feathers are preserved for exportation:

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tion: the flesh is partly eaten fresh, but the greater portion dried for winter's provision.

The fowling from below has its share of danger. The party goes on the expedition in a boat; and when it has attained the base of the precipice, one of the most daring having fastened a rope about his waist, and furnished himself with a long pole with an iron hook at one end, either climbs, or is thrust up by his companions, who place a pole under his breech, to the next footing spot he can reach. He, by means of the rope, brings up one of the boat's crew; the rest are drawn up in the same manner, and each is furnished with his rope and fowling staff. They then continue their progress upwards in the same manner, till they arrive at the region of birds; and wander about the face of the cliff in search of them. They then act in pairs; one fastens himself to the end of his associate's rope, and in places where birds have nestled beneath his footing, he permits himself to be lowered down, depending for his security on the strength of his companion, who has to haul him up again: but it sometimes happens that the person above is overpowered by the weight, and both inevitably perish. They fling the fowl into the boat, which attends their motions, and receives the booty. They often pass seven or eight days in this tremendous employ, and lodge in the crannies which they find in the face of the precipice.

Plate XC. fig. 1. In some remote parts of Russia there is practised a singular invention for taking great quantities of gelinottes or grous. They choose the most open places in the birch woods; and there they plant long forks in the earth opposite the larger trees. On these forks is laid a horizontal stick, gallows-wise, to which are tied small bundles of ears of corn. At a small distance from this part of the contrivance, is a kind of large funnel or inverted cone, made with long birch twigs, thin and flexible, the lower extremities of which are stuck in the earth, very near to one another; but by spreading towards the top, forms there an opening of above a yard in diameter. In this opening is placed a wheel made of two circles that intersect each other, and are surrounded with straw and ears of corn. This wheel turns on an axis fastened to the side of the funnel, in such a manner, that there is room enough between the sticks of the cone and the circles to admit of the wheel's turning freely about. The birds first perch upon the transverse stick near the tree; and when they have a mind to fall upon the corn tied to the wheel, they must necessarily stand upon one of the projecting parts of the circles of which it is composed. At that instant the wheel turns, and the gelinotte falls, head foremost, to the bottom of the trap, which is there so contracted that he cannot get out. They sometimes find the machine half full of gelinottes.

The following method of netting or catching of wild pigeons is eagerly pursued as a diversion in different parts of Italy, particularly by the inhabitants of Cava in the Hither Principato, and is thus described by Mr Swinburne. The people "assemble in parties; and if any stranger chances to stray to their rendezvous, they give him a most cordial welcome. I am not in the least surprised (says Mr Swinburne) at their passionate fondness for this sport, as I found it extremely bewitching, keeping the attention constantly alive, and the springs of the mind pleasingly agitated by expectation; the situations where the toils are spread are incomparably beautiful, the air is pure and balsamic, and every thing around breathes health and satisfaction. When the periodical flights of stock-doves return from the northern and western parts of Europe to gain warmer regions for their winter abode, the fowler repairs to the mountain, and spreads his nets across the intermediate hollows, the passes through which the birds direct their course, to avoid unnecessary elevation in their flight. These nets are hung upon a row of large trees planted for the purpose. The branches being very thick and close at top, and the pole lofty and bare, a great opening is left below for the toils, which reach to the ground; and, by means of pulleys, fall in a heap with the least effort. Sometimes they are extended upon poles that exceed the height of the trees. At a small distance is a lofty circular turret, like a column with a little capital or cap, upon which a man is stationed to watch the approach of the game. As he commands a free view over all the country, and practice has made his sight acute as that of the lynx, he descries the birds at a wonderful distance. The doves advance with great velocity; but the alert watchman is prepared for them; and just as they approach his post, hurls a stone above them with a sling: upon this the whole flock, whose fears have birds of prey for their great object, supposing the stone to be an enemy of that kind ready to pounce them, dart down like lightning to avoid the blow by passing under the trees; but there they rush into the jaws of death, by dashing against the net, which instantly drops, and so entangles them that not one of them can escape the active hands of the fowler. These birds are sometimes taken by dozens at one fall, and are accounted fine eating. The dexterity with which the slingers manage their weapon is very remarkable; they throw the stone to a great height without any violent effort, and even without whirling the sling round before they discharge the pellet. In the Pyrenean mountains, where the same diversion is followed, the watchmen use a bow and arrow, trimmed with the feathers of a hawk."

The following simple but ingenious method of catching aquatic birds is used in Mexico by the natives. The lakes of the Mexican vale, as well as others of the kingdom, are frequented by a prodigious number of ducks, geese, and other water-birds. The Mexicans leave some empty gourds to float upon the water, where those birds resort, that they may be accustomed to see and approach them without fear. The bird-catcher goes into the water so deep as to hide his body, and covers his head with a gourd; the ducks come to peck at it; and then he pulls them by the feet under water; and in this manner secures as many as he pleases.

Bird-Lime, a viscid substance, prepared after different ways. The most common bird-lime among us is made from holly-bark, boiled ten or twelve hours; when the green coat being separated from the other, it is covered up a fortnight in a moist place; then pounded into a tough paste, so that no fibres of the wood are discernible, and washed in a running stream till no motes appear; put up to ferment four or five days,

skimmed

Bird-Lime. skimmed as often as any thing arises, and laid up for use. To use it, a third part of nut-oil, or thin grease, must be incorporated with it over the fire.

The juice of holly-bark is a very peculiar substance. But if trials were made, it seems probable, that many other juices would be found to have the same clammy nature. The misletoe affords a juice even superior to that of the holly; and if a young shoot of the common alder be cut through, there will a stringy juice draw out in threads, and follow the knife like bird-lime or the juice of the holly. It seems in this tree to be lodged, not in the bark, but in certain veins just within the circle of the wood. The roots of all the hyacinths also afford a tough and stringy juice of the same kind; and so does the asphodel, the narcissus, and the black bryony root, in a surprising quantity.

When twigs, &c. smeared with bird-lime, are to be put in places subject to wet, the common bird-lime is apt to have its force soon taken away. It is necessary, therefore, to have recourse to a particular sort, which, from its property of bearing water unhurt, is called *water bird-lime;* and is prepared thus: Take a pound of strong and good bird-lime; wash it thoroughly in spring-water, till the hardness is all removed; and then beat it well, that the water may be clean separated, so as not a drop remains; then dry it well, and put it into an earthen pot; add to it as much capon's grease as will make it run. Then add two spoonfuls of strong vinegar, one spoonful of oil, and a small quantity of Venice turpentine. Let the whole boil for some minutes over a moderate fire, stirring it all the time. Then take it off: and when there is occasion to use it, warm it, and cover the sticks well with it. This is the best sort of bird-lime for snipes and other birds that love wet places.

The most successful method of using the common bird-lime is this: Cut down the main branch or bough of any bushy tree whose twigs are thick, straight, long, and smooth, and have neither knots nor prickles. The willow and the birch-tree afford the best of this kind. Let all the superfluous shoots be trimmed off, and the twigs all made neat and clean; they must all be well covered with the bird-lime, within four inches of the bottom; but the main bough from which they grow must not be touched with the lime. No part of the bark, where the lime should come, must be left bare: but it is a nice matter to lay it on properly; for if it be too thick it will give the birds a distaste, and they will not come near it; and if there be too little of it, it will not hold them when they are there. When the bush is thus prepared, it must be set up in some dead hedge, or among some growing bushes near the outskirts of a town, a farmer's back-yard, or the like, if it be in the spring; for these places are the resort of the small birds at that time. If it be used in summer, the bush must be placed in the midst of a quickset hedge, or in groves, bushes, or white thorn trees, near fields of corn, hemp, flax, and the like; and in the winter, the proper places are about stacks of corn, hovels, barns, and the like. When the lime-bush is thus planted, the sportsman must stand as near it as he can without being discovered; and with the mouth, or otherwise, make such sorts of notes as the birds do when they attack or call to one another. There are bird-calls to be bought for this use; but the most expert method is to learn the notes of call of the several birds, and imitate them by a sort of whistling. When one bird is thus enticed to the bush, and hung fast, the business of the sportsman is not to run up to take it, but to be patient; for it will hang itself more fast by its struggling to get away; and its fluttering will bring more to the bush, so that several may be taken together. The time of the day for this sport is from sunrise to ten o'clock, and from one to sunset. Another very good method of bringing the birds together, is by a stale: a bat makes a very good stale; but it must be fastened, so as to be in sight at a distance. An owl is a still better stale; for this bird never goes abroad but it is followed by all the small birds in the neighbourhood. They will gather together in great numbers about it; and having no convenient place to sit on but the lime-bush, will be taken in great numbers. If a living owl or bat is not to be had, the skin stuffed will serve the purpose, and will last twenty years. Some have used the image of an owl carved in wood, and painted in the natural colours; and it has been found to succeed very well.

Bird-Lime | Birds-Nests.

Divination by BIRDS. See AUGURY.

Migration of BIRDS. } See ORNITHOLOGY *Index*.
Nidification of BIRDS. }

Singing BIRDS are, the nightingale, blackbird, starling, thrush, linnet, lark, throstle, Canary-bird, bulfinch, goldfinch, &c. See some very curious experiments and observations on the singing of birds, Phil. Trans. vol. lxiii. part ii. N° 31. Their first sound is called *chirp*, which is a single sound repeated at short intervals; the next *call*, which is a repetition of one and the same note; and the third sound is called *recording*, which a young bird continues to do for ten or eleven months, till he is able to execute every part of his song; and when he is perfect in his lesson, he is said to *sing his song round*. Their notes are no more innate than language in man; they all sing in the same key. The honourable author Daines Barrington has there attempted to reduce their comparative merits to a scale; and to explain how they first came to have particular notes. See *Song of Birds*, ORNITHOLOGY *Index*.

Methods of preserving BIRDS. See ORNITHOLOGY *Index*.

BIRDS, in *Heraldry*, according to their several kinds, represent either the contemplative or active live. They are the emblems of liberty, expedition, readiness, swiftness, and fear. They are more honourable bearings than fishes, because they participate more of air and fire, the two noblest and highest elements, than of earth and water. Birds must be borne in coat-armour, as is best fitting the propriety of their natural actions of going, sitting, standing, flying, &c. Birds that are either whole-footed, or have their feet divided, and yet have no talons, are said to be *membered;* but the cock, and all birds of prey with sharp and hooked beaks and talons for encounter or defence, are termed *armed*. In the blazoning of birds, if their wings be not displayed, they are said to be borne close; as, *he beareth an eagle*, &c. close.

BIRDS-Nests, in *Cookery*, the nest of a small Indian swallow *, very delicately tasted, and frequently mixed among soups. On the sea-coasts of China, at certain seasons of the year, there are seen vast numbers of these birds;

* See B[...]rundo.

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birds; they leave the inland country at their breeding-time, and come to build in the rocks, and fashion their nests out of a matter which they find on the shore, washed thither by the waves. The nature of this substance is scarcely yet ascertained. According to Kempfer, it is mollusccæ or sea-worms; according to M. le Poivre, fish-spawn; according to Dalrymple, sea-weeds; and, according to Linnæus, it is the animal substance frequently found on the beach, which fishermen call *blubbers* or *jellies*. The nests are of a hemispheric figure, and of the size of a goose's egg, and in substance much resemble the ichthyocolla or *isinglass*. The Chinese gather these nests, and sell them to all parts of the world; they dissolve in broths, &c. and make a kind of jelly of a very delicious flavour.

These nests (Mr Marsden informs us) are found in great abundance in the island of Sumatra, particularly about Croe, near the south end of the island. Four miles up the river of that name is a large cave, where the birds build in vast numbers. The nests are distinguished into white and black; of which the first are by far the more scarce and valuable, being found in the proportion of one only to twenty-five. "The white sort (says Mr Marsden) sells in China at the rate of 1000 to 1500 Spanish dollars the pecul; the black is usually disposed of at Batavia for about 20 dollars the same weight, where it is chiefly converted into glue, of which it makes a very superior kind. The difference between the two has by some been supposed to be owing to the mixture of the feathers of the birds with the viscous substance of which the nests are formed; and this they deduce from the experiment of steeping the black nests for a short time in hot water, when they are said to become in a great degree white. Among the natives I have heard a few assert that they are the work of a different species of bird. It was suggested to me, that the white might probably be the recent nests in which they were taken; and the black, such as have been used for a number of years successively. This opinion appearing plausible, I was particular in my inquiries as to that point, and learned what seemed much to corroborate it. When the natives prepare to take the nests, they enter the caves with torches, and forming ladders according to the usual mode, of a single bamboo, notched, they ascend and pull down the nests, which adhere in numbers together, from the side and top of the rock. They informed me, that the more frequently and regularly the cave is stripped, the greater proportion of white nests they are sure to find, and that on this experience they often make a practice of beating down and destroying the old nests in larger quantities than they trouble themselves to carry away, in order that they may find white nests the next season in their room. The birds, during the building time, are seen in large flocks on the beach, collecting in their bills the foam which is thrown up by the surf, of which there is little doubt but they construct their nests, after it has undergone perhaps a preparation, from a commixture with their saliva, or other secretion with which nature has provided them for that purpose."

BIREMIS, in Roman antiquity, a vessel with two rows of oars; concerning the disposition of which authors are not agreed.

BIRETUM, or BIRRETUM, a sort of black bonnet, or covering of the head, in form of a pyramid, much used in Italy and France, about 500 or 600 years ago, as a badge of victory, honour, or sacerdotal preferment.

BIRKENHEAD, or BERKENHEAD, SIR JOHN, a famous political author, was born about the year 1615. Being recommended to Dr William Laud archbishop of Canterbury, he became his secretary; in which office he showed such capacity and diligence, that the archbishop, by his diploma, created him master of arts in 1639; and in the year following, by letter commendatory from the same prelate, he was chosen probationer fellow of All-Soul's College. This obliged him to reside constantly at Oxford; and on King Charles I.'s making that city his head-quarters during the civil war, our author was made choice of to write a kind of journal in defence of the royal cause, by which he gained great reputation. By his majesty's recommendation, he was chosen reader in moral philosophy; which employment he enjoyed till 1648, when he was expelled by the parliament visitors. He retired afterwards to London, where he wrote several poetical pieces; and having adhered steadily to his principles, he acquired the title of the *loyal poet*, and suffered several imprisonments. He published, while he thus lived in obscurity, some very satirical compositions, mostly levelled against the republican grandees, and written with great poignancy. Upon the restoration of King Charles II. our author was rewarded for his loyalty. He was created, April 16. 1661, on the king's letters sent for that purpose, doctor of the civil law by the university of Oxford; and in that quality, as an eminent civilian, was consulted by the convocation on the question, Whether bishops ought to be present in capital cases? He was about the same time elected to serve in parliament for Wilton in the county of Wilts. He was knighted November 14. 1662; and upon Sir Richard Fanshaw's going in a public character to the court of Madrid, he was appointed to succeed him as master of requests. He lived afterwards in credit and esteem, and received various favours from the court, which, however, drew upon him some very severe attacks from those who opposed the court. Mr Wood has treated him with great severity; but his memory has been transmitted with honour to posterity by others, particularly by Dryden, Langbaine, and Winstanly. He died in Westminster, December 4. 1679; and was interred in St Martin's in the Fields.

BIRKENFIELD, a thriving village of the Prussian states, in the grand duchy of the Lower Rhine. It is seated near the river Nahe, in E. Long. 7. 9. N. Lat. 49. 35.

BIRMINGHAM, a very large town of Warwickshire in England, situated in W. Long. 1. 35. N. Lat. 52. 30. It is no corporation, being only governed by two constables and two bailiffs; and it is therefore free for any person to come and settle there; which has contributed greatly not only to the increase of the buildings, but also of the trade, which is the most flourishing of any in England for all sorts of iron work, besides many other curious manufactures. The town stands on the side of a hill, nearly in the form of a half-moon. The lower part is filled with the workshops and warehouses of the manufacturers, and consists chiefly of old buildings. The upper part of the town

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Birmingham ‖ Birth.

town contains a number of new and regular streets, and a handsome square elegantly built. It has several handsome churches. A theatre was built here in 1792, which cost 14,000l. There is a large and well conducted school on Lancaster's principle, and another on Dr Bell's. There is a charity work-house, a general hospital built in 1766, and a dispensary built in 1808. Including the parishes of Aston and Edgebaston, Birmingham contained 85,753 inhabitants in 1811.

BIRON, Armand de Gontault, Lord of, Marshal of France, and a celebrated general in the 16th century, signalized himself by his valour and conduct in several sieges and battles. He was made grand-master of the artillery in 1569, and nobody dared to assault him at the massacre of St Bartholomew. He was the first who declared for Henry IV. He brought a part of Normandy under his subjection, and dissuaded him from retiring to England or Rochelle. But he was killed by a cannon-ball, at the siege of Epernay, on the 26th of July 1592. He was a very universal scholar: and used to carry a pocket-book, in which he wrote down every thing that appeared remarkable; which gave rise to a proverb very much used at court: When a person happened to say any thing uncommon, they told him, *You have found that in Biron's pocket-book.*

BIROTA, or Birotum, in Roman antiquity, a kind of vehicle, so denominated from its moving upon two wheels. It carried about 200 pound weight, and was drawn by three mules.

BIRRUS, in Roman antiquity, a cloak, made of woollen cloth, worn by the soldiers. Also a robe anciently worn by the priests or bishops.

BIRTH, in *Midwifery*, signifies the same with delivery. See Midwifery.

Birth is also used for a person's descent; and is said to be high or low according to the circumstances of his ancestry.

There is scarcely any truth (Mr Knox observes in his Essays) of which the world has been more frequently reminded by the moralists, than the unreasonableness of that veneration which is paid to birth. They have been told, that virtue alone is true nobility; but though they have acknowledged the assertion to be founded in reason, they have continued, with uniform perseverance, in the same error. The luminous glory of an illustrious ancestor, seems to have diffused a brilliancy over a long line of descendants, too opaque of themselves to emit any original irradiations.

"Gratitude (continues our elegant author), which first raises a benefactor to a distinguished rank in civil honours, is willing to continue its kindness to his immediate offspring. The distinction is rendered hereditary. This predilection for an ancestor soon leads to the accumulation of honours and possessions in his successors; and the incense originally offered because it was deserved, is at last lavished at the shrine of opulence, independently of merit.

"Subordination is, indeed, essential to society. The order of nobles, as hereditary guardians of the laws, is found an useful political establishment; and none seem so well adapted to supply it, as they who have been raised to eminence by their ancestors, and who possess a territorial patrimony in the land which they are to protect. All that is contended for is, that the recommendation of birth may not set aside or depreciate real merit, the praise of learning, and the intrinsic value of virtuous exertions.

Birth.

"It is a remarkable circumstance in the history of mankind, that some of the best books have been written, and some of the greatest achievements performed, by those whose origin was truly plebeian. The politest and genteelest books, whether the sentiments or the style be considered, have been produced by slaves, or the descendants of slaves. Horace, Phædrus, and Terence, wrote in a style which must have been the standard of a court, to an intercourse with which they were by no means entitled by their extraction. The founders of the most distinguished families emerged from the middle and the lower classes, by the superior vigour of their natural abilities, or by extraordinary efforts, assisted by fortune: and unless the adventitious circumstances of wealth and civil honours can effect a change in the constituent principles of the mind and body, there is certainly no real superiority to be derived in a boasted pedigree of Tudors and Plantagenets. And yet there have appeared flatterers, who have indirectly suggested, that the minds of the nobility seem to be cast in a finer mould, and to have an elegance inherent in their original constitution. According to this hypothesis, we must go on to suppose, that the mind of a commoner exalted to the higher order of senators, catches this elegance by the contagion of invisible effluvia. On his creation he undergoes a kind of new birth, and puts off the exuviæ which encumbered and degraded him in the lower regions. Thus are all the occult perfections of noble blood to be infused by the mandate of a monarch. 'But no,' said Maximilian to a man who asked to be ennobled by him, 'though I can give you riches and a title, I cannot make you noble.'

"In truth, there is many a nobleman, according to the genuine idea of nobility, even at the loom, at the plough, and in the shop; and many more in the middle ranks of mixed society. This genuine idea contains in it generosity, courage, spirit, and benevolence, the qualities of a warm and open heart, totally unconnected with the accidental advantages of riches and honour: and many an English sailor has possessed more of the real hero than a lord of the admiralty.

"If indeed there is any substantial difference in the quality of their blood, the advantage is probably on the side of the inferior classes. Their indigence and their manual employments require temperance and exercise, the best purifiers of the animal juices. But the indolence which wealth excites, and the pleasures which fashionable life admits without restraint, have a natural tendency to vitiate and enfeeble the body as well as the mind: and among the many privileges inherited by him who boasts nobility in his veins, he commonly receives the seeds of the most painful and the impurest diseases. He displays indeed a coronet on his coat of arms, and he has a long pedigree to peruse with secret satisfaction; but he has often a gout or a scrofula, which make him wish to exchange every drop derived from his Norman ancestors, for the pure tide that warms a peasant's bosom.

"The spirit of freedom, moral, mental, and political, which prevails in Britain, precludes that unreasonable

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sonable attachment to birth, which, in the countries of despotism, tends to elevate the noble to a rank superior to humanity. In our neighbour's land, the region of external elegance united with real meanness, the implicit veneration paid to birth adds to the weight of legal oppression. A Frenchman of the plebeian order attends to a count or a marquis with all the silent submission of idolatry: on the contrary, there is no doubt but that an English gondolier would box with the best lord in the land, if he were affronted by him, without the least regard for his star and ribbon. It would indeed be an additional pleasure to the natural delight of conquest, to have bruised a puny lord. Even the more refined and polished do not idolize illustrious birth. In truth, wealth appears to be the object of more universal veneration. Noble blood and noble titles, without an estate to support them, meet with great compassion indeed, but with little respect; nor is the man who has raised himself to eminence, and who behaves well in it, neglected and despised because he derives no lustre from his forefathers. In a commercial country, where gain is the general object, they who have been most successful in its pursuit will be revered by many, whatever was their origin. In France, where honour is pursued from the monarch to the cleanser of a jakes, the distinction of birth, even with extreme poverty, is enviable. The brother of a marquis would rather starve on a beggarly pension, than pollute himself with a trade by which he might acquire the revenues of a German kingdom. In our land of good sense this folly is losing ground; and the younger brothers of noble houses often think it no disgrace to rival the heir in a princely fortune acquired by honourable merchandise.

"As the world becomes more enlightened, the exorbitant value which has been placed on things not really valuable will decrease. Of all the effects of man's capricious admiration, there are few less rational than the preference of illustrious descent to personal merit, of diseased and degenerate nobility to health, to courage, to learning, and to virtue. Of all the objects of pursuit which are not in our own power, the want of distinguished birth may most easily be dispensed with, by those who possess a solid judgment of that which makes and keeps us happy. There may be some reason to repine at the want of wealth and fame; but he who has derived from his parent health, vigour, and all the powers of perception, need not lament that he is unnoticed at the herald's office.

"It has been observed, that virtue appears more amiable when accompanied with beauty; it may be added, that it is more useful when recommended to the notice of mankind by the distinction of an honourable ancestry. It is then greatly to be wished, that the nobly born would endeavour to deserve the respect which the world pays them with alacrity, by employing their influence to benevolent purposes; to those purposes which can at all times be accomplished, even when the patriotic exertions of the field and cabinet are precluded."

Birth, or *Berth*, the station in which a ship rides at anchor either alone or in a fleet, or the distance between the ship and any adjacent object, comprehending the extent of the space in which she ranges at the length of her cables: as, *she lies in a good birth*, i. e. in a convenient situation, or at a proper distance from the shore and other vessels; and where there is good anchoring ground, and shelter from the violence of the wind and sea.

Birth also signifies the room or apartment where any particular number of the officers and ship's company usually mess and reside. In a ship of war there is commonly one of these between every two guns.

Birth-Day, the anniversary return of the day whereon a person was born. The ancients placed a good deal of religion in the celebration of birth-days, and took omens from thence of the felicity of the coming year. The manner of celebrating birth-days, was by a splendid dress: wearing a sort of rings peculiar to that day: offering sacrifices; the men to their genius, of wine, frankincense; the women to Juno: giving suppers, and treating their friends and clients; who in return made them presents, wrote and sung their panegyrics, and offered vows and good wishes for the frequent happy returns of the same day. The birth-days of emperors were also celebrated with public sports, feasts, vows, and medals struck on the occasion. But the ancients, it is to be observed, had other sorts of birth-days besides the days on which they were born. The day of their adoption was always reputed as a birth-day, and celebrated accordingly. The emperor Adrian, we are told, observed three birth days; viz. the day of his nativity, of his adoption, and of his inauguration. In those times it was held, that men were not born only on those days when they first came into the world, but on those days when they arrived at the chief honours and commands in the commonwealth, e. gr. the consulate. Hence that of Cicero in his oration *ad Quirites*, after his return from exile: *A parentibus, id quod necesse erat, parvus sum procreatus; a vobis natus sum consularis.*

BIRTHWORT. See Aristolochia, Botany *Index*.

BIRVIESCA, a town of Old Castile in Spain, and capital of a small territory called *Bureva*. W. Long. 2. 15. N. Lat. 42. 35.

BIRZA, a town of Poland, in the province of Samogitia. E. Long. 25. 5. N. Lat. 56. 35.

BISA, or Biza, a coin of Pegu, which is current there for half a ducat. It is also a weight used in that kingdom.

BISACCIA, a small handsome town of Italy, in the Ulterior Principato, and in the kingdom of Naples, with a bishop's see. E. Long. 15. 35. N. Lat. 41. 3.

BISACUTA, in middle-age writers, an axe with two edges, or which cuts either way; or a missive weapon pointed at both ends. Walsingham represents the *securis bisacuta* as peculiar to the Scottish nation. See *Battle Axe*.

BISBÆA, a feast celebrated by the Messapii after the pruning of their vines, to obtain of the gods that they might grow again the better. The word is formed from βισβη, used by some for a vine.

BISCARA, a town of Africa in the kingdom of Algiers, seated in the eastern or Levantine government, in E. Long. 5. 50. N. Lat. 35. 10. This city belonged to the province of Zeb in Numidia, which lies south of the kingdom of Labez; but the Algerines, in their annual inroads to carry off slaves, made themselves masters

Biscara, Biscay.

sters of Biscara, in order to facilitate their entrance into the southern provinces. It retains still some remains of the ancient city that gave name to this territory; and hath a garrison to keep the inhabitants in awe, and who usually bring lions, tigers, and other wild beasts for sale to strangers. The city of Algiers is never without a great number of Biscarans, who are employed in the hardest and lowest offices, as cleansing of streets, emptying of vaults, sweeping chimneys, &c.; and when they have got about 10 or 12 crowns by this drudgery, they return to their country, where they are respected as worthy men on account of their money, the inhabitants of this province being almost entirely destitute of coin, and reckoned the most miserable of all the Arabian tribes.

BISCAY, a province of Spain, bounded on the north by the sea called the *Bay of Biscay*, on the south by Old Castile, on the west by Asturias of Santilana, and on the east by the territories of Alava and Guipuscoa. It is in length about seventy-four miles; but the breadth is much less, and very unequal. This country in general is mountainous and barren; but in some places it produces corn, and everywhere a great quantity of apples, oranges, and citrons. They make cyder with the apples, which is their common drink. Besides this, they have wine called *chacolino*, which is pleasant, but will not keep long, and therefore is used instead of small beer. Their valleys produce a little flax, and their hills a great deal of timber for ships. The sea affords them excellent fish of all sorts. The wool that is exported here comes from Old Castile; but their greatest riches are produced by their mines of iron; which metal is extremely good, and is transported to all parts. They have likewise artificers that work in iron; and are, in particular, famous for working swords and knives. Biscay is the country of the ancient Cantabri, so imperfectly subdued by Augustus, and so slightly annexed to the Roman empire. Their mountains have in all ages afforded them temptations and opportunities of withdrawing themselves from every yoke that has been attempted to be imposed upon them. Their language is accounted aboriginal, and unmixed with either Latin, French, or Spanish. It is so totally different from the Castilian, that we seldom meet with any of the peasants that understand one word of Spanish. The Biscayners are stout, brave, and choleric to a proverb. The best sailors in Spain belong to the ports of Biscay, and its mountains produce a very valuable race of soldiers. Their privileges are very extensive, and they watch over them with a jealous eye. They have no bishops in the province, and style the king only *Lord of Biscay*. The men are well-built and active, like all mountaineers. The most singular thing in their dress is the covering of their legs: they wrap a piece of coarse gray or black woollen cloth round them, and fasten it on with many turns of tape. The women are beautiful, tall, light, and merry; their garb is neat and pastoral; their hair falls in long plaits down their backs; and a veil or handkerchief, twisted round in a coquetish manner, serves them for a very becoming head-dress. On Sundays they generally wear white, tied with rose-coloured knots. The population of Biscay in 1788 was only 310,758, of whom 4100 were monks and nuns.

BISCAY, *New*, a province of North America, in the audience of Guadalajara. It has New Mexico on the north, Culiacan on the west, Zacatecas on the south, and Panuca with Florida on the east. It is about 300 miles from east to west, and 360 from north to south. In general it is well watered, fruitful, moderately temperate, and abounds in all sorts of provisions, except the mountains of Topia, which are barren. The original inhabitants are not all brought under subjection, they having four large towns in the morasses, that are of difficult access; for this reason the Spaniards have built three small fortified towns, which are well inhabited, for the defence of their silver mines. The latitude is from 25 to 28 degrees.

Biscay ‖ Bischop.

BISCHOFISHEIM, a town of Germany, in the county of Hanau Munzenberg, and now included in the territory of the free town of Frankfort. It is three miles east of Hanau. E. Long. 9. 2. N. Lat. 50. 5.

BISCHOFF ZELL, a town of Switzerland, in the canton of Thurgau. It is governed by a council, partly Catholic and partly Lutheran; and both denominations hold divine service in the parish church. It was formerly subject to the bishop of Constance. It is seated on the Thur, at the place where the Sitter falls into this river, almost half way between Constance and St Gall. E. Long. 9. 23. N. Lat. 47. 33.

BISCHOP, or BISKOP, JOHN DE, an excellent artist, born at the Hague in 1646. He is spoken of with great commendation as a painter, and his drawings from the great masters are held in the highest estimation by the curious. In these he had succeeded so happily, as to preserve with the greatest exactness the style of the painter whose pictures he copied. But as an engraver he is most generally known; and his works are numerous. They are chiefly etchings, harmonized with the graver; and though slight, yet free, spirited, and pleasing. He gives a richness to the colour, and a roundness to the figures, far beyond what is usually done with the point, so little assisted by the graver. His figures in general are well drawn; but in a mannered, rather than a correct, style. The extremities indeed are not always well marked, or his heads equally expressive or beautiful. It is said of him, that he owed his excellence to his own genius alone, having never studied under any master by whose instruction he might have been benefited. He worked chiefly at Amsterdam, where he died in 1686, aged 40 years.

BISCHOP, *Cornelius*, portrait and history painter, was born at Antwerp in 1630, and was the disciple of Ferdinand Bol. His pencil, his tint of colouring, his style and manner, had a strong resemblance of his master; and by many competent judges he is esteemed not inferior to him in historical subjects as well as in portrait, having been always assiduous to study after nature. A painting by this master, consisting of a few figures by candle light, was so much admired by Louis XIV. that he purchased it at a high price, and placed it in the royal collection; and the king of Denmark admitted his works among those of the best masters. However, notwithstanding the encomiums bestowed on this master by the Flemish writers, an impartial judge would perhaps think his compositions but heavy and without expression, and his works in general not worthy of all that commendation which is lavished upon them. He died in 1674.

BISCHOP, *Abraham*, son of Cornelius Bischop, was instructed

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instructed by his father to design historical subjects and portraits; but preferred the painting of fowl, particularly those of the domestic kind, to any other subjects which were recommended to him. He designed every object after nature, and usually painted in a large size, such as ornamental furniture for grand halls; and every species of fowl was so exactly like nature in its attitude, character, and plumage, that his works were beheld with universal approbation.

BISCHWELLER, a fortress of France in the department of the Lower Rhine. E. Long. 7. 0. N. Lat. 48. 40.

BISCHROMA, in *Music*, the same as our triple quaver. See CHROMA.

BISCUTELLA, BUCKLER-MUSTARD, or *Bastard Mithridate-mustard*. See BOTANY *Index*.

BISEGLIA, a populous town of Italy, in the kingdom of Naples and Terra de Bari, with a bishop's see, seated near the gulf of Venice, in E. Long. 16. 49. N. Lat 41. 18.

BISERRULA. See BOTANY *Index*.

BISERTA, a town of the kingdom of Tunis in Africa, seated on a gulf of the same name, in E. Long. 10. 40. N. Lat. 37. 20. The gulf is a very large one, and the *Sinus Hipponensis* of the ancients. It is formed by the Capes Blanco and Ziebeb; and has a beautiful sandy inlet near four leagues wide, which once admitted the largest vessels, but through the negligence of the Turks can now admit only those of the smallest size, and is in danger in a short time of being totally choked up. Some remains of the great pier of Hippo are still extant; by which it appears to have run out into the sea so as to break the north-east wind, and make this one of the safest and most beautiful havens in these parts. On the south, this gulf hath a communication with a lake of the same name, so as to form a kind of canal between it and the Mediterranean sea. Through this canal a constant stream is observed alternately discharging itself from the sea to the lake, and from the lake to the sea, in the same manner as the Atlantic ocean is observed to do in the Mediterranean, and back again; so that what the lake loses by exhalations is soon recruited by the sea, which in hot seasons runs into it with a very brisk current to keep up the equilibrium. The millets of this lake are the best in Barbary; great quantities of their roes, dried and made into BOTARGO, are sent from hence into the Levant, where they are accounted a great dainty. The town was formerly very considerable; and, though not above a mile in circuit, is said to have contained 6000 houses; whereas both it and the villages under it now scarcely contain that number of inhabitants. It has still, however, some strong castles and batteries to defend it, especially towards the sea. There are also two very capacious prisons for slaves, a large magazine or warehouse for merchandise, and two towers with some other works to defend the entrance of the haven. The city, though so near the sea, is well supplied with fresh water from springs that surround it on every side towards the land. It is likewise well furnished with variety of fish from the adjacent lake. Most of the inhabitants of Biserta, as well as of the adjacent country on both sides of the canal, are employed in the fishing trade, which begins about the end of October, and ends in the beginning of May; for the rains then sweetening the waters, make the fish come into it in vast quantities during that season; but afterwards they either disappear, or grow lean, dry, and unfit to eat. The people here are extremely poor; yet very proud, ill-natured, and faithless; insomuch that Muley Hasun Bey, one of their sovereigns, used to say, that none of his subjects deserved his resentment so much as they, since neither fear nor love could keep them faithful.—Biserta hath about eight villages under its government; a large plain called *Matter* or *Mater;* and the territory of Choros, the *Clypea* or *Corobis* of the ancients. This is a tract of great extent, and would be very fertile were it not for the frequent incursions of the Arabs. The people are very poor, live meanly, and go worse clad. Their choicest dainty is their couscou, a kind of cake, made of flour, eggs, and salt, which they dry and keep all the year round. Their dress is nothing else than a piece of coarse cloth wrapped round their bodies, and another round their heads by way of a turban; and most of them go barefooted and barelegged. The poorer sort have nothing but a few skins laid on the floor to sleep upon; but the rich have narrow couches fixed against the wall, about five or six feet high, to which they mount by a ladder. They are very expert horsemen, as most in these countries are, and ride without saddle or bridle; nor do they ever shoe their horses. They are still more miserable from the neighbourhood of the Arabs, who living altogether by plunder, robbery, and murder, oppress the poor inhabitants with their frequent inroads and cruel exactions. The Bisertines, both of the city and country, are the most superstitious people in Barbary, scarcely going anywhere without hanging a quantity of amulets about their own, or, if they ride, their horse's neck also. Their amulets are only scraps of parchment or paper, with some strange characters written upon them, which they sew up in a piece of leather, silk, &c. and imagine when worn about them to be a preservative against all accidents.

BISET, CHARLES EMANUEL, a painter of considerable eminence, was born at Mechlin in 1633; and even in his early productions showed a lively and ready invention. He was remarkable for introducing a multitude of figures into his designs, with an extraordinary variety of drapery peculiar to every nation. His general subjects were conversations, balls, concerts, and assemblies of gay and genteel persons, which were correctly designed and well coloured; though their actions and attitudes were sometimes very indelicate. His pictures had a strong effect at a distance; yet when they were more nearly inspected, they showed a neatness of pencil, a spirited touch, and a good expression.

BISHOP, a prelate or person consecrated for the spirtual government and direction of a diocese. The word comes from the Saxon *bischop*, and that from the Greek ἐπισκοπος, an *overseer* or *inspector:* which was a title the Athenians gave to those whom they sent into the provinces subject to them, to see whether every thing was kept in order; and the Romans gave the same title to those who were inspectors and visitors of the bread and provision. It appears from a letter of Cicero, that he himself had a bishopric; being *episcopus Oræ et Campaniæ*.

A bishop differs from an archbishop in the following particulars: That an archbishop with bishops consecrate a bishop, as a bishop with priests ordain a priest; that

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Bishop. that the archbishop visits a province as the bishop a diocese; that the archbishop convocates a provincial synod as the bishop a diocesan one; and that the archbishop has canonical authority over all the bishops of his province, as the bishop over the priests in his diocese. It is a long time since bishops have been distinguished from mere priests or presbyters; but whether that distinction be of divine or human right, whether it was settled in the apostolical age or introduced since, is much controverted. But whether the apostles settled any thing of this kind themselves, or whether they left the spiritual economy in the hands of the presbyters, or of those together with the people, it appears that in a little time the functions of the priesthood were divided, and the priests distinguished into degrees; the political part of religion being, according to some, assigned principally to bishops, and the evangelical to the priests, &c. Or, according to others, the functions of teaching and preaching were reserved to the bishop, and that of ordination superadded; which was their principal distinction, and the mark of their sovereignty in their diocese.

By the ancient discipline, bishops were to be married once, and not to put away their wives on pretence of religion; but a second marriage was a disqualification for this order. If they lived chaste, they were ranked as confessors. Some bishops, in the middle age, on account of their *regalia* or temporalities, were obliged to a military service called *hostis*, by which they were to lead their vassals into the field, and attend the king in his military expeditions. This Charlemagne excused, and even forbade: but the prohibition was little regarded; since we find the thing often practised afterwards.

The election of bishops was anciently placed in the clergy, and the people of the parish, province, or diocese; but afterwards, princes and magistrates, patriarchs and popes, usurped the power. The election was to be within three months after the vacancy of the see; and the person to be chosen out of the clergy of that church. Formerly the bishop claimed a share in the election of an archbishop: but this was set aside by the popes.

In England, during the Saxon times, all ecclesiastical dignities were conferred by the king in parliament. At length, however, after several contests, especially between Archbishop Anselm and Henry I. in consequence of a grant of King John, recognized in Magna Charta, and established by stat. 25 Edw. III. stat. 6. § 3. bishops were elected by the chapters of monks or canons, some shadow of which still remains in the present method of disposing of bishoprics; but by stat. 25 Henry VIII. cap. 20. the right of nomination was restored to the crown.

Ordinarily at least three bishops are required in the ceremony of consecrating a bishop; but in some cases a single one might suffice. The English succession of Protestant bishops stands on this last ground. In England, the king being certified of the death of a bishop by the dean and chapter, and his leave requested to elect another, the *conge d'elire* is sent to them, with a letter missive, nominating the person whom he would have chosen. The election is to be within twelve days after the receipt of it, otherwise the king by letters patent appoints whom he pleases; and the chapter, in case of refusing the person named by the king, incurs a *præmunire*. After election, and its being accepted of the bishop, the king grants a mandate under the great seal for confirmation; which the bishop consigns to his vicar-general; consisting mostly in a solemn citation of such as have any objections to the bishop elect, a declaration of their contumacy in not appearing, and an administration of the oaths of allegiance and supremacy, of simony, and canonical obedience. Sentence being read by the vicar-general, the bishop is installed in the province of Canterbury by the archdeacon; the fact is recorded by a public notary; and the bishop is invested with full powers to exercise all spiritual jurisdictions, though he cannot sue for his temporalities till after consecration. Then follows the consecration by the archbishop or some other bishop appointed by lawful commissions, and two assistant bishops: the ceremony of which is much the same as in the Romish church, save that having put on the episcopal robes, the archbishop and bishops lay their hands on the new prelate's head, and consecrate him with a certain form of words. The process of the translation of a bishop to another bishopric only differs in this, that there is no consecration. The age of a bishop is to be at least thirty years; and by the ancient discipline, none were to be chosen but those who had passed through all the inferior orders; but in some cases of necessity this was dispensed with, and deacons, nay laymen, were raised *per saltum* to the episcopal dignity.

The form of consecrating a bishop is different in different churches. In the Greek church, the bishop elect being by the assistant bishops presented for consecration, and the instrument of election put in his hand; after several prayers (the first called *diaconicum*) demanding consecration, makes profession of his faith; after which he receives a benediction. He is then interrogated as to the belief of the Trinity; to which he answers by a *long profession of faith*, and receives a second benediction. Lastly, he is asked what he thinks of the *incarnation*; to which he answers in a *third profession of faith*; which is followed by a third benediction; after which the consecrator gives him the pastoral staff: then he is led up to the altar; where, after certain prayers, and three crosses on his head, he receives the *pallium*, if he be an archbishop or patriarch; he then receives the kiss of peace of his consecrator and two assistants; and sitting down, reads, prays, and gives the communion to his consecrators and others.

In the Romish church, the bishop elect being presented by the elder assistant to the consecrator, takes the oath: he is then examined as to his faith: and after several prayers, the New Testament is drawn over his head, and he receives the chrism or unction on his head. The pastoral staff, ring, and gospel, are then given him; and after communion, the mitre is put on his head; each ceremony being accompanied with proper prayers, &c. the consecration ends with *Te Deum*. These last-mentioned ceremonies are laid aside in the consecration of English bishops. Nevertheless, the book of consecration set forth in the time of Edward VI. and confirmed by act of parliament, in which some of them are enjoined, is declared to be the standard for this purpose by the thirty-sixth article.

The function of a bishop in England may be considered

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sidered as twofold, viz. what belongs to his order, and what belongs to his jurisdiction. To the episcopal order belong the ceremonies of dedication, confirmation, and ordination; to the episcopal jurisdiction, by the statute law, belong the licensing of physicians, chirurgeons, and schoolmasters, the uniting small parishes (though this last privilege is now peculiar to the bishop of Norwich), assisting the civil magistrate in the execution of statutes relating to ecclesiastical matters, and compelling the payment of tenths and subsidies due from the clergy. By the common law, the bishop is to certify the judges, touching legitimate and illegitimate births and marriages; and by that and the ecclesiastical law, he is to take care of the probate of wills and granting administrations; to collate to benefices, grant institutions on the presentation of other patrons, command induction, order the collecting and preserving the profits of vacant benefices for the use of the successors, defend the liberties of the church, and visit his diocese once in three years. To the bishop also belong suspension, deprivation, deposition, degradation, and excommunication.

All bishops of England are peers of the realm, except the bishop of Man; and, as such sit and vote in the house of lords; they are barons in a threefold manner, viz. feudal, in regard to the temporalities annexed to their bishoprics; by writ, as being summoned by writ to parliament; and lastly, by patent and creation: accordingly they have the precedence of all other barons, and vote as barons and bishops; and claim all the privileges enjoyed by the temporal lords, excepting that they cannot be tried by their peers, because, in cases of blood, they themselves cannot pass upon the trial, for they are prohibited by the canons of the church (as already observed) to be judges of life and death. They have the title of *Lords and Right Reverend fathers in God.* Besides two archbishops, there are 24 bishops in England: exclusive of the bishop of Sodor and Man, who has no seat in the house of peers. The bishops of London, Durham, and Winchester, take place from the other bishops, who are to rank after them according to their seniority of consecration. —There is now also a bishop in our settlement of Nova Scotia. In Scotland, before the Presbyterian establishment, there were two archbishoprics and 12 bishoprics.

Bishop's Court, an ecclesiastical court, held in the cathedral of each diocese, the judge whereof is the bishop's chancellor, who judges by the civil and canon law; and if the diocese be large, he has his commissaries in remote parts, who hold what they call *consistory courts*, for matters limited to them by their commission.

Bishop and his Clerks, some little islands and rocks on the coast of Pembrokeshire, near St David's in Wales, which are very dangerous to mariners.

Bishop's-Aukland. See Aukland.

Bishop's Castle, a town of Shropshire in England, seated near the river Clun. It is a corporation, sends two members to parliament, and contained 1367 inhabitants in 1811. W. Long. 2. 55. N. Lat. 52. 30.

Bishop's-Stortford, a town of Hertfordshire in England, seated on the side of a hill, in E. Long. 0. 25. N. Lat. 51. 50. It has several good inns, but the streets are not paved. It has a large church, one Presbyterian and one Quaker meeting. Here was formerly a castle called *Weymore Castle*, wherein a garrison was kept. Population in 1811, 2630.

BISHOPING, a term among horse-dealers, to denote the sophistications used to make an old horse appear young, a bad one good, &c.

BISHOPRIC, the district over which a bishop's jurisdiction extends, otherwise called a diocese.

In England there are 24 bishoprics besides that of Sodor and Man; in Ireland 18.

BISI, Bonaventura, a celebrated miniature painter, was born at Bologna, and was a disciple of Lucio Massari. But his sole delight was in miniature painting, and in that way he arrived at great excellence. Instead of working from his own invention, or original design, he employed himself to imitate, in small size, the pictures of Guido, Corregio, Titian, and other great masters, and those he finished with astonishing grace, neatness, and beauty. A great number of the works of this master are in the duke's gallery at Modena, and are highly valued. He died in 1662, his age unknown.

BISIGNANO, a town of Italy, in the kingdom of Naples, and in the Hither Calabria. It hath a strong fort, a bishop's see, and the title of a principality. It is seated on a mountain near the river Boccona, in E. Long. 16. 40. N. Lat. 39. 37.

BISK or Bisque, in cookery, a rich sort of broth or soup, made of pigeons, chickens, force-meat, mutton-gravy, and other ingredients. The word is French, formed, as some think, from *biscocta;* because the bisque, consisting of a diversity of ingredients, needs several repeated coctions to bring it to perfection. There is also a *demi-bisque*, made at a low expence, in which only half the ingredients are used; and a bisque of fish, made of carps minced with their roes and lobsters.

BISKUIT, or Biscuit, a kind of bread prepared by the confectioners, of fine flour, eggs, and sugar, and rose or orange water; or of flower, eggs, and sugar, with aniseeds, and citron peel, baked again and again in the oven, in tin or paper moulds. There are divers sorts of biskuit; as seed-biskuit, fruit-biskuit, long-biskuit, round-biskuit, Naples-biskuit, sponge-biskuit, &c.

Sea-Biskuit is a sort of bread much dried by passing the oven twice, to make it keep for sea-service. For long voyages they bake it four times, and prepare it six months before the embarkation. It will keep good a whole year.

To preserve sea-biskuit from insects, Mr Hales advises to make the fumes of burning brimstone pass through the casks full of bread. Biskuit may be likewise preserved a long time, by keeping it in casks well calked, and lined with tin.

The ancients had their biskuit prepared after the like manner, and for the like use, as the moderns. The Greeks called it ἄρτος δίπυρος, *q. d.* bread put twice to the fire. The Romans give it the name of *panis nauticus*, or *capta.* Pliny denominates it *vetus aut nauticus panis tusus atque iterum coctus.* By which it appears, that after the first baking, they ground or pounded it down again for a second. In some middle-age writers, it is called *paximas, paximus*, and *panis paximatus.* Among the Romans we also meet with a kind of land-biskuit for the camp service, called *buccellatum*, sometimes *expeditionalis annona*, which was baked much; but to make it lighter for carriage, and less liable to corrupt, the coction was continued till the bread was reduced one-fourth of its former weight.

BISKOP. See Bischop.

BISMILLAH, a solemn form used by the Mahometans at the beginning of all their books and other writings, signifying, *In the name of the most merciful God*.

Bismillah is also used among the Arabs as a word of invitation to eat. An Arab prince will frequently sit down to eat in the street before his own door, and call to all that pass, even beggars, in this word, who do not fail to come and sit down to eat with him; for the Arabs are great levellers, and set every body upon a footing with them.

BISMUTH, or Tin-glass, a metal of a reddish or yellowish-white colour and a lamellated texture. See Chemistry and Mineralogy *Index*.

BISNAGAR, formerly a very large and powerful kingdom of Asia, comprehending the kingdoms of Kanara, Messowr, Travankor, Madura, Marava, and Tanjour. It was called *Bisnagar* from its capital city, and took the name of *Narsinga* from one of its rajahs or kings. We know nothing certain concerning this kingdom before the year 1520, when Khrisna Rajah, king of Bisnagar, made war with Adel Khan king of Visiapur, from whom he resolved to take the city of Rachol, situated in the island of Salsette near Goa, which he said had belonged to his ancestors. The king of Bisnagar's army consisted of 733,000 foot, 35,000 horse, 586 elephants with towers on their backs, each of which had four men in it; besides these were 12,000 water-carriers, and the army was followed by 20,000 common women. The city, however, resisted this formidable army for three months; at the end of which, Adel Khan came to its relief with an army of 120,000 foot, 18,000 horse, 150 elephants, and many heavy cannon. In the engagement the king of Bisnagar proved victorious, and almost entirely destroyed the army of Adel Khan, taking from him 4000 horses, 100 elephants, 400 cannon, &c. Soon after he took the city by assault; but consented to restore the booty taken in the former battle, provided Adel Khan consented to come and kiss his foot as the sovereign lord of Kanara. This base condition was accepted, but accidentally prevented from being put in execution. From this time we hear of nothing remarkable till the year 1558, when a Portuguese of the city of *Meliapur* or *St Thomas*, on the coast of Coromandel, persuaded Ramah Rajah, then king of Bisnagar, to march against that place, telling him the plunder would be worth 2,000,000, and that the destruction of Meliapur would be of great service to the images in the pagods which were thrown down by the Christians. The king set out accordingly with an army of 500,000 men; but the inhabitants, instead of preparing for their defence, sent him a present of 4000 ducats. This somewhat appeased him: however, he would not enter the city, but ordered the inhabitants of both sexes, with all their valuable effects, to be brought into his presence; which being done, he found that the value of their whole substance did not exceed 80,000 ducats. On this he ordered the informer to be thrown to the elephants, who tore him in pieces; after which he dismissed the citizens, and restored all their goods so punctually, that only a silver spoon happening to be missing, it was sought for, and returned to the owner. In 1565, the happy state of this kingdom excited the envy of the kings of Dekan: who, having raised an army of 500,000 foot and 50,000 horse, defeated and killed the king of Bisnagar, though at the head of an army almost twice as numerous, and took the royal city itself. They are said to have spent five months in plundering it, although the inhabitants had before carried off 1550 elephants loaded with money and jewels to the amount of upwards of 100,000,000 of gold; besides the royal chair for state days, whose price could not be estimated. The victors, however, found a diamond of the size of an ordinary egg, besides another of a size somewhat inferior, and several other jewels of immense value. Afterwards, however, they were forced to abandon the kingdom, as being too large for them to keep in their hands. From this time the kingdom of Bisnagar remained pretty much unmolested till about the year 1627, when it was subdued by Aurengzebe, second son to Shah Jehan, and hath ever since remained subject to the Great Mogul. In some places of this kingdom, it is said, the roads have great forests of bamboos on each side, which are so thick that it is impossible for a man to pass. These forests are full of monkeys; and what is singular, those on the one side seem to be enemies to those on the other; for if a basket of rice is set down on the road with a parcel of small sticks about it, the monkeys on each side will come out and fall a-fighting with the sticks till one of the parties retreats. This, it is said, is often done by travellers for diversion. They catch the wild elephants here in pitfalls, and then tame them by means of others already tamed. The town of Bisnagar is now in ruins. It is situated in E. Long. 78. 0. N. Lat. 15. 14.

BISNOW, or Bischnou, a sect of the Banians in the East Indies; they call their god Ram-ram, and give him a wife: They adorn his image with golden chains, necklaces of pearls, and all sorts of precious stones. They sing hymns in honour of their god, mixing their devotion with dances and the sound of drums, flagelets, brazen basons, and other instruments. This sect lives wholly upon herbs and pulse, butter and milk. In this sect, the wives do not burn themselves after their husband's death, as is practised by those of the *samarath* sect; but content themselves with a perpetual widowhood.

BISOMUM, or Disomum, in Roman antiquity, a tomb for two dead bodies, or the ashes of two. The ancients frequently buried two, three, or four bodies in the same sepulchre, disposed aside of each other; for it was held an impiety to lay one a-top of another. Hence the sepulchres of the primitive Christians had the words *bisomi*, *trisomi*, *quadrisomi*, &c. inscribed on them, to indicate the number of bodies deposited in them.

BISON, in *Zoology*, the trivial name of a species of bos. See Bos, Mammalia *Index*.

BISQUIT, or Biskuit. See Biskuit.

BISSAGOS, a cluster of islands on the coast of Negroland in Africa, situated between the mouth of the

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the rivers Gambia and Rio Grande. Their names are *Bulam*, *Cassuabar*, *La Gallinci*, *Cazegut*, *Calacha*, and *Oranguana*, with some other small islands: but the only one which merits a particular description is that of Bulam. Each of these islands is governed by a king of its own; and as all those petty monarchs are quite independent, they frequently make war with each other, yet they always unite against the inhabitants of Bifara, who are their common enemies. They have canoes that carry from 25 to 40 men with their provisions and arms, which are sabres and bows and arrows. The inhabitants are negroes; who are tall, strong, and healthy, though they live only on fish, nuts, and palm-oil; choosing rather to sell the rice, millet, and other grain produced in their country, to the Europeans, than not to gratify their passion for trinkets and ornaments. In general they are idolaters; cruel and savage in their disposition, and when they happen to quarrel, and are disappointed of their revenge, they frequently drown or stab themselves. An attempt was made in 1792 to plant a colony on Bulama, one of these islands, but it entirely failed.

BISSAO, an island on the coast of Africa, a few leagues to the south-east of the river Gambia, and separated from the continent only by the channel of the river Geves. In this island the French have a factory, and there is also a fort belonging to the Portuguese, at both of which a great trade is carried on. The island is about 35 or 40 miles in circumference, having an agreeable prospect to the sea, from which it rises by a gentle ascent on every side to an eminence in the centre of the island. There are however a great many hills inferior in height to that in the middle, and separated by beautiful and fertile valleys divided by little rivulets, which at the same time augment the richness and elegance of the scene. So rich is the soil of Bissao, that wheat and maize spring up to the size of Indian corn, or rather resemble a field covered over with reeds or bamboos. The cattle also are of an extraordinary size, and seem to keep pace with the extravagant growth of the corn. Milk and wine are in the greatest abundance; but the island affords neither hogs nor horses. The former are forbid by the natives to be imported; and something in the soil or climate renders it unfit for the increase of the latter, which never thrive here. The dress of the men of all ranks in Bissao is only a skin fixed to the girdle before and behind. The dress of the married women consists of a cotton petticoat; but virgins go entirely naked, wearing only bracelets of different kinds on their arms and legs. If they are of high quality, their bodies are marked or painted with a variety of hideous forms of snakes and other figures, which, as their colour is jet-black, gives their skins somewhat the appearance of flowered satin. Even the princess royal herself, the eldest daughter of the emperor, is only distinguished from other women by the elegance of those paintings and the richness of her bracelets. One very extraordinary ornament used in this country is a large iron ring with a flat round surface on the outside instead of a stone, upon which the ring changes with a bit of iron, in such a manner as to converse with the greatest facility by means of the different sounds produced; but this kind of language is used only among the polite and the great. All the Bissaons are idolaters, nor has commerce introduced the smallest change in their manners, but their ideas of religion are exceedingly confused. Their chief idol is a little image called *China*, of which the worshippers give very absurd accounts; but, besides this, every man invents a god for himself: trees are held sacred; and if not adored as gods, are worshipped as the residence of some divinity. The government is despotic, the will of the emperor being a law to his people. Of this we have an instance in Bissao, not to be matched in any other country whatever. This is no other than a present which one subject may make of the house and estate of his neighbour to the emperor; and as it is most commonly his majesty's pleasure to accept of such presents, the proprietor dares not resist, but immediately sets about building another house, though even this he cannot do without the prince's leave; and if this should not be readily granted, he must live with his family in the open air till permission to build a new house can be obtained.

BISSAT, Peter, professor of canon law in the university of Bononia, in Italy, was descended from the earls of Fife in Scotland, and born in that county in the reign of James V. He was educated at St Andrews: from thence he removed to Paris; and, having spent some time in that university, proceeded to Bononia, where he commenced doctor of laws, and was afterwards appointed professor of canon law. He continued in that honourable employment several years with great reputation, and died in the year 1568. He is said to have been not only a learned civilian, but an excellent poet, orator, and philosopher. *Patricii Bissatti opera omnia*, viz. *poemata*, *orationes*, *lectiones feriales*, *&c. Lib. de irregularitate*, *&c.* were published at Venice in 1565, 4to.

BISSENPOUR, a small district of the kingdom of Bengal in the East Indies, which has all along preserved its independence. It has been governed time immemorial by a Bramin family of the tribe of Rajahput. Here the purity and equity of the ancient political system of the Indians are found unadulterated. This singular government, the finest and most striking monument in the world, has till now been beheld with too much indifference. We have no remains of ancient nations but brass and marble, which speak only to imagination and conjecture, those uncertain interpreters of manners and customs that no longer exist. Were a philosopher transported to Bissenpour, he would immediately be a witness of the life led by the first inhabitants of India many thousand years ago: he would converse with them; he would trace the progress of this nation, celebrated as it were from its very infancy; he would see the rise of a government which, being founded in happy prejudices, in a simplicity and purity of manners, in the mild temper of the people, and the integrity of the chieftains, has survived those innumerable systems of legislation, which have made only a transitory appearance on the stage of the world with the generations they were designed to torment. More solid and durable than those political structures, which, raised by imposture and enthusiasm, are the scourges of human kind, and are doomed to perish with the foolish opinions that gave them birth, the government of Bissenpour, the offspring of a just attention to order and the laws of nature, has been established and maintained

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maintained upon unchangeable principles, and has undergone no more alteration than those principles themselves. The singular situation of this country has preserved to the inhabitants their primitive happiness and the gentleness of their character, by securing them from the danger of being conquered, or of imbruing their hands in the blood of their fellow-creatures. Nature has surrounded them with water; and they need only open the sluices of their river to overflow the whole country. The armies sent to subdue them have so frequently been drowned, that the plan of enslaving them has been laid aside; and the projectors of it have thought proper to content themselves with an appearance of submission.

Liberty and property are sacred in Bissenpour. Robbery, either public or private, is never heard of. As soon as any stranger enters the territory, he comes under the protection of the laws, which provide for his security. He is furnished with guides at free cost, who conduct him from place to place, and are answerable for his person and effects. When he changes his conductors, the new ones deliver to those they relieve an attestation of their conduct, which is registered and afterwards sent to the rajah. All the time he remains in the country, he is maintained and conveyed with his merchandise at the expence of the state, unless he desires leave to stay longer than three days in the same place. In that case, he is obliged to defray his own expences; unless he is detained by any disorder, or other unavoidable accident. This beneficence to strangers is the consequence of the warmth with which the citizens enter into each others interests. They are so far from being guilty of an injury to each other, that whoever finds a purse, or other thing of value, hangs it upon the first tree he meets with, and informs the nearest guard, who give notice of it to the public by beat of drum. These maxims of probity are so generally received, that they direct even the operations of government. Out of about 350,000l. on an average it annually receives, without injury to agriculture or trade, what is not wanted to supply the unavoidable expences of the state is laid out in improvements. The rajah is enabled to engage in these humane employments, as he pays the Moguls only what tribute and at what times he thinks proper.

BISSEXTILE, in *Chronology*, a year consisting of 366 days, being the same with our leap-year. See CHRONOLOGY.

BISTI, in commerce, a small coin of Persia: Some say that it is among the current silver coins of Persia, and worth only a little above three farthings of our money; others speak of it again as a money of account.

BISTONIS, in *Ancient Geography*, a lake of Thrace near Abdera, on which dwelt the Bistones: hence *Bistonius Tyrannus* is by Lucan used to denote Diomedes king of Thrace, who fed his horses with human flesh; and *Bistonius turbo*, a wind blowing from Thrace.

BISTORT, or KNOTGRASS. See POLYGONUM, BOTANY *Index*.

BISTOURY, in *Surgery*, an instrument for making incisions, of which there are different kinds; some being of the form of a lancet, others straight and fixed in the handle like a knife, and others crooked with the sharp edge on the inside.

BISTRE, among painters, signifies the burnt oil extracted from the soot of wood.

It is of a brown transparent colour, having much the same effect in water-painting, where alone it is used, as brown pink in oil. Though this colour is extremely serviceable in water-colours, and much valued by those who know and can procure it; yet it is not in general use here, perhaps on account of its not being easily procured of a perfect kind; hardly any of it being good, but what is imported from France. Perhaps the principal reason for this is, that dry beechwood affords the best soot for making it: and it is not easy to procure such here without mixture of the soot of green wood, or other combustibles that deprave it for this purpose: or it is possible that they who have pretended to prepare it, have been ignorant of the proper means; there not being any receipt or directions in books that treat of these matters, from whence they could learn the proper process.

Bistre may, however, be prepared with great ease in the following manner.—Take any quantity of soot, of dry wood, but let it be of beech wherever that can be procured. Put it into water in the proportion of two pounds to a gallon; and boil them half an hour: then after the fluid has stood some little time to settle, but while yet hot, pour off the clearer part from the earthy sediment at the bottom; and if on standing longer it forms another earthy sediment, repeat the same method, but this should be done only while the fluid remains hot: then evaporate the fluid to dryness: and what remains will be good bistre, if the soot was of a proper kind.—The goodness of bistre may be perceived by its warm deep brown colour, and transparency when moistened with water.

BISTRICZ, a handsome strong town of Transilvania, seated on a river of the same name, in E. Long. 25. 3. N. Lat. 47. 33.

BIT, or BITT, an essential part of a bridle. Its kinds are various. 1. The musrol, snaffle, or watering-bit. 2. The canon-mouth, jointed in the middle. 3. The canon with a fast mouth, all of a piece, only kneed in the middle, to form a liberty or space for the tongue; fit for horses too sensible or ticklish, and liable to be continually bearing on the hand. 4. The canon-mouth, with the liberty in form of a pigeon's neck; proper where a horse has too large a tongue. 5. The canon with a port-mouth, and an upset or mounting liberty; where a horse has a good mouth, but large tongue. 6. The scatch-mouth, with an upset; ruder but more secure than a canon-mouth. 7. The canon-mouth with a liberty; proper for a horse with a large tongue and round bars. 8. The masticadour, or slavering bit, &c. The several parts of a snaffle, or curb-bit, are the mouth-piece, the cheeks and eyes, guard of the cheek, head of the cheeks, the port, the welts, the campanel or curb and hook, the bosses, the bolsters and rabbets, the water-chains, the side-bolts and rings, kirbles of the bit or curb, trench, top-rol, flap and jieve. The importation of bits for bridles is now prohibited.

BITS, or *Bitts*, in *Ship-Building*, the name of two great timbers, usually placed abaft the manger, in the ship's ship's loof, through which the cross-piece goes: The use of it is to belay the cable thereto while the ship is at anchor.

BIT is also used in commerce for a piece of coin current in Jamaica, and valued at $7\frac{1}{2}$d.

BITBURGH, a town of the Netherlands, in the duchy of Luxemburg. E. Long. 6. 43. N. Lat. 50. 0.

BITCH, the female of the dog kind. See CANIS.

BITCHE, a town of Lorrain, now in the department of the Moselle, seated at the foot of the mountains near the river Swolbe. E. Long. 7. 44. N. Lat. 49. 5.

BITETO, a town of Italy, in the kingdom of Naples, and in the Terra di Bari. E. Long. 16. 56. N. Lat. 41. 8.

BITHYNIA, an ancient kingdom of Asia, formerly known by the names of *Mysia*, *Mygdonia*, *Babryicia*, *Mariandynia*, and *Bithynia*. It was bounded on the west by the Bosphorus Thracius and part of the Propontis, on the south by the river Rhyndacus and Mount Olympus, on the north by the Euxine sea, and on the east by the river Parthenius. The chief cities were *Myrlea*, *Nicomedia*, *Chalcedon*, *Heraclea*, and *Prusa*.—As to its history, we find nothing of moment recorded; except the infamous conduct of Prusias, one of its kings, in delivering up to the Romans Hannibal, the great Carthaginian general, who fled to him for protection. His great grandson Nicomedes IV. bequeathed the kingdom to the Romans. From them it was taken by the Turks, to whom it still remains subject, but has no modern name.

BITONTO, an episcopal town in Italy, in the kingdom of Naples and Terra di Bari. It is seated in a plain, eight miles south of the gulf of Venice, in E. Long. 16. 52. N. Lat. 41. 13.

BITTACLE. See BINACLE.

BITTER, an epithet given to all bodies of an opposite taste to sweetness. For the medical virtues of bitters, see MATERIA MEDICA.

BITTER, a sea term, signifying any turn of the cable about the bits, so as that the cable may be let out by little and little. And when the ship is stopped by a cable, she is said *to be brought up by a bitter*. Also that end of the cable which is wound about the bits is called *the bitter end of the cable*.

BITTER-Apple. See COLOCYNTHIS, BOTANY *Index*.

BITTER-Salt. See *EPSOM-Salt*.

BITTER-Sweet. See SOLANUM, BOTANY *Index*.

BITTERN. See ARDEA, ORNITHOLOGY *Index*.

BITTERN in the salt works, the brine remaining after the salt is concreted: this they ladle off, that the salt may be taken out of the pan, and afterwards put in again; when, being farther boiled, it yields more salt. See SALT.

BITUMENS, in *Natural History*, are oily matters, of a strong smell, and of different consistencies, which are found in many places within the earth. See CHEMISTRY and MINERALOGY.

BITUMEN JUDAICUM. See ASPHALTUM, MINERALOGY *Index*.

BITUREX, BITURIGES, or *Bituricæ*, afterwards corrupted to *Bourges*; the name of *Avaricum*, from the custom of the lower age of calling towns from the names of the people. See AVARICUM.

BITURIGES (Cæsar); *Bituriges Cubi* (Strabo, Pliny, Ptolemy); a people in that part of Gallia Celtica afterwards assigned to Aquitania. Now called *Berry*.

BITURIGES Vibisci (Ptolemy), a people of Aquitain.

BIVALVES, a term sometimes used for such shells as consist of two pieces.—It is also an appellation given by botanists to such pods or capsules as consist of two valves enclosing the seeds.

BIVENTER, in *Anatomy*, called also *digastric*, or *two-bellied*, a muscle of the lower jaw. See ANATOMY, *Table of the Muscles*.

BIUMBRES, in *Geography*, an appellation given to the inhabitants of the torrid zone, by reason, at two different seasons of the year, their shadows are projected two different ways. The biumbres are the same with those otherwise denominated *amphiscii*.

BIXA, the ROUCOU or *Arnotto Tree*. See BOTANY *Index*.

BIZARRE, denoting *capricious*, &c. a term used among florists for a particular kind of carnation, which has its flowers striped or variegated with three or four colours.

BIZARRO, in the Italian music, denotes a fanciful kind of composition, sometimes fast, slow, soft, strong, &c. according to the fancy of the composer.

BIZOCHI, or BISOCHI, in *Church History*, certain heretical monks, said to have assumed the religious habit contrary to the canons, rejected the sacraments, and maintained other errors.

BLACK, DR JOSEPH, distinguished for his discoveries in chemistry, was born in France, on the banks of the Garonne in the year 1728. His father was a native of Belfast, but descended from a Scotch family who had been some time settled there. Mr Black, the father, was engaged in the wine trade; and for the purpose of carrying it on, he resided chiefly at Bourdeaux.

He is represented as a man of extensive information, of candid and liberal sentiments, and of amiable manners; but particularly distinguished by the strength of his attachments and the warmth of his heart. These amiable and estimable qualities in the character of Mr Black, attracted the attention, and procured the friendship and intimacy of the discerning and benevolent Montesquieu, who was one of the presidents of the court of justice in the province while Mr Black resided at Bourdeaux. Letters and fragments of correspondence between the president and Mr Black are still preserved in the family, as precious relics and memorials of the intercourse, honourable to both, which subsisted between that great man and their ancestor.

Some time before Mr Black retired from business, he sent his son Joseph, then in his twelfth year, to Belfast, on account of his education. And having completed the usual course of instruction in a grammar school, he was sent to the university of Glasgow in the year 1746. During the time which he studied at that seminary, his attention seems to have been chiefly directed to physical science; and he became a favourite pupil of Dr Dick, then professor of natural philosophy. When Dr Black had finished the ordinary course of general study at the university, he made choice of the profession of medicine; and he directed his views to

those

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Black. those pursuits and studies which were necessary to qualify him for that profession.

It was about this time that Dr Cullen had been appointed to the lectureship of chemistry in the university of Glasgow. Hitherto this science had been only treated as a curious and in some respect a useful art. This great man, conscious of his own strength, and taking a wide and comprehensive view, saw the unoccupied field of philosophical chemistry open before him. He was satisfied that it was susceptible of great improvement by means of liberal inquiry and rational investigation. He was therefore determined to enter the unbeaten path, and to lead his followers to those unexplored regions which are included in the wide ranges of this comprehensive and attractive science. It was at this time that Dr Black became the pupil of Dr Cullen; and it was perhaps to this fortunate coincidence that Dr Black was indebted for the foundation of his future reputation as a philosopher and a chemist. The liberal and extensive views of Cullen happily accorded with the enlarged habits of thought which the young philosopher had previously acquired. Dr Cullen took a deep interest in the progress of his students. He delighted in encouraging and aiding their efforts; and therefore perceiving the bias of Black's pursuits, soon attached him to himself. And by the intercourse and intimacy which followed he was led into the same train of thought, and conducted into the same course of studies. He was received into a closer connexion, and became a valuable assistant in all Dr Cullen's chemical operations. The experiments of Black were frequently adduced to prove facts which were stated in the lecture, and they were considered as good authority. Thus commenced a mutual confidence and friendship which was highly honourable to both, and was never afterwards mentioned by Dr Black but with gratitude and respect.

In the year 1751 Dr Black went to Edinburgh to complete the course of his medical studies. There he resided in the house of his cousin-german, Mr Russel, professor of natural philosophy in that university, a gentleman of enlarged views and liberal sentiments, whose conversation and studies must have been both agreeable and profitable to his young friend.

At this time the mode of action of lithontriptic medicines, but particularly lime-water, in alleviating the pains of stone and gravel, divided the opinions of professors and practitioners. This subject became extremely interesting both to the physician and chemist. And as it is usual for the students to enter warmly into those discussions which give rise to much difference of opinion among the teachers, this subject, quite suited to his taste, particularly attracted and interested the attention of Mr Black, who was then one of Dr Cullen's most zealous and intelligent pupils. It appears from some of his memorandums, that he at first held the opinion that the causticity of alkalies is owing to the igneous matter which they derive from quicklime. But having prosecuted his experiments on magnesia, this grand secret of nature was laid open to his view. This led him to conclude, that the acrimony of these substances was not owing to their combination with igneous particles; that it was their peculiar property; and that they lost this property and became mild, by combining with a certain portion of air, to which he gave the name of *fixed air*; because it was fixed or became solid in the substances in the composition of which it entered.

This grand discovery, which forms one of the most important eras of chemical science, was the subject of his inaugural dissertation, published at the time that he was admitted to his medical degree in the university of Edinburgh. He had not availed himself of the time he had studied at Glasgow, but took the whole course prescribed by the rules of the university. This delay, it has been suppo-ed, may have been owing to the investigation of the subject in which he had engaged not having been completed, which determined him to proceed with caution, till he had established his doctrine by a train of decisive experiments.

About the time that Dr Black obtained his medical degree, Dr Cullen was removed to Edinburgh, which made a vacancy in the chemical chair at Glasgow. While he remained at that university, Dr Black had been a diligent and attentive student; and the discovery published in his inaugural essay had added much to his reputation. He was therefore looked up to as a person amply qualified to fill the vacant chair; and accordingly, in the year 1756, he was appointed professor of anatomy, and lecturer on chemistry in the university of Glasgow. And it was perhaps fortunate for himself, fortunate for the public and for science, that a situation so favourable presented itself, a situation which allowed him full time to dedicate his talents chiefly to the cultivation of chemistry, which had now become his favourite science.

Along with the lectureship on chemistry, Dr Black's first appointment in the university of Glasgow was to the professorship of anatomy. The latter branch of medical study was either not so suitable to his taste, or he did not consider himself so well qualified to be useful in it; for soon after, arrangements were made with the professor of medicine, by which the professors exchanged departments, when Dr Black undertook that of the institutes and practice of medicine.

At this time, his lectures on medicine formed his chief task. And the perspicuity and simplicity, the caution and moderation which he discovered in the doctrines which he delivered, gave great satisfaction. The time and attention which were occupied in these lectures, and in the medical practice in some measure necessarily connected with his situation, are supposed by some to have been the principal cause of Dr Black's having suddenly stopped short in that brilliant career on which he at first so successfully entered. It is, however, more probable, that the calm and unambitious temper which seems to have been a striking feature of his character, and which a less friendly hand than his learned biographer would have set down as nearly allied to indolence, checked the spirit of ardour and perseverance which was necessary to encourage and carry him forward in the path of discovery and research. Whatever may have been the cause, it is to be regretted, that Dr Black, so conspicuous for his patient, judicious, and elegant mode of investigation, and so distinguished for the simplicity, perspicuity, and precision of his reasonings and deductions, should have contributed so little in rearing the noble superstructure of chemical science, the foundation of which he had been the means of establishing on a firm and sold basis.

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The theory of the nature of quicklime, and the cause of its causticity, was soon known to the German chemists, and from them it met with strong opposition. Various mysterious doctrines at this time prevailed in the German schools concerning the peculiar nature of fire. As their notions of the causticity of alkaline substances involved some of these doctrines, a great many objections were started to a theory which threatened to overthrow long established and favourite opinions. The most formidable opponent to the new theory was Professor Meyer of Osnaburgh. All the phenomena of the causticity and mildness of lime and alkalies, were, according to his explanation, to be accounted for, by the action of a substance of a peculiar nature, to which he gave the name of *acidum pingue*. This substance, which was supposed to be formed in the lime during calcination, consisted of an igneous matter in a certain state of combination with other substances. It is a matter of some surprise that Dr Black should have experienced any uneasiness on account of the opposition made to his discovery by mere hypothesis unsupported by facts or even by plausible argument, when his own doctrine had been fully and irrefragably established by the sure test of decisive experiment. Nor is it less surprising, that he should have taken great pains for several years in the course of his lectures, in refuting the arguments and in combating the objections of Meyer to his own theory.

Dr Black's reception at the university of Glasgow was highly flattering and encouraging. As a student, he had not only done himself much credit by his successful progress in the different pursuits in which he was engaged, but he had also during his residence there conciliated the attachment and affection of the professors in a high degree. When he returned as a professor, he was immediately connected in the strictest friendship with Dr Adam Smith, then professor of moral philosophy in that university. And this friendship, which now commenced, grew stronger and stronger, and was never interrupted through the whole of their lives. A simplicity and sensibility, an incorruptible integrity, the strictest delicacy and correctness of manners, marked the character of each of the philosophers, and firmly bound them in the closest union.

At Glasgow, Dr Black soon acquired great reputation as a professor, and became a favourite physician in that large and active city. His engaging countenance, his agreeable and attractive manners, free from all studied endeavours to please, and the kind concern he took in the cases intrusted to his care, made him a most welcome visitor in every family.

It was between the years 1759 and 1763, that he brought to maturity his speculations concerning heat, which had occupied his attention at intervals, from the very first dawn of his philosophical investigations. His discoveries in this department of science were by far the most important of all that he made, and perhaps indeed the most valuable which appeared during the busy period of the 18th century. To enter fully into the nature of his investigations would be improper in this place; but the sum of them all was usually expressed by him in the following propositions.

When a solid body is converted into a fluid, there enters into it and unites with it, a quantity of heat, the presence of which is not indicated by the thermometer, and this combination is the cause of the fluidity which the body assumes. On the other hand, when a fluid body is converted into a solid, a quantity of heat separates from it, the presence of which was not formerly indicated by the thermometer. And this separation is the cause of the solid form which the fluid assumes.

When a liquid body is raised to the boiling temperature, by the continued and copious application of heat, its particles suddenly attract to themselves a great quantity of heat, and by this combination their mutual relation is so changed that they no longer attract each other, but are converted into an elastic fluid like air. On the other hand, when these elastic fluids, either by condensation or by the application of cold bodies, are reconverted into liquids, they give out a vast quantity of heat, the presence of which was not formerly indicated by the thermometer.

Thus water when converted into ice gives out 140° of heat, and ice when converted into water absorbs 140° of heat, and water when converted into steam absorbs about 1000° of heat without becoming sensibly hotter than 212°. Philosophers had been long accustomed to consider the thermometer as the surest method of detecting heat in bodies, yet this instrument gives no indication of the 140° of heat which enter into air when it is converted into water, nor of the 1000° which combine with water when it is converted into steam. Dr Black, therefore, said that the heat is concealed (*latet*) in the water and steam, and he briefly expressed this fact by calling the heat in that case *latent heat*.

Dr Black having established this discovery by simple and decisive experiments, drew up an account of the whole investigation, and read it to a literary society which met every Friday, in the faculty-room of the college, consisting of the members of the university, and several gentlemen of the city who had a relish for philosophy and literature. This was done April 23. 1762, as appears by the registers. This doctrine was immediately applied by its author to the explanation of a vast number of natural phenomena, and in his experimental investigations he was greatly assisted by his two celebrated pupils Mr Watt and Dr Irvine.

As Dr Black never published an account of his doctrine of latent heat, though he detailed it every year subsequent to 1762 in his lectures, which were frequented by men of science from all parts of Europe; it became known only through that channel, and this gave an opportunity to others to pilfer it from him piece-meal. Dr Crawford's ideas respecting the capacity of bodies for heat, were originally derived from Dr Black, who first pointed out the method of investigating that subject.

The investigations of Lavoisier and Laplace concerning heat, published many years after, were obviously borrowed from Dr Black, and indeed consisted in the repetition of the very experiments which he had suggested. Yet these philosophers never mention Dr Black at all: every thing in their dissertation assumes the air of originality; and indeed they appear to have been at great pains to prevent the opinions and discoveries of Dr Black from being known among their countrymen. But perhaps the most extraordinary procedure was that of Mr Deluc; this philosopher had

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Black.

expressed his admiration of Dr Black's theory of latent heat, and had offered to become his editor. Dr Black, after much entreaty, at last consented, and the proper information was communicated to Mr Deluc. At last the *Idées sur la Meteorologie* of that philosopher appeared in 1788. But what was the astonishment of Dr Black and his friends, when they found the doctrine claimed by Deluc as his own, and an expression of satisfaction at the knowledge which he had acquired of Dr Black's coincidence with him in opinion! (M. Deluc has published an answer to this charge in his own vindication. See *Edin. Rev.* N° 12. 1805.)

Dr Black continued in the university of Glasgow from 1756 to 1766. In 1766 Dr Cullen was appointed professor of medicine in the university of Edinburgh, and thus a vacancy was made in the chemical chair of that university. Dr Black was with universal consent appointed his successor. In this new scene his talents were more conspicuous, and more extensively useful. He saw this, and while he could not but be highly gratified by the great concourse of pupils which the high reputation of the medical school of Edinburgh brought to his lectures, his mind was forcibly impressed by the importance of his duties as a teacher. This had an effect which perhaps was on the whole rather unfortunate. He directed his whole attention to his lectures, and his object was to make them so plain that they should be adapted to the capacity of the most illiterate of his hearers. The improvement of the science seems to have been laid aside by him altogether. Never did any man succeed more completely. His pupils were not only instructed but delighted. Many became his pupils merely in order to be pleased. This contributed greatly to extend the knowledge of chemistry. It became in Edinburgh a fashionable part of the accomplishment of a gentleman.

Perhaps also the delicacy of his constitution precluded him from exertion; the slightest cold, the most trifling approach to repletion, immediately affected his breast, occasioned feverishness, and if continued for two or three days brought on a spitting of blood. Nothing restored him but relaxation of thought and gentle exercise. The sedentary life to which study confined him was manifestly hurtful, and he never allowed himself to indulge in any intense thinking without finding these complaints sensibly increased.

So completely trammeled was he in this respect, that although his friends saw others disingenuous enough to avail themselves of the novelties announced by Dr Black in his lectures, and therefore repeatedly urged him to publish an account of what he had done, this remained unaccomplished to the last. Dr Black often began the task, but was so nice in his notions of the manner in which it should be executed, that the pains he took in forming a plan of the work, never failed to affect his health, and oblige him to desist. Indeed he peculiarly disliked appearing as an author. His inaugural dissertation was the work of duty. His *Experiments on Magnesia, Quicklime, and other alkaline substances*, was necessary to put what he had indicated in his inaugural dissertations on a proper foundation. His *Observations on the more ready freezing of Water that has been boiled*, published in the Philosophical Transactions for 1774, was also called for; and his *Analysis of the Waters of some Boiling Springs in Iceland*, made at the request of his friend T. I. Stanley, Esq. was read to the Royal Society of Edinburgh, and published by the council. And these are the only works of his which have appeared in print.

The aspect of Dr Black was comely and interesting. His countenance exhibited that pleasing expression of inward satisfaction, which, by giving ease to the beholder, never fails to please. His manner was unaffected and graceful. He was affable, and readily entered into conversation, whether serious or trivial. He was a stranger to none of the elegant accomplishments of life. He had a fine musical ear, with a voice which would obey it in the most perfect manner; for he sung, and performed on the flute, with great taste and feeling, and could sing a plain air at sight, which many instrumental performers cannot do. Without having studied drawing, he had acquired a considerable power of expressing with his pencil, and seemed in this respect to have the talents of a history painter. Figure indeed of every kind attracted his attention. Even a retort, or a crucible, was to his eye an example of beauty or deformity.

He had the strongest claim to the appellation of a man of propriety and correctness. Every thing was done in its proper season, and he ever seemed to have leisure in store. He loved society, and felt himself beloved in it; never did he lose a single friend, except by the stroke of death.

His only apprehension was that of a long continued sick bed, less perhaps from any selfish feeling, than from the consideration of the trouble and distress which it would occasion to attending friends: and never was this generous wish more completely gratified. On the 26th Nov. 1799, and in the 71st year of his age, he expired without any convulsions, shock, or stupor, to announce or retard the approach of death. Being at table with his usual fare, some bread, a few prunes, and a measured quantity of milk diluted with water, and having the cup in his hand, when the last stroke of the pulse was to be given, he set it down on his knees which were joined together, and kept it steady with his hand in the manner of a person perfectly at ease; and in this attitude expired without spilling a drop, and without a writhe in his countenance, as if an experiment had been required to show to his friends the facility with which he departed. His servant opened the door to tell him that some one had left his name; but getting no answer, stepped about half-way towards him, and seeing him sitting in that easy posture, supporting his bason of milk with one hand, he thought that he had dropt asleep, which sometimes happened after his meals. He went back and shut the door, but before he went down stairs, some anxiety which he could not account for, made him return again and look at his master. Even then he was satisfied after coming pretty near him, and turned to go away; but returning again, and coming close up to him, he found him without life. (*Preface to Black's Lect.* by Dr Robison).

BLACK, a well known colour, supposed to be owing to the absence of light, most of the rays falling upon black substances being not reflected but absorbed by them. Concerning the peculiar structure of such bodies as fits them for appearing of this or that particular colour, see COLOUR and DYEING.

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BLACK-Act; the statute of 9 Geo. I. c. 22. is commonly called the *Waltham black act*, because it was occasioned by the devastations committed near Waltham in Essex, by persons in disguise, or with their faces blacked. By this statute it is enacted, that persons hunting armed and disguised, and killing or stealing deer, or robbing warrens, or stealing fish out of any river, &c. or any persons unlawfully hunting in his majesty's forests, &c. or breaking down the head of any fish-pond, or killing, &c. of cattle, or cutting down trees, or setting fire to house, barn, or wood, or shooting at any person, or sending letters either anonymous or signed with a fictitious name demanding money, &c. or rescuing such offenders, are guilty of felony, without benefit of clergy. This act is made perpetual by 31 Geo. II. c. 42.

BLACK-Bird. See TURDUS, ORNITHOLOGY *Index*.

BLACK-Book of the Exchequer. See EXCHEQUER.

BLACK-Books, a name given to those which treat of necromancy, or, as some call it, *negromancy*. The black-book of the English monasteries was a detail of the scandalous enormities practised in religious houses, compiled by order of the visitors under King Henry VIII. to blacken, and thus hasten their dissolution.

BLACK-Cap. See MOTACILLA, ORNITHOLOGY *Index*.

BLACK-Cock. See TETRAO, ORNITHOLOGY *Index*.

BLACK-Eagle. See FALCO, ORNITHOLOGY *Index*.

BLACK-Eunuchs, in the customs of the eastern nations, are Ethiopians castrated, to whom their princes commonly commit the care of their women. See EUNUCH.

BLACK-Forest, a forest of Germany, in Suabia, running from north to south between Ortnau, Brisgaw, part of the duchy of Wirtemberg, the principality of Fustemburg towards the source of the Danube, as far as the Rhine above Basil. It is part of the ancient Hercynian forest.

BLACK-Friars, a name given to the Dominican order; called also *predicants*, and *preaching friars*; in France, *jacobins*.

BLACK-Jack, or *Blende*, is a mineral also called *false galena*, *blinde*, &c. See BLENDE, MINERALOGY *Index*.

BLACK-Land, in *Agriculture*, a term by which the husbandmen denote a particular sort of clayey soil, which, however, they know more by its other properties than by its colour, which is rarely any thing like a true black, and often but a pale gray. This, however pale when dry, always blackens by means of rains, and when ploughed up at these seasons it sticks to the ploughshares, and the more it is wrought the muddier and duskier coloured it appears, This sort of soil always contains a large quantity of sand, and usually a great number of small white stones.

BLACK-Lead. See PLUMBAGO, MINERALOGY *Index*.

BLACK-Leather, is that which has passed the curriers hands, where, from the russet, as it was left by the tanners, it is become black, by having been scored and rubbed three times on the grain-side with copperas water. See LEATHER.

BLACK-Legs, a name given in Leicestershire to a disease frequent among calves and sheep. It is a kind of jelly which settles in their legs, and often in the neck, between the skin and flesh.

BLACK-Mail, a certain rate of money, corn, cattle, or other matter, anciently paid by the inhabitants of towns in Westmoreland, Cumberland, Northumberland, and Durham, to divers persons inhabiting on or near the borders, being men of name, and allied with others in those parts, known to be great robbers and spoil-takers; in order to be by them freed and protected from any pillage. Prohibited by 43 Eliz. c. 13. The origin of this word is much contested, yet there is ground to hold the word *black* to be here a corruption of blank or white, and consequently to signify a rent paid in a small copper coin called *blanks*. This may receive some light from a phrase still used in Picardy, where speaking of a person who has not a single halfpenny, they say, *il n' a pas une blanque maille*.

BLACK-Monks, a denomination given to the Benedictines, called in Latin *nigri monachi*, or *nigro-monachi*; sometimes *ordo nigrorum*, "the order of blacks."

BLACK-Oats. See OATS.

BLACK-Procession, in ecclesiastical writers, that which is made in black habits, and with black ensigns and ornaments. See PROCESSION. Anciently at Malta there was a black procession every Friday, where the whole clergy walked with their faces covered with a black veil.

BLACK-Rent, the same with black-mail, supposed to be rents formerly paid in provisions and flesh, not in specie.

BLACK-Rod. See ROD.

BLACK-Row Grains, a species of iron-stone or ore found in the mines about Dudley in Staffordshire.

BLACK Sea. See SUPPLEMENT.

BLACK-Sheep, in the oriental history, the ensign or standard of a race of Turcomans settled in Armenia and Mesopotamia; hence called the *dynasty of the black sheep*.

BLACK Stones and *Gems*, according to Dr Woodward, owe their colour to a mixture of tin in their composition.

BLACK-Strakes, a range of planks immediately above the wales in a ship's side. They are always covered with a mixture of tar and lamp black.

BLACK-Tin, in *Mineralogy*, a denomination given to the tin-ore when dressed, stamped, and washed ready for the blowing-house, or to be melted into metal. It is prepared into this state by means of beating and washing; and when it has passed through several buddles or washing troughs, it is taken up in form of a black powder, like fine sand, called *black-tin*.

BLACK-Wadd, in *Mineralogy*, a kind of ore of manganese, remarkable for its property of taking fire when mixed with linseed oil in a certain proportion. It is found in Derbyshire, and is used as a drying ingredient in paints; for when ground with a large quantity of oily matter it loses the property above mentioned. See MANGANESE, MINERALOGY *Index*.

BLACK-Water, the name of two rivers in Ireland; one of which runs through the counties of Cork and Waterford, and falls into Youghal bay; and the other, after watering the county of Armagh, falls into Lough Neagh.

BLACK-Whytlof, in our old writers, bread of a middle fineness betwixt white and brown, called in some parts *ravel-bread*. In religious houses, it was the bread made

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made for ordinary guests, and distinguished from their household loaf, or *panis conventualis*, which was pure manchet, or white bread.

Black-Work, iron wrought by the blacksmiths; thus called by way of opposition to that wrought by white-smiths.

BLACKALL, Dr Offspring, bishop of Exeter in the beginning of the 18th century, was born at London in 1654, and educated at Catharine-Hall, Cambridge. For two years he refused to take the oath of allegiance to King William and Queen Mary, but at last submitted to the government, though he seemed to condemn the Revolution, and all that had been done pursuant to it. He was a man of great piety, had much primitive simplicity and integrity, and a constant evenness of mind. In a sermon before the house of commons, January 30. 1699, he animadverted on Toland's assertion in his life of Milton, that Charles I. was not the writer of the *Icon Basilike*, and for some insinuations against the authenticity of the Holy Scriptures; which produced a controversy between him and that author. In 1700, he preached a course of sermons in St Paul's at Boyle's lecture, which were afterwards published; and was consecrated bishop of Exeter in 1707. He died at Exeter in 1716, and was interred in the cathedral there.

BLACKBANK, a town of Ireland, in the county of Armagh and province of Ulster, seated in W. Long. 6. 55. N. Lat. 54. 12.

BLACKBERRY, See Rubus, Botany *Index*.

BLACKBURN, a town of Lancashire in England, seated near the river Derwent. It takes its name from the brook Blackwater which runs through it. W. Long. 2. 15. N. Lat. 53. 40.

BLACKING is sometimes used for a factitious black; as lamp-black, shoe-black, &c. A mixture of ivory or lamp-black with linseed-oil makes the common oil blacking. For a shining blacking, small-beer or water is used instead of oil, in the proportion of about a pint to an ounce of the ivory-black, with the addition of half an ounce of brown sugar, and as much gum arabic. The white of an egg substituted for the gum makes the black more shining; but is supposed to hurt the leather, and make it apt to crack.

BLACKLOCK, Dr Thomas, a clergyman, was born at Annan in the south of Scotland in the year 1721. His father was a bricklayer; but though in this humble sphere of life, was of a respectable character, and not deficient in knowledge and urbanity. The son was not quite six months old when he lost his eyesight in the smallpox. This misfortune rendered him incapable of learning any of the mechanical arts; and therefore his father kept him at home, and with the assistance of some friends fostered that inclination which, at a very early period, he showed for books. This was done by reading to him first the simple sort of publications which are commonly put into the hands of children, and then several of our best authors, such as Milton, Spenser, Prior, Pope, and Addison. His companions, whom his early gentleness and kindness of disposition, as well as their compassion for his misfortune, strongly attached to him, were very assiduous in their good offices, in reading to instruct and amuse him. By their assistance he acquired some knowledge of the Latin tongue, but he never was at a grammar-school till at a more advanced period of life. Poetry was even then his favourite reading; and he found an enthusiastic delight in the works of the best English poets, and in those of his countryman Allan Ramsay. Even at an age so early as twelve he began to write poems, one of which is preserved in the collection that was published after his death, and is not perhaps inferior to any of the premature compositions of boys assisted by the best education, which are only recalled into notice by the future fame of their authors.

He had attained the age of nineteen when his father was killed by the accidental fall of a malt-kiln belonging to his son-in-law. This loss, heavy to any one at that early age, would have been, however, to a young man possessing the ordinary means of support, and the ordinary advantages of education, comparatively light; but to him—thus suddenly deprived of that support on which his youth had leaned—destitute almost of every resource which industry affords to those who have the blessings of sight—with a body feeble and delicate from nature, and a mind congenially susceptible—it was not surprising that this blow was doubly severe, and threw on his spirits that despondent gloom to which he then gave way in the following pathetic lines, and which sometimes overclouded them in the subsequent period of his life.

"Dejecting prospect! soon the hapless hour
"May come; perhaps this moment it impends,
"Which drives me forth to penury and cold,
"Naked, and beat by all the storms of heav'n,
"Friendless and guideless to explore my way;
"Till, on cold earth this poor unshelter'd head
"Reclining, vainly from the ruthless blast
"Respite I beg, and in the shock expire."

He lived with his mother for about a year after his father's death, and began to be distinguished as a young man of uncommon parts and genius. These were at that time unassisted by learning; the circumstances of his family affording him no better education than the smattering of Latin which his companions had taught him, and the perusal and recollection of the few English authors which they, or his father in the intervals of his professional labours, had read to him. Poetry, however, though it attains its highest perfection in a cultivated soil, grows perhaps as luxuriantly in a wild one. To poetry, as we have before mentioned, he was devoted from his earliest days; and about this time several of his poetical productions began to be handed about, which considerably enlarged the circle of his friends and acquaintance. Some of his compositions being shewn to Dr Stevenson, an eminent physician of Edinburgh, who was accidentally at Dumfries on a professional visit, that gentleman formed the benevolent design of carrying him to the Scotch metropolis, and giving to his natural endowments the assistance of a classical education. He came to Edinburgh in the year 1741, and was enrolled a student of divinity in the university there, though at that time without any particular view of entering into the church. In that university he continued his studies under the patronage of Dr Stevenson till the year 1745, when he retired to Dumfries, and resided in the house of Mr M'Murdo, who had married his sister, during the whole time of the civil war, which then raged in the country, and particularly

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cularly disturbed the tranquillity of the metropolis. When peace was restored to the nation, he returned to the university, and pursued his studies for six years longer. During this last residence in Edinburgh, he obtained, among other literary acquaintance, that of the celebrated Mr Hume, who attached himself warmly to Mr Blacklock's interests, and was afterwards particularly useful to him in the publication of the 4to edition of his Poems, which came out by subscription in London in the year 1756. Previously to this, two editions in 8vo had been published at Edinburgh, the first in 1746, and the second in 1754.

In the course of his education at Edinburgh, he acquired a proficiency in the learned languages, and became more a master of the French tongue than was then common in that city. For this last acquisition he was chiefly indebted to the social intercourse to which he had the good fortune to be admitted in the house of Provost Alexander, who had married a native of France. At the university he attained a knowledge of the various branches of philosophy and theology, to which his course of study naturally led, and acquired at the same time a considerable fund of learning and information in those various departments of science and belles lettres, from which his want of sight did not absolutely preclude him.

In 1757, he began a course of study, with a view to give lectures in oratory to young gentlemen intended for the bar or the pulpit. On this occasion he wrote to Mr Hume, informed him of his plan, and requested his assistance in the prosecution of it. But Mr Hume doubting the probability of its success, he abandoned the project; and then, for the first time, adopted the decided intention of going into the church of Scotland. After applying closely for a considerable time to the study of theology, he passed the usual trials in the presbytery of Dumfries, and was by that presbytery licensed a preacher of the gospel in the year 1759. As a preacher he obtained high reputation, and was fond of composing sermons, of which he has left some volumes in manuscript, as also a Treatise on Morals.

In 1762 he married Miss Sarah Johnston, daughter of Mr Joseph Johnston surgeon in Dumfries; a connexion which formed the great solace and blessing of his future life, and gave him, with all the tenderness of a wife, all the zealous care of a guardian and a friend. This event took place a few days before his being ordained minister of the town and parish of Kircudbright, in consequence of a presentation from the crown, obtained for him by the earl of Selkirk, a benevolent nobleman, whom Mr Blacklock's situation and genius had interested in his behalf. But the inhabitants of the parish, whether from that violent aversion to patronage, which was then so universal in the southern parts of Scotland, from some political disputes which at that time subsisted between them and his noble patron, or from those prejudices which some of them might naturally enough entertain against a pastor deprived of sight, or perhaps from all these causes united, were so extremely disinclined to receive him as their minister, that after a legal dispute of nearly two years, it was thought expedient by his friends, as it had always been wished by himself, to compromise the matter, by resigning his right to the living, and accepting a moderate annuity in its stead. With this slender provision he removed in 1764 to Edinburgh; and to make up by his industry a more comfortable and decent subsistence, he adopted the plan of receiving a certain number of young gentlemen as boarders into his house, whose studies in languages and philosophy he might, if necessary, assist. In this situation he continued till the year 1787, when he found his time of life and state of health required a degree of quiet and repose which induced him to discontinue the receiving of boarders. In 1767 the degree of doctor in divinity was conferred on him by the university and Marischal college of Aberdeen.

In the occupation which he thus exercised for so many years of his life, no teacher was perhaps ever more agreeable to his pupils, nor master of a family to its inmates, than Dr Blacklock. The gentleness of his manners, the benignity of his disposition, and that warm interest in the happiness of others which led him so constantly to promote it, were qualities that could not fail to procure him the love and regard of the young people committed to his charge; while the society, which esteem and respect for his character and his genius often assembled at his house, afforded them an advantage rarely to be found in establishments of a similar kind.

In this mixed society he appeared to forget the privation of sight, and the melancholy which it might at other times produce in his mind. He entered, with the cheerful playfulness of a young man, into all the sprightly narrative, the sportful fancy, and the humorous jest that arose around him. Next to conversation, music was perhaps the source of his greatest delight; for he not only relished it highly, but was himself a tolerable performer on several instruments, particularly the flute. He generally carried in his pocket a small *flageolet*, on which he played his favourite tunes; and was not displeased when asked in company to play or to sing them; a natural feeling for a blind man, who thus adds a scene to the drama of his society.

Of the happiness of others, however, we are incompetent judges. Companionship and sympathy bring forth those gay colours of mirth and cheerfulness which they put on for a while, to cover perhaps that sadness which we have no opportunity of witnessing. Of a blind man's condition we are particularly liable to form a mistaken estimate; we give him credit for all those gleams of delight which society affords him, without placing to their full account those dreary moments of darksome solitude to which the suspension of that society condemns him. Dr Blacklock had from nature a constitution delicate and nervous, and his mind, as is almost always the case, was in a great degree subject to the indisposition of his body. He frequently complained of a lowness and depression of spirits, which neither the attention of his friends, nor the unceasing care of a most affectionate wife, were able entirely to remove. The imagination we are so apt to envy and admire, serves but to irritate this disorder of the mind; and that fancy in whose creation we so much delight, can draw, from sources unknown to common men, subjects of disgust, disquietude, and affliction. Some of his latter poems express a chagrin, though not of an ungentle sort, at the supposed failure of his imaginative powers, or at the fastidiousness of modern times, which he despaired to please.

 "Such

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Blacklock, Blackmore.

"Such were his efforts, such his cold reward,
"Whom once thy partial tongue pronounc'd a bard;
"Excursive, on the gentle gales of spring,
"He rov'd, whilst favour imp'd his timid wing;
"Exhausted genius now no more inspires,
"But mourns abortive hopes and faded fires;
"The short-liv'd wreath, which once his temple grac'd,
"Fades at the sickly breath of squeamish taste;
"Whilst darker days his fainting flames immure
"In cheerless gloom and winter premature."

These lines are, however, no proof of "exhausted genius," or "faded fires." "Abortive hopes," indeed, must be the lot of all who, like Dr Blacklock, reach the period of old age. In early youth, the heart of every one is a poet; it creates a scene of imagined happiness and delusive hopes; it clothes the world in the bright colours of its own fancy; it refines what is coarse, it exalts what is mean; it sees nothing but disinterestedness in friendship, it promises eternal fidelity in love. Even on the distresses of its situation it can throw a certain romantic shade of melancholy, that leaves a man sad, but does not make him unhappy. But at a more advanced age, "the fairy visions fade," and he suffers most deeply who has indulged them the most.

About the time that these verses were written, Dr Blacklock was, for the first time, afflicted with what to him must have been peculiarly distressful. He became occasionally subject to deafness, which, though he seldom felt it in any great degree, was sufficient, in his situation, to whom the sense of hearing was almost the only channel of communication with the external world, to cause very lively uneasiness. Amidst these indispositions of body, however, and disquietudes of mind, the gentleness of his temper never forsook him, and he felt all that resignation and confidence in the Supreme Being which his earliest and his latest life equally acknowledged. In summer 1791 he was seized with a feverish disorder, which at first seemed of a slight, and never rose to a very violent kind; but a frame so little robust as his was not able to resist it, and after about a week's illness it carried him off on the 7th day of July of that year.

Dr Blacklock's writings consist chiefly of poems, of which an edition in 4to was published in 1793. To that edition was added, an Essay on the Education of the Blind, translated from the French of M. Hauy. He was also the author of the article BLIND in the last edition of this work.

BLACKMORE, SIR RICHARD, a physician, and voluminous writer of theological, poetical, and physical works. Having declared himself early in favour of the Revolution, King William, in 1697, chose him one of his physicians in ordinary, and conferred the honour of knighthood on him. On Queen Anne's accession, Sir Richard was also appointed one of her physicians, and continued so for some time. Dryden and Pope treated the poetical performances of Blackmore with great contempt; and in a note to the mention made of him in the Dunciad, we are informed that his "indefatigable muse produced no less than six epic poems; Prince and King Arthur, 20 books; Eliza, 10; Alfred, 12; The Redeemer, 6; beside Job, in folio; the whole book of Psalms; The Creation, seven books; Nature of Man, three books; and many more." But notwithstanding Blackmore was much ridiculed by the wits, he is not without merit; and Addison has, in the Spectator, bestowed some liberal commendations on his poem on the Creation. It must be mentioned, too, in honour of Sir Richard, that he was a chaste writer, and a warm advocate for virtue, at a time when an almost universal degeneracy prevailed. He had been very free in his censures on the libertine writers of his age; and it was owing to some liberty he had taken of this kind, that he drew upon him the resentment of Mr Dryden. He had likewise given offence to Mr Pope; for having been informed by Mr Curl that he was the author of a travestie on the first Psalm, he took occasion to reprehend him for it in his Essay on Polite Learning. Besides what are above mentioned, Sir Richard wrote some theological tracts, and several treatises on the plague, small-pox, consumptions, the spleen, gout, dropsy, &c. and many other poetical pieces. He died October 9. 1729.

Blackmore, Blackstone.

BLACKNESS, the quality of a black body; or a colour arising from such a texture and situation of the superficial parts of the body as does, as it were, deaden, or rather absorb, the light falling upon it, without reflecting any, or very little of it, to the eye.—In which sense, *blackness* stands directly opposed to *whiteness*; which consists in such a texture of parts as indifferently reflects all the rays thrown upon it, of what colour soever they be.

Des Cartes, says Dr Priestley, though mistaken with respect to the nature of light and colours, yet distinguishes justly between black and white; observing, that black suffocates and extinguishes the light that falls upon it, but that white reflects it. See BLACK.

BLACKS, in *Physiology*. See NEGROES.

BLACKS, is also a name given to an association of disorderly and ill-designing persons, formerly herding chiefly about Waltham in Essex, who destroyed deer, robbed fish-ponds, ruined timber, &c. See *Black-Act*.

BLACKSTONE, SIR WILLIAM, an eminent English lawyer, was born at London, in July 1723. His father, Mr Charles Blackstone, a silk-man, citizen, and bowyer of London, died some months before the birth of our author, who was the youngest of four children: and their mother died before he was 12 years old. Even from his birth, the care both of his education and fortune was kindly undertaken by his maternal uncle Mr Thomas Bigg, an eminent surgeon in London, and afterwards on the death of his elder brothers, owners of the Chilton estate, which is still enjoyed by that family. In 1730, being about seven years old, he was put to school at the Charter-house; and in 1735 was, by the nomination of Sir Robert Walpole, on the recommendation of Charles Wither of Hall in Hampshire, Esq. his cousin by the mother's side, admitted upon the foundation there. In this excellent seminary he applied himself to every branch of youthful education, with the same assiduity which accompanied his studies through life. His talents and industry rendered him the favourite of his masters, who encouraged and assisted him with the utmost attention: so that at the age of 15 he was at the head of the school, and although so young, was thought well qualified to be removed to the university. He was accordingly entered a commoner at Pembroke college

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Blackstone.

lege in Oxford, on the 30th of November 1738, and was the next day matriculated. At this time he was elected to one of the Charter-house exhibitions by the governors of that foundation, to commence from the Michaelmas preceding; but was permitted to continue a scholar there till after the 12th of December, being the anniversary commemoration of the founder, to give him an opportunity of speaking the customary oration which he had prepared, and which did him much credit. About this time also he obtained Mr Benson's gold prize-medal of Milton, for verses on that poet. In the February following, the society of Pembroke college unanimously elected him to one of Lady Holford's exhibitions for Charter-house scholars in that house. Here he prosecuted his studies with unremitting ardour; and although the classics, and particularly the Greek and Roman poets, were his favourites, they did not entirely engross his attention: logic, mathematics, and the other sciences, were not neglected. At the early age of 20, he compiled a treatise entitled *Elements of Architecture*, intended for his own use only, and not for publication; but esteemed by those judges who have perused it, in no respect unworthy his maturer judgment and more exercised pen.

Having determined on his future plan of life, and made choice of the law for his profession, he was entered in the Middle Temple on the 20th of November 1741. He now found it necessary to quit the more amusing pursuits of his youth, for the severer studies to which he had dedicated himself; and betook himself seriously to reading law. He expressed his disagreeable sensations on this occasion in a copy of verses, since published by Dodsley in vol. iv. of his miscellanies, entitled *The Lawyer's Farewell to his Muse;* in which the struggle of his mind is expressed so strongly, so naturally, with such elegance of sense and language, and harmony of versification, as must convince every reader that his passion for the muses was too deeply rooted to be laid aside without much reluctance; and that, if he had pursued that flowery path, he would perhaps have proved inferior to few of our English poets. Several little fugitive pieces besides this, have at times been communicated by him to his friends; and he left (but not with a view of publication) a small collection of juvenile pieces, both originals and translations, inscribed with this line from Horace,

Nec lusisse pudet, sed non incidere ludum.

Some notes on Shakespeare, which just before his death he communicated to Mr Steevens, and which were inserted by him in his last edition of that author, show how well he understood the meaning, as well as the beauties, of that his favourite among the English poets.

In November 1743, he was elected into the society of All-Soul's college; and in the November following, he spoke the anniversary speech in commemeration of Archbishop Chicheley the founder, and the other benefactors to that house of learning, and was admitted actual fellow. From this period he divided his time between the university and the Temple, where he took chambers in order to attend the courts: in the former he pursued his academical studies, and on the 12th of June 1745 commenced bachelor of civil law: in the latter he applied himself closely to his profession, both in the hall and in his private studies, and on the 28th of November 1746 was called to the bar. Though he was little known or distinguished in Westminster hall, he was actively employed during his occasional residence at the university, in attending to its interests, and mingling with and improving its interior concerns. In May 1749, as a small reward for his services, and to give him further opportunities of advancing the interests of the college, Mr Blackstone was appointed steward of their manors. And in the same year, on the resignation of his uncle Seymour Richmond, Esq. he was elected recorder of the borough of Wallingford in Berkshire, and received the king's approbation on the 30th of May. The 26th of April 1750, he commenced doctor of civil law, and thereby became a member of the convocation, which enabled him to extend his views beyond the narrow circle of his own society, to the general benefit of the university at large. In the summer 1753, he took the resolution of wholly retiring to his fellowship and an academical life, still continuing the practice of his profession as a provincial counsel.

His Lectures on the Laws of England appear to have been an early and favourite idea; for in the Michaelmas term, immediately after he quitted Westminster-hall, he entered on the province of reading them at Oxford; and we are told by the author of his life, that even at their commencement, such were the expectations formed from the acknowledged abilities of the lecturer, they were attended by a very crowded class of young men of the first families, characters, and hopes; but it was not till the year 1758, that the lectures in the form they now bear were read at the university. Mr Viner having by his will left not only the copyright of his abridgment, but other property to a considerable amount, to the university of Oxford, to found a professorship, fellowships, and scholarships of common law, he was on the 20th October 1758 unanimously elected Vinerian professor; and on the 25th of the same month read his first introductory lecture, which he published at the request of the vice-chancellor and heads of houses, and afterwards prefixed to the first volume of his Commentaries. His lectures now had gained such universal applause, that he was requested by a noble personage who superintended the education of our present sovereign, then prince of Wales, to read them to his royal highness; but as he was at that time engaged to a numerous class of pupils in the university, he thought he could not, consistently with that engagement, comply with this request, and therefore declined it. But he transmitted copies of many of them for the perusal of his royal highness; who, far from being offended at an excuse grounded on so honourable a motive, was pleased to order a handsome gratuity to be presented to him. It is doubtful whether the Commentaries were originally intended for the press; but many imperfect and incorrect copies having got abroad, and a pirated edition of them being either published, or preparing for publication in Ireland, the learned lecturer thought proper to print a correct edition himself; and in November 1765 published the first volume under the title of *Commentaries on the Laws of England;* and in the course of the four succeeding years, the remaining parts of this admirable work.

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Blackstone, Blackwall.

work. It ought to be remarked, that before this period the reputation his lectures deservedly acquired him had induced him to resume his practice in Westminster-hall; and in a course somewhat inverted from the general progress of his profession, he who had quitted the bar for an academic life, was sent back from the college to the bar, with a considerable increase of business. He was likewise elected into parliament, first for Hindon, and afterwards for Westbury in Wilts; but in neither of these departments did he equal the expectations his writings had raised. The part he took in the Middlesex election drew upon him the attack of some persons of ability in the senate, and likewise a severe animadversion of one of the keenest polemical writers* in the paper war of that day. This circumstance probably strengthened the aversion he professed to parliamentary attendance; "where, (he said) amidst the rage of contending parties, a man of moderation must expect to meet with no quarter from any side:" and when, on the resignation of Mr Dunning in 1770, he was offered the place of solicitor-general, he refused that office; but shortly afterwards, on the promotion of Sir Joseph Yates to a seat in the court of common-pleas, accepted a seat on the bench, and by the death of Sir Joseph succeeded him there also. As a judge, he was not inactive; but, when not occupied in the duties of his station, was generally engaged in some scheme of public utility. The act for detached houses for hard labour for convicts, as a substitute for transportation, owed its origin in a great measure to him.

* *Junius.*

It ought not to be omitted, that the last augmentation of the judges salaries, calculated to make up the deficiencies occasioned by the heavy taxes they are subject to, and thereby render them more independent, was obtained in a great measure by his industry and attention. This respectable and valuable man died on the 14th of February 1780, in the 50th year of his age.

BLACKWALL, Anthony, A. M. a learned author, after completing his academical education at Emanuel college, Cambridge, was appointed head master of the free school at Derby, and lecturer of All-hallows there, where he first distinguished himself in the literary world by an edition of Theognis, printed at London in 1706, and was afterwards head master of the free school at Market-Bosworth in Leicestershire. The grammar whereby he initiated the youth under his care into Latin, was of his own composing, and so happily fitted for the purpose, that he was prevailed on to make it public, though his modesty would not permit him to fix his name to it, because he would not be thought to prescribe to other instructors of youth. It is entitled, "A New Latin Grammar; being a short, clear, and easy introduction of young Scholars to the Knowledge of the Latin Tongue; containing an exact Account of the two first Parts of Grammar." In his "Introduction to the Classics," first published in 1718, 12mo, he displayed the beauties of those admirable writers of antiquity, to the understanding and imitation even of common capacities; and that in so concise and clear a manner, as seemed peculiar to himself. But his greatest and most celebrated work was, "The sacred Classics defended and illustrated; or, An Essay humbly offered towards preserving the Purity, Propriety, and True Eloquence of the Writers of the New Testament," in 2 vols. Mr Blackwall had the felicity to bring up many excellent scholars in his seminaries at Derby and Bosworth; among others, the celebrated Richard Dawes, author of the *Miscellanea Critica*. A gentleman who had been his scholar, being patron of the church of Clapham in Surrey, presented him to that living as a mark of his gratitude and esteem. This happening late in life, and Blackwall having occasion to wait upon the bishop of the diocese, he was somewhat pertly questioned by a young chaplain as to the extent of his learning. "Boy (replied the indignant veteran), I have forgot more than ever you knew!" He died at Market-Bosworth, April 8. 1730.

Blackwall, Blackwell.

BLACKWELL, Thomas, an eminent Scottish writer, was son of a minister at Aberdeen, and born there 1701. He had his grammatical learning at a school in Aberdeen, studied Greek and philosophy in the Marischal college there, and took the degree of M. A. in 1718. Being greatly distinguished by uncommon parts, and an early proficiency in letters, he was, Dec. 1723, made Greek professor in the college where he had been educated; and continued to teach that language with applause even to his death. In 1737, was published at London, but without his name, "An Enquiry into the Life and Writings of Homer," 8vo; a second edition of which appeared in 1736; and not long after, "Proofs of the Enquiry into Homer's Life and Writings," which was a translation of the Greek, Latin, Spanish, Italian, and French notes, subjoined to the original work. In 1748, he published "Letters concerning Mythology," 8vo; without his name also. The same year, he was made principal of the Marischal college in Aberdeen, and is the only layman who hath been appointed principal of that college, since the patronage came to the crown, by the forfeiture of the Marischal family, in 1716; all the other principals having been ministers of the church of Scotland. March 1752, he took the degree of doctor of laws: and the year following came out the first volume of his Memoirs of the Court of Augustus, 4to. The second volume appeared in 1755; and the third, which was posthumous, and left incomplete by the author, was fitted for the press by John Mills, Esq. and published in 1764. At the same time was published a third edition of the two former volumes: Which is a proof of the good reception the work met with from the public; though it must be acknowledged that the parade with which it is written, and the peculiarity of its language, exposed it to some severity of censure.

Soon after he became principal of his college, he married a merchant's daughter of Aberdeen, by whom he had no children. Several years before his death, his health began to decline: his disorder was of the consumptive kind, and thought to be forwarded by an excess of abstemiousness which he imposed upon himself. His disease increasing, he was advised to travel, and accordingly set out in Feb. 1757; however, he was not able to go farther than Edinburgh, in which city he died the 8th of March following, in his 56th year. He was a very ingenious and very learned man: he had an equable flow of temper, and a truly philosophic spirit,

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spirit, both which he seems to have preserved to the last; for on the day of his death he wrote to several of his friends.

BLACKWELL, *Alexander*, son of a dealer in knit-hose, at Aberdeen, where he received a liberal education, studied physic under Boerhaave at Leyden, took the degree of M. D. and acquired a proficiency in the modern languages. On his return home, happening to stay some time at the Hague, he contracted an intimacy with a Swedish nobleman. Marrying a gentleman's daughter in the neighbourhood of Aberdeen, he proposed practising his profession in that part of the kingdom; but in two years finding his expectations disappointed, he came to London, where he met with still less encouragement as a physician, and commenced corrector of the press for Mr Wilkins a printer. After some years spent in this employment, he set up as a printer himself: and carried on several large works till 1734, when he became bankrupt. In what manner he subsisted for a considerable time after this event we do not learn, unless it was by the ingenuity of his wife, who published "A curious Herbal, containing 500 Cuts of the most useful Plants which are now used in the Practice of Physic, engraved on folio Copperplates, after Drawings taken from the Life, by Elizabeth Blackwell. To which is added a short Description of the Plants, and their common Uses in Physic, 1739," 2 vols. folio. In or about the year 1740 he went to Sweden, and renewing his intimacy with the nobleman he knew at the Hague, again assumed the medical profession, and was very well received in that capacity; till turning projector, he laid a scheme before his Swedish majesty for draining the fens and marshes, which was well received, and many thousands employed in prosecuting it under the doctor's direction, from which he had some small allowance from the king. This scheme succeeded so well, he turned his thoughts to others of greater importance, which in the end proved fatal to him. He was suspected of being concerned in a plot with Count Tessin, and was tortured; which not producing a confession, he was beheaded August 9. 1748; and soon after this event appeared "A genuine Copy of a Letter from a merchant in Stockholm to his correspondent in London; containing an Impartial Account of Doctor Alexander Blackwell, his Plot, Trial, Character, and Behaviour, both under Examination and at the Place of Execution; together with a copy of a Paper delivered to a Friend upon the Scaffold." He possessed a good natural genius, but was somewhat flighty and a little conceited. His conversation, however, was facetious and agreeable; and he might be considered on the whole as a well-bred accomplished gentleman.

BLADDER, in *Anatomy*, a thin expanded membranous body, found in several parts of an animal, serving as a receptacle of some juice, or of some liquid excrement; from whence it takes various denominations, as *urine-bladder*, *gall-bladder*, &c.

BLADDER, by way of eminence, is a large vessel which serves as a receptacle of the urine of animals, after its secretion from the blood in the kidneys. This is sometimes also called, by way of distinction, the *urinary bladder*, *vesica urinaria*. The bladder is situated in the pelvis of the abdomen; in men immediately on the rectum; in women on the vagina uteri. See ANATOMY *Index*.

Though the urinary bladder be naturally single, yet there have been instances of nature's varying from herself in this particular. The bladder of the famous Casaubon, upon dissecting his body after his death, was found to be double; and in the Philosophical Transactions, we have an account of a triple bladder found in the body of a gentleman who had long been ill and no one could guess the cause.

The urinary bladders of brutes are differently contrived from the human bladder, and from each other according to the structure, economy, and manners of living of each creature. See ANATOMY *Index*.

Bladders, when below a certain magnitude, are more usually denominated by the diminutive vesicles, *vesiculæ*. Of these we meet with many sorts both in the animal and vegetable world; some natural, as in the lungs, especially of frogs, and, as some also imagine, in the muscles; others morbid or preternatural, as the *hydatides*, and those observable in the itch. Naturalists have also discovered bladders in the thorax and abdomen of birds, as well as others in the belly of fishes, called *air-bladders*, and *swims*.

Vegetable bladders are found everywhere in the structure of the bark, the fruit, pith, and *parenchyma* or pulp; besides those morbid ones raised on the surface of leaves by the puncture of insects.

BLADDER-Nut. See STAPHYLÆA, BOTANY *Index*.

BLADDER-Senna. See COLUTEA, BOTANY *Index*.

BLADE, in commerce, a thin slender piece of metal, either forged by the hammer or run and cast in moulds, to be afterwards sharpened to a point, edge, or the like.

Sword-blades are made by the armourers, knife-blades by the cutlers, &c. The English and Damascus blades are most esteemed; among the French, those of Vienne in Dauphiny have the preference. The conditions of a good blade of a small sword are, that it be light and tough, apter to bend than break. When it will stand in the bend, it is called *a poor man's blade*.

BLADEN, MARTIN, a translator and dramatic author, was formerly an officer in the army, bearing the commission of a lieutenant-colonel in Queen Anne's reign, under the great duke of Marlborough, to whom he dedicated a translation of Cæsar's Commentaries, which he had completed, and which is to this day a book held in good estimation. In 1714, he was made one of the Lords Commissioners of Trade and Plantations; and in 1717 was appointed envoy extraordinary to the court of Spain, in the room of —— Brett, Esq. but declined it, choosing rather to keep the post he already had, which was worth 1000l. per annum, and which he never parted with till his death, which was in May 1746. He was also many years member of parliament for the town of Portsmouth. He wrote two dramatic pieces; both of which (for the one is only a masque introduced in the third act of the other) were printed in the year 1705, without the author's consent. Their names are, 1. Orpheus and Euridice, a masque. 2. Solon, a tragic-comedy.

BLADUM, in the middle-age writers, is taken for all sort of standing corn in the blade and ear. The word is also written *blatum*, *blava*, and *blavium*.

In our old charters, the word *bladum* included the whole

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whole product of the ground, fruit, corn, flax, grass, &c. and whatever was opposed to living creatures. It was sometimes also applied to all sorts of grain or corn thrashed on the floor. But the word was more peculiarly appropriated to bread-corn, or wheat, called in French *blé*. Thus the knights templars are said to have granted to Sir Wido de Meriton's wife *duas summas bladi*.

BLAEU, William, a famous printer of Amsterdam, a disciple and friend of Tycho Brahe's: his Atlas, his Treatises of the Globes, Astronomical Institutions, &c. and his fine impressions, have secured his memory. He died in 1638.

BLAFART, in commerce, a small coin, current at Cologne, worth something more than a farthing of our money.

BLAGRAVE, John, the second son of John Blagrave of Bulmarsh-court near Sunning in Berkshire, descended of an ancient family in that county. From a grammar school at Reading he was sent to St John's college in Oxford, where he applied himself chiefly to the study of mathematics, and without taking any degree, afterwards retired to his patrimonial seat of Southcole-lodge near Reading, where he spent the remainder of his life. In this mansion he died in the year 1611; and was buried in the church of St Lawrence, where a sumptuous monument was erected to his memory. Having never married, he bequeathed to all the posterity of his three brothers, the sum of 50l. each, payable at the age of 26; and he calculated his donation so well, that near fourscore of his nephews and their descendants have reaped the benefit of it. He also settled certain lands at Swallowfield in the same county, as a provision for the poor for ever. Among other charities, he left ten pounds to be annually disposed of in the following manner: On Good Friday, the church-wardens of each of the three parishes of Reading send to the town-hall *one virtuous maid, who has lived five years with her master*: there, in the presence of the magistrates, these three virtuous maids throw dice for the ten pounds. The two losers are returned with a fresh one the year following, and again the third year, till each has had three chances. He is said to have been not more remarkable for his mathematical knowledge than for his candour and generosity to his acquaintance. His works are, 1. *A mathematical jewel*. Lond. 1585, fol. 2. *Of the making and use of the familiar staff*. Lond. 1590, 4to. 3. *Astrolabium uranicum generale*. Lond. 1596, 4to. 4. *The art of dialing*. Lond. 1609, 4to.

BLAIN, among farriers, a distemper incident to beasts, being a certain bladder growing on the root of the tongue against the windpipe, which swells to such a pitch as to stop the breath. It comes by great chafing and heating of the stomach, and is perceived by the beast's gaping and holding out his tongue, and foaming at the mouth. To cure it, cast the beast, take forth his tongue, and then, slitting the bladder, wash it gently with vinegar and a little salt.

BLAIR, Dr Hugh, a distinguished clergyman of the church of Scotland, was born in Edinburgh in 1718. His father, John Blair, was a merchant in that city, and grandson of the famous Mr Robert Blair, minister of St Andrew's, and chaplain to King Charles I.; and one of the most distinguished clergymen of the period in which he lived. The views of Dr Blair, from his earliest youth, were turned toward the church, and his education received a suitable direction. After the usual grammatical course at school, he entered the humanity class in the university of Edinburgh, in October 1730, and spent eleven years at that celebrated seminary, assiduously employed in the literary and scientific studies prescribed by the church of Scotland to all who are to become candidates for her license to preach the gospel. During this important period he was distinguished among his companions both for diligence and proficiency; and obtained from the professors under whom he studied repeated testimonies of approbation. One of them deserves to be mentioned particularly, because in his own opinion it determined the bent of his genius toward polite literature. An essay, Πεϱι του καλου, *On the Beautiful*, written by him when a student of logic in the usual course of academical exercises, had the good fortune to attract the notice of Professor Stevenson, and, with circumstances honourable to the author, was appointed to be read in public at the conclusion of the session. This mark of distinction made a deep impression on his mind; and the essay which merited it he ever after recollected with partial affection, and preserved to the day of his death as the first earnest of his fame.

At this time Dr Blair commenced a method of study which contributed much to the accuracy and extent of his knowledge, and which he continued to practise occasionally even after his reputation was fully established. It consisted in making abstracts of the most important works which he read, and in digesting them according to the train of his own thoughts. History, in particular, he resolved to study in this manner; and, in concert with some of his youthful associates, he constructed a very comprehensive scheme of chronological tables for receiving into its proper place every important fact that should occur. The scheme devised by this young student for his own private use was afterwards improved, filled up, and given to the public, by his learned friend Dr John Blair, prebendary of Westminster, in his valuable work, "Chronology and History of the World."

In the year 1739, Dr Blair took his degree of A.M. On that occasion he printed and defended a thesis, *De Fundamentis et Obligatione Legis Naturæ*, which contains a short but masterly discussion of this important subject, and exhibits, in elegant Latin, an outline of the moral principles which have been since more fully unfolded and illustrated in his Sermons.

The university of Edinburgh, about this period, numbered among her pupils many young men who were soon to make a distinguished figure in the civil, the ecclesiastical, and the literary history of their country. With most of them Dr Blair entered into habits of intimate connection, which no future competition or jealousy occurred to interrupt, which held them united through life in their views of public good, and which had the most beneficial influence on their own improvement, on the progress of elegance and taste among their contemporaries, and on the general interests of the community to which they belonged.

On the completion of his academical course, he underwent the customary trials before the presbytery of Edinburgh, and received from that venerable body a license

Blair.

license to preach the gospel on the 21st of October 1741. His public life now commenced with very favourable prospects. The reputation which he brought from the university was fully justified by his first appearance in the pulpit; and, in a few months, the fame of his eloquence procured for him a presentation to the parish of Colessie in Fife, where he was ordained to the office of the holy ministry on the 23d of September 1742. But he was not permitted to remain long in this rural retreat. A vacancy in the second charge of the Canongate of Edinburgh furnished to his friends an opportunity of recalling him to a station more suited to his talents. And, though one of the most popular and eloquent clergymen in the church was placed in competition with him, a great majority of the electors decided in favour of this young orator, and restored him, in July 1743, to the bounds of his native city.

In this station Dr Blair continued eleven years, discharging with great fidelity and success the various duties of the pastoral office. His discourses from the pulpit in particular attracted universal admiration. They were composed with uncommon care; and occupying a middle place between the dry metaphysical discussion of one class of preachers, and the loose incoherent declamation of another, they blended together, in the happiest manner, the light of argument with the warmth of exhortation, and exhibited captivating specimens of what had hitherto been rarely heard in Scotland—the polished, well-compacted, and regular didactic oration.

In consequence of a call from the town-council and general session of Edinburgh, he was translated from the Canongate to Lady Yesters, one of the city churches, on the 11th of October 1754: and on the 15th of June 1758, he was promoted to the High Church of Edinburgh, the most important ecclesiastical charge in the kingdom. To this charge he was raised at the request of the lords of council and session, and of the other distinguished official characters, who have their seats in that church. And the uniform prudence, ability, and success, which, for a period of more than forty years, accompanied all his ministerial labours in that conspicuous and difficult station, sufficiently evince the wisdom of their choice.

Hitherto his attention seems to have been devoted almost exclusively to the attainment of professional excellence, and to the regular discharge of his parochial duties. No production of his pen had yet been given to the world by himself, except two sermons preached on particular occasions; some translations, in verse, of passages of Scripture, for the psalmody of the church; and a few articles in the Edinburgh Review, a publication begun in 1755, and conducted for a short time by some of the ablest men in the kingdom. But standing as he now did at the head of his profession, and released by the labour of former years from the drudgery of weekly preparation for the pulpit, he began to think seriously on a plan for teaching to others that art which had contributed so much to the establishment of his own fame. With this view, he communicated to his friends a scheme of Lectures on Composition; and having obtained the approbation of the university, he began to read them in the college on the 11th of December 1759. To this undertaking he brought all the qualifications requisite for executing it well; and along with them a weight of reputation which could not fail to give effect to the lessons he should deliver. For beside the testimony given to his talents by his successive promotions in the church, the university of St Andrews, moved chiefly by the merit of his eloquence, had, in June 1757, conferred on him the degree of D. D. a literary honour which at that time was very rare in Scotland. Accordingly his first course of lectures was well attended, and received with great applause. The patrons of the university, convinced that they would form a valuable addition to the system of education, agreed in the following summer to institute a rhetorical class, under his direction, as a permanent part of their academical establishment; and on the 7th of April 1762, his majesty was graciously pleased "To erect and endow a professorship of rhetoric and belles lettres in the university of Edinburgh, and to appoint Dr Blair, in consideration of his approved qualifications, regius professor thereof, with a salary of 70l." These lectures he published in 1783, when he retired from the labours of the office; and the general voice of the public has pronounced them to be a most judicious, elegant, and comprehensive system of rules for forming the style, and cultivating the taste of youth.

About the time in which he was occupied in laying the foundations of this useful institution, he had an opportunity of conferring another important obligation on the literary world, by the part which he acted in rescuing from oblivion the poems of Ossian. It was by the solicitation of Dr Blair and Mr John Home that Mr Macpherson was induced to publish his *Fragments of Ancient Poetry;* and their patronage was of essential service in procuring the subscription which enabled him to undertake his tour through the Highlands, for collecting the materials of Fingal, and of those other delightful productions which bear the name of Ossian. To these productions Dr Blair applied the test of genuine criticism; and soon after their publication gave an estimate of their merits in a *Dissertation*, which, for beauty of language, delicacy of taste, and acuteness of critical investigation, has few parallels. It was printed in 1763, and spread the reputation of its author throughout Europe.

The great objects of his literary ambition being now attained, his talents were for many years consecrated solely to the important and peculiar employments of his station. It was not till the year 1777, that he could be induced to favour the world with a volume of the sermons which had so long furnished instruction and delight to his own congregation. But this volume being well received, the public approbation encouraged him to proceed; three other volumes followed at different intervals; and all of them experienced a degree of success of which few publications can boast. They circulated rapidly and widely, wherever the English tongue extends; they were soon translated into almost all the languages of Europe; and his present majesty, with that wise attention to the interests of religion and literature which distinguishes his reign, was graciously pleased to judge them worthy of a public reward. By a royal mandate to the exchequer in Scotland, dated the 25th of July 1780, a pension of 200l. a-year was conferred on their author, which continued unaltered till his death.

The motives which gave rise to the fifth volume are

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Blair.

are sufficiently explained by himself in his address to the reader. The sermons which it contains were composed at very different periods of his life; but they were all written out anew in his own hand, and in many parts recomposed, during the course of the summer 1800, after he had completed his eighty-second year. They were delivered to the publishers about six weeks before his death in the form and order in which they now appear. And it may gratify his readers to know that the last of them which he composed, though not the last in the order adopted for publication, was the sermon on *a Life of Dissipation and Pleasure*—a sermon written with great dignity and eloquence, and which should be regarded as his solemn parting admonition to a class of men whose conduct is highly important to the community, and whose reformation and virtue he had long laboured most zealously to promote.

The sermons which he has given to the world are universally admitted to be models in their kind; and they will long remain durable monuments of the piety, the genius, and sound judgment of their author. But they formed only a small part of the discourses he prepared for the pulpit. The remainder modesty led him to think unfit for the press: and, influenced by an excusable solicitude for his reputation, he left behind him an explicit injunction that his numerous manuscripts should be destroyed. The greatness of their number was creditable to his professional character, and exhibited a convincing proof that his fame as a public teacher had been honourably purchased by the most unwearied application to the private and unseen labours of his office. It rested on the uniform intrinsic excellence of his discourses in point of matter and composition, rather than on foreign attractions; for his delivery, though distinct, serious, and impressive, was not remarkably distinguished by that magic charm of voice and action which captivates the senses and imagination, and which in the estimation of superficial hearers, constitutes the chief merit of a preacher.

In that department of his professional duty which regarded the government of the church, Dr Blair was steadily attached to the cause of moderation. From diffidence, and perhaps from a certain degree of inaptitude for extemporary speaking, he took a less public part in the contests of ecclesiastical politics than some of his cotemporaries; and, from the same causes, he never would consent to become moderator of the general assembly of the church of Scotland. But his influence among his brethren was extensive: his opinion, guided by that sound uprightness of judgment which formed the predominant feature of his intellectual character, had been always held in high respect by the friends with whom he acted, and for many of the last years of his life it was received by them almost as a law. The great leading principle in which they cordially concurred with him, and which directed all their measures, was to preserve the church on the one side from a slavish corrupted dependence on the civil power, and on the other from a greater infusion of democratical influence than is compatible with good order, and the established constitution of the country.

The reputation which he acquired in the discharge of his public duties was well sustained by the great respectability of his private character. Deriving from family associations a strong sense of clerical decorum, feeling on his heart deep impressions of religious and moral obligation, and guided in his intercourse in the world by the same correct and delicate taste which appeared in his writings, he was eminently distinguished through life, by the prudence, purity, and dignified propriety of his conduct. His mind, by constitution and culture, was admirably formed for enjoying happiness:—well balanced in itself by the nice proportion and adjustment of its faculties, it did not incline him to any of those eccentricities, either of opinion or of action, which are too often the lot of genius; free from all tincture of envy, it delighted cordially in the prosperity and fame of his companions; sensible to the estimation in which he himself was held, it disposed him to dwell at times on the thought of his success with a satisfaction which he did not affect to conceal; inaccessible alike to gloomy and to peevish impressions, it was always master of its own movements, and ready, in an uncommon degree, to take an active and pleasing interest in every thing, whether important or trifling, that happened to become for the moment the object of his attention. This habit of mind, tempered with the most unsupecting simplicity, and united to eminent talents and inflexible integrity, while it secured to the last his own relish of life, was wonderfully calculated to endear him to his friends, and to render him an invaluable member of any society to which he belonged. Indeed few men have been more universally respected by those who knew him, more sincerely esteemed in the circle of his acquaintance, or more tenderly beloved by those who enjoyed the blessings of his private and domestic connection.

In April 1748, he married his cousin Catharine Bannatine, daughter of the Rev. James Bannatine, one of the ministers of Edinburgh. By her he had a son who died in infancy, and a daughter who lived to her twenty-first year, the pride of her parents, and adorned with all the accomplishments that became her age and sex. Mrs Blair herself, a woman of great good sense and spirit, was also taken from him a few years before his death, after she had shared with the tenderest affection in all his fortunes, and contributed near half a century to his happiness and comfort.

Dr Blair had been naturally of a feeble constitution of body; but as he grew up his constitution acquired greater firmness and vigour. Though liable to occasional attacks from some of the sharpest and most painful diseases that afflict the human frame, he enjoyed a general state of good health; and, through habitual cheerfulness, temperance, and care, survived the usual term of human life. For some years he had felt himself unequal to the fatigue of instructing his very large congregation from the pulpit; and, under the impression which this feeling produced, he has been heard at times to say, with a sigh, 'that he was left almost the last of his cotemporaries.' Yet he continued to the end in the regular discharge of all his other official duties, and particularly in giving advice to the afflicted, who from different quarters of the kingdom solicited his correspondence. His last summer was devoted to the preparation of his fifth volume of sermons; and in the course of it he exhibited a vigour of understanding and capacity of exertion equal to that of his best days.

He began the winter pleased with himself on account of the completion of this work, and his friends were

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were flattered with the hope that he might live to enjoy the accession of emolument and fame which he expected it would bring. But the seeds of a mortal disease were lurking unperceived within him. On the 24th of December 1800, he complained of a pain in his bowels, which, during that and the following day, gave him but little uneasiness; and he received as usual the visits of his friends. On the afternoon of the 26th, the symptoms became violent and alarming: He felt that he was approaching the end of his appointed course: and retaining to the last moment the full possession of his mental faculties, he expired on the morning of the 27th, with the composure and hope which became a Christian pastor.

Blair, *John*, a Scottish author, was cotemporary with, and the companion, some say the chaplain, of Sir William Wallace. He attended that great hero in almost all his exploits: and, after his death, which left so great a stain on the character of Edward I. of England, he wrote his memoirs in Latin. The injury of time has destroyed this work, which might have thrown the greatest light on the history of a very busy and remarkable period. An inaccurate fragment of it only has descended to us, from which little can be learned, and which was published, with a commentary, by Sir Robert Sibbald.

Blair, *James*, an eminent divine, was born and bred in Scotland, where he had at length a benefice in the episcopal church; but meeting with some discouragements, he came to England in the latter end of the reign of King Charles II. and was sent by Dr Compton as a missionary to Virginia, and was afterwards, by the same bishop, made commissary for that colony, the highest office in the church there. He distinguished himself by his exemplary conduct and unwearied labours in the work of the ministry; and finding that the want of proper seminaries for the advancement of religion and learning was a great damp upon all attempts for the propagation of the gospel, he formed a design of erecting and endowing a college at Williamsburgh, in Virginia, for professors and students in academical learning. He therefore not only set on foot a voluntary subscription; but, in 1693, came to England to solicit the affair at court: when Queen Mary was so well pleased with the noble design, that she espoused it with particular zeal; and King William readily concurring with her majesty, a patent was passed for erecting and endowing a college by the name of the *William and Mary college*, of which Mr Blair was appointed president, and enjoyed that office near 50 years. He was also rector of Williamsburgh, and president of the council in that colony. He wrote, Our Saviour's divine Sermon on the Mount explained, in several sermons, 4 vols. octavo; and died in 1743.

Blair, *John*, an eminent chronologist, was educated at Edinburgh; and coming to London was for some time usher of a school in Hedge-Lane. In 1754, he presented to the world that valuable publication, "The Chronology and History of the World, from the Creation to the year of Christ 1753. Illustrated in LVI. Tables; of which four are introductory and contain the centuries prior to the first Olympiad; and each of the remaining LII. contains in one expanded view 50 years, or half a century." This volume, which is dedicated to Lord Chancellor Hardwicke, was published by subscription, on account of the great expence of the plates, for which the author apologized in his preface, where he acknowledged great obligations to the earl of Bath, and announced some chronological dissertations, wherein he proposed to illustrate the disputed points, to explain the prevailing systems of chronology, and to establish the authorities upon which some of the particular eras depend. In January 1755, he was elected a fellow of the Royal Society; and in 1761 of the Society of Antiquaries. In 1756 he published a second edition of his "Chronological Tables." In September 1757, he was appointed chaplain to the princess dowager of Wales, and mathematical tutor to the duke of York; and on Dr Townshend's promotion to the deanery of Norwich, the services of Dr Blair were rewarded, March 10. 1761, with a prebendal stall at Westminster. The vicarage of Hinckley happening to fall vacant six days after, by the death of Dr Morris, Dr Blair was presented to it by the dean and chapter of Westminster; and in August that year he obtained a dispensation to hold with it the rectory of Burton Coggles in Lincolnshire. In September 1763 he attended his royal pupil the duke of York in a tour to the continent; had the satisfaction of visiting Lisbon, Gibraltar, Minorca, most of the principal cities in Italy, and several parts of France, and returned with the duke in August 1764. In 1768 he published an improved edition of his "Chronological Tables," which he dedicated to the princess of Wales, who had expressed her early approbation of the former edition. To the new edition were annexed, "Fourteen Maps of Ancient and Modern Geography, for illustrating the Tables of Chronology and History. To which is prefixed a Dissertation on the Progress of Geography." In March 1771, he was presented by the dean and chapter of Westminster to the vicarage of St Bride's in the city of London; which made it necessary for him to resign Hinckley, where he had never resided for any length of time. On the death of Mr Sims, in April 1776, he resigned St Bride's, and was presented to the rectory of St John the Evangelist in Westminster; and in June that year obtained a dispensation to hold the rectory of St John with that of Horton, near Colebrooke Bucks. His brother Captain Blair falling gloriously in the service of his country in the memorable sea-fight of April 12. 1782, the shock accelerated the Doctor's death. He had at the same time the influenza in a severe degree, which put a period to his life, June 24. 1782. His library was sold by auction December 11-13th, 1782; and a course of his "Lectures on the Canons of the Old Testament" hath since been advertised as intended for publication by his widow.

Blair of Athol, a castle belonging to the duke of Athol, seated in a district of the same name, in Perthshire in Scotland. W. Long. 3. 30. N. Lat. 56. 46. This castle was besieged by the Highland army in 1746; and bravely defended by Sir Andrew Agnew, who was reduced to eat horse's flesh, until he was relieved by the Hessians under the earl of Crawford.

BLAISE, a military order instituted by the kings of Armenia, in honour of St Blaise, anciently bishop of Sebasta in that country, the patron saint of that nation.

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Justinian calls them knights of St Blaise and St Mary, and places them not only in Armenia, but in Palestine. They made a particular vow to defend the religion of the church of Rome, and followed the rule of St Basil. The precise year of the institution of the knights of St Blaise is not known; but they appear to have commenced about the same time with the knights Templars and Hospitallers; to the former of which they bore a near affinity, the regulars being the same in both.

BLAISOIS, a late province of France, bounded on the north by Beauce, on the east by the Orleannois, on the south by Berry, and on the west by Touraine. It now forms the department of Loire and Cher. Blois is the capital town.

BLAKE, Robert, a famous English admiral, born August 1589 at Bridgewater in Somersetshire, where he was educated at the grammar-school. He went from thence to Oxford in 1615, where he was entered at St Alban's Hall. From thence he removed to Wadham college; and on the 10th of February 1617, he took the degree of bachelor of arts. In 1623, he wrote a copy of verses on the death of Mr Camden, and soon after left the university. He was tinctured pretty early with republican principles, and disliking that severity with which Dr Laud, then bishop of Bath and Wells, pressed uniformity in his diocese, he began to fall into the puritanical opinions. His natural bluntness causing his principles to be well known, the puritan party returned him member for Bridgewater in 1640; and he served in the parliament army with great courage during the civil war: but when the king was brought to trial, he highly disapproved the measure as illegal, and was frequently heard to say, *he would as freely venture his life to save the king, as ever he did to serve the parliament.* But this is thought to have been chiefly owing to the humanity of his temper, since after the death of the king he fell in wholly with the republican party, and, next to Cromwell, was the ablest officer the parliament had.

In 1648-9, he was appointed, in conjunction with Colonel Dean and Colonel Popham, to command the fleet; and soon after blocked up Prince Maurice and Prince Rupert in Kinsale harbour. But these getting out, Blake followed them from port to port: and at last attacked them in that of Malaga, burnt and destroyed their whole fleet, two ships only excepted, the Reformation in which Prince Rupert himself was, and the Swallow commanded by his brother Prince Maurice. In 1652, he was constituted sole admiral; when he defeated the Dutch fleet commanded by Van Tromp, Ruyter, and de Wit, in three several engagements, in which the Dutch lost 11 men of war, 30 merchant ships, and according to their own accounts, had 1500 men slain. Soon after Blake and his colleagues, with a grand fleet of 100 sail, stood over to the Dutch coast; and forced their fleet to fly for shelter into the Texel, where they were kept for some time by Monk and Dean, while Blake sailed northward. At last, however, Tromp got out, and drew together a fleet of 120 men of war; and on the 3d of June, the generals Dean and Monk came to an engagement with the enemy off the North Foreland with indifferent success: but the next day Blake coming to their assistance with 18 ships, gained a complete victory; so that if the Dutch had not saved themselves on Calais sands, their whole fleet had been sunk or taken.

In April 1653, Cromwell turned out the parliament, and shortly after assumed the supreme power. The states hoped great advantages from this, but were disappointed. Blake said on this occasion to his officers, "It is not for us to mind state affairs, but to keep foreigners from fooling us."—In November 1654 Cromwell sent him with a strong fleet into the Mediterranean, with orders to support the honour of the English flag, and to procure satisfaction for the injuries that might have been done to our merchants. In the beginning of December, Blake came into the road of Cadiz, where he was treated with all imaginable respect; a Dutch admiral would not hoist his flag while he was there; and his name was now grown so formidable, that a French squadron having stopped one of his tenders, which had been separated from Blake in a storm, the admiral, as soon as he knew to whom it belonged, sent for the captain on board, and drank Blake's health before him with great ceremony, under a discharge of five guns, and then dismissed him. The Algerines were so much afraid of him, that, stopping the Sallee rovers, they obliged them to deliver up what English prisoners they had on board, and then sent them freely to Blake, in order to purchase his favour. This, however, did not prevent his coming on the 10th of March before Algiers, and sending an officer on shore to the dey to demand satisfaction for the piracies committed on the English, and the release of all the English captives. The dey, in his answer, alleged, that the ships and captives belonged to private men, and therefore he could not restore them without offending all his subjects, but that he might easily redeem them: and if he thought good, they would conclude a peace with him, and for the future offer no acts of hostility to the English: and having accompanied this answer with a large present of fresh provisions, Blake left Algiers, and sailed on the same errand to Tunis; the dey of which place not only refused to comply with his request, but denied him the liberty of taking in fresh water. "Here (said he), are our castles of Goletto and Porto Ferino; do your worst." Blake, at hearing this, began, as his custom was when highly provoked, to curl his whiskers; and after a short consultation with his officers, bore into the bay of Porto Ferino with his great ships and their seconds; and coming within musket-shot of the castle and the line, fired on both so warmly, that in two hours time the castle was rendered defenceless, and the guns on the works along the shore were dismounted, though 60 of them played at a time on the English. Blake found nine ships in the road, and ordered every captain to man his long boat with choice men, to enter the harbour and fire the Tuniseens; which they happily effected, with the loss of 25 men killed and 48 wounded, while he and his men covered them from the castle by playing continually on them with their great guns. This daring action spread the terror of his name through Africa and Asia. From Tunis he sailed to Tripoli, caused the English slaves to be set at liberty, and concluded a peace with that government. Thence returning to Tunis, the Tuniseens implored his mercy, and begged him to grant them peace, which he did upon terms highly advantageous to England. He next sailed to Malta, and obliged the knights to restore the effects taken

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taken by their privateers from the English; and by these great exploits so raised the glory of the English name, that most of the princes and states in Italy thought fit to pay their compliments to the Protector, by sending solemn embassies to him.

He passed the next winter either in lying before Cadiz, or in cruizing up and down the Straits: and was at his old station, at the mouth of that harbour, when he received information that the Spanish plate fleet had put into the bay of Sancta Cruz, in the island of Teneriffe: upon this he weighed anchor, with 25 men of war, on the 13th of April 1657; and on the 20th rode with his ships off the bay of Sancta Cruz, where he saw 16 Spanish ships lying in the form of a half-moon. Near the mouth of the haven stood a castle furnished with great ordnance; besides which there were seven forts round the bay, with six, four, and three guns on each, joined to each other by a line of communication manned with musketeers. To make all safe, Don Diego Diagues, general of the Spanish fleet, caused all the smaller ships to be moored close along the shore; and the six large galleons stood farther out at anchor, with their broadsides towards the sea. Blake having prepared for the fight, a squadron of ships was drawn out to make the first onset, commanded by Captain Stayner in the Speaker frigate; who no sooner received orders, than he sailed into the bay, and fell upon the Spanish fleet, without the least regard to the forts which spent their shot prodigally upon them. No sooner were these entered into the bay, but Blake, following after, placed several ships to pour broadsides into the castle and forts; and these played their parts so well, that, after some time, the Spaniards found their forts too hot to be held. In the mean time, Blake struck in with Stayner, and bravely fought the Spanish ships, out of which the enemy were beaten by two o'clock in the afternoon; when Blake, finding it impossible to carry them away, ordered his men to set them on fire; which was done so effectually, that they were all reduced to ashes, except two, which sunk downright, nothing remaining above the water but part of the masts. The English having now obtained a complete victory, were reduced to another difficulty by the wind, which blew so strong into the bay, that they despaired of getting out. They lay under the fire of the castles and of all the forts, which must in a little time have torn them to pieces. But the wind suddenly shifting, carried them out of the bay; where they left the Spaniards in astonishment at the happy temerity of their audacious victors. This is allowed to have been one of the most remarkable actions that ever happened at sea. "It was so miraculous (says the earl of Clarendon), that all men who knew the place wondered that any sober man, with what courage soever endowed, would ever have undertaken it; and they could hardly persuade themselves to believe what they had done; whilst the Spaniards comforted themselves with the belief, that they were devils and not men who had destroyed them in such a manner." This was the last and greatest action of the gallant Blake. He was consumed with a dropsy and scurvy; and hastened home, that he might yield up his last breath in his native country, which he had so much adorned by his valour. As he came within sight of land, he expired.—Never man, so zealous for a faction, was so much respected and esteemed by the opposite factions. Disinterested, generous, liberal; ambitious only of true glory, dreadful only to his avowed enemies; he forms one of the most perfect characters of that age, and the least stained with those errors and violences which were then so predominant. The Protector ordered him a pompous funeral at the public charge: but the tears of his countrymen were the most honourable panegyric on his memory. The lord Clarendon observes, "that he was the first man who brought ships to contemn castles on shore, which had ever been thought very formidable, and were discovered by him to make a noise only, and to fright those who could be rarely hurt by them. He was the first that infused that degree of courage into seamen, by making them see by experience what mighty things they could do if they were resolved; and the first that taught them to fight in fire as well as in water."

BLAMONT, a town of France, in the department of Meurthe, seated on a little river called *Vesouze*, 12 miles south of Luneville, and containing 1860 inhabitants in 1815. E. Long. 6. 51. N. Lat. 48. 35.

BLANC. See BLANK.

BLANC, a town of France, in the department of Indre, seated on the river Creuse, by which it is divided into two parts. The land about it is barren, and full of trees, heath, and lakes. Population 3850 in 1815. E. Long. 1. 13. N. Lat. 46. 38.

Mont BLANC, a stupendous mountain in Savoy, the highest of the Alps, and encompassed by those wonderful collections of snow and ice called the *Glaciers*. See ALPS.

Of these glaciers there are five, which extend almost to the plain of the vale of Chamouni, and are separated by wild forests, corn fields, and rich meadows; so that immense tracts of ice are blended with the highest cultivation, and perpetually succeed to each other in the most singular and striking vicissitude. All these several valleys of ice, which lie chiefly in the hollows of the mountains, and are some leagues in length, unite together at the foot of Mont Blanc; the highest mountain in Europe, and probably of the ancient world.

The summit of this mountain was deemed inaccessible before Dr Paccard, a physician at Chamouni, attempted to reach it in August 1786, and succeeded in the attempt. Soon after, the same undertaking was accomplished by M. de Saussure, who has published a narrative of the journey. He arrived at Chamouni, situated at the foot of the mountain, in the beginning of July 1787; but bad weather prevented him from ascending until the first of August, when he began his expedition, accompanied by a servant and eighteen guides, who carried his philosophical and other apparatus. His son was left at the Priory in Chamouni, and was employed in making meteorological observations, with which those made on the top of the mountain might be compared. Although it is scarcely six miles and three quarters in a straight line from the priory of Chamouni to the top of Mont Blanc, it requires nevertheless 18 hours to gain the summit, owing to the bad roads, the windings, and the great perpendicular height of the mountain. That he might be perfectly at liberty to pass the night on what part of the mountain he pleased, he carried a tent with him; and

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Mont Blanc.

and he and his company slept in it the first night on that eminence which is first met with, and which is on the south of the priory, and about a mile perpendicularly above the village.

Hitherto the journey was free from danger, or even difficulty; the road being either rocky or covered with grass; but thence upwards it was either wholly covered with snow, or consisted of the most slippery ice. But the second day's journey was attended with many difficulties. The ice valley on the side of the hill must be passed, in order to gain the foot of that chain of rocks bordering on the perpetual snows which cover Mont Blanc. The passage through this valley is extremely dangerous, since it is intersected with numerous wide, deep, and irregular chasms, which can only be crossed by means of bridges naturally formed of snow, and these often very slender, extended as it were over an abyss. One of the guides had almost perished here the evening before, as he with two others went to reconnoitre the road. They had the precaution to tie themselves together with a long rope, and he in the middle had the misfortune to have the snow-bridge, over the wide and deep chasm, break under him, so that he remained suspended between his two comrades. M. de Saussure and his retinue passed very near the opening through which this man had fallen, and shuddered at the danger in which the poor fellow had been involved. The difficulties they had to encounter in this valley, and the winding road they were obliged to take through it, occasioned their being three hours in crossing it, although in a straight line its breadth is not above three quarters of a mile.

After having reached the rocks, they mounted in a serpentine direction to a valley filled with snow, which runs from north to south to the foot of the highest pinnacle. The surface of the snow in this valley has numerous fissures, which penetrate so deep that their bottom is nowhere to be seen, although they are of considerable breadth. The sides of these fissures, where the snow is broken perpendicularly, afford an opportunity of observing the successive horizontal layers of snow which are annually formed.

The guides were desirous of passing the night near one of the rocks on the side of this valley; but as the loftiest of them is at least 1400 yards perpendicularly lower than the summit of the mountain, M. de Saussure was desirous of ascending higher; in consequence of which it would be necessary to encamp on the snow: but he found it difficult to convince his companions of the practicability of the plan. They imagined that during the night an intolerable cold prevailed in those heights which were eternally covered with snow, and they were seriously afraid of perishing. By proper encouragements, however, he induced them to proceed; and at four in the afternoon they arrived at the second of the three plains of snow which they had to pass. Here they encamped at the height of 3100 yards above the priory of Chamouni, and 4250 yards above the level of the sea, which is about 200 yards higher than the peak of Teneriffe. They did not proceed to the last plain, on account of the day having been far advanced; and they were also apprehensive of exposing themselves to the avalanches which are frequently tumbling from the summit of the mountain. They dug a deep hole in the snow, sufficiently wide to contain the whole company, and covered its top with the tent-cloth.

Mont Blanc.

In making this encampment, they began to experience the effects of the rarity of the atmosphere. Robust men, to whom seven or eight hours walking or rather climbing were an absolute nothing, had scarcely raised five or six shovels full of snow, before they were under the necessity of resting and relieving each other almost incessantly. One of them, who had gone back a small distance to fill a cask with some water which he had seen in one of the crevices of the snow, found himself so much disordered in his way, that he returned without the water, and passed the night in great pain. M. de Saussure, who is so much accustomed to the air of mountains as to say, "That in general I feel myself better in such air than in that of the plains, was exhausted with the fatigue of making his meteorological observations. The principal inconvenience which the thinness of the air produces, is an excessive thirst. They had no means of procuring water but by melting the snow; and the little stove which they had carried with them, afforded but a feeble supply for twenty men.

This region of the mountain presents to the view nothing but snow of the purest and most dazzling whiteness, forming a very singular contrast with the sky, which appears remarkably black.

"No living creature (says M. de Saussure) is to be seen in these desolate regions, nor is the least trace of vegetation to be discovered. It is the habitation of cold and silence! When I reflected that Dr Paccard, and his guide Jacques Balmat, who first visited these deserts, arrived here at the decline of the day, without shelter, without assistance, and wholly ignorant where or how they were to pass the night, without even the certainty that it was possible for men to exist in the places they had undertaken to visit; and yet that they were able to pursue their journey with unremitted intrepidity, I could not but admire their strength and courage. My guides were so firmly prepossessed with the fear of cold, that they shut up every aperture of the tent with the utmost exactness; so that I suffered very considerably from the heat and the vitiated air, which had become highly noxious from the breaths of so many people in a small room. I was frequently obliged, in the course of the night, to go out of the tent, in order to relieve my breathing. The moon shone with the brightest splendour, in the midst of a sky as black as ebony. Jupiter, rayed like the sun, arose from behind the mountain in the east. The light of these luminaries was reflected from the white plain or rather bason in which we were situated; and dazzling eclipsed every star except those of the first and second magnitude. At length we composed ourselves to sleep. We were, however, soon awakened by the noise of an immense mass of snow (*avalanche*) which had fallen down from the top of the mountain, and covered part of the slope over which we were to climb the next day."

As they were obliged to melt a great quantity of snow, and prepare many necessaries for their farther progress in their journey, it was late the next morning before they took their departure.

"We began our ascent (continues M. de Saussure) to the third and last plain, and then turned to the left, in our way to the highest rock, which is on the east part

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Mont Blanc.

part of the summit. The ascent is here very steep, being about 39 degrees inclined to the horizon, and bounded on each side by precipices. The surface of the snow was so hard and slippery, that our pioneers were obliged to hew out their footsteps with hatchets. Thus we were two hours in climbing a hill of about 530 yards high. Having arrived at this last rock, we turned to the westward, and climbed the last ascent, whose height is about 300 yards, and its inclination about 28 or 29 degrees. On this peak the atmosphere is so rare, that a man's strength is exhausted with the least fatigue. When we came near the top, I could not walk fifteen or sixteen steps without stopping to take breath; and I frequently perceived myself so faint, that I was under the necessity of sitting down from time to time; and in proportion as I recovered my breath, I felt my strength renewed. All my guides experienced similar sensations, in proportion to their respective constitutions. We arrived at the summit of Mont Blanc at 11 o'clock in the forenoon.

"I now enjoyed the grand spectacle which was under my eyes. A thin vapour, suspended in the inferior regions of the air, deprived me of the distinct view of the lowest and most remote objects, such as the plains of France and Lombardy; but I did not so much regret this loss, since I saw, with remarkable clearness, what I principally wished to see, viz. the assemblage of those high ridges, with the true form and situations of which I had long been desirous of becoming thoroughly acquainted. I could scarcely believe my eyes. I thought myself in a dream when I saw below my feet so many majestic peaks, especially the Needles, the Midi-Argentiere, and Géant, whose bases had proved so difficult and dangerous of access. I obtained a perfect knowledge of their proportion to, and connexion with, each other; of their form and structure: and a single view removed more doubts, and afforded more information, than whole years of study.

"While I was thus employed, my guides pitched my tent, and were fixing the apparatus for the experiments I had proposed to make on boiling water; but when I came to dispose my instruments for that purpose, I was obliged, almost at every instant, to desist from my labours, and turn all my thoughts to the means of respiration. When it is considered that the mercury in the barometer was no higher than 16 inches and a line (17.145 inches English), and that this air had consequently little more than half the density of that on the plains, the breathing must necessarily be increased, in order to cause, in a given time, the passage of a sufficient quantity of air through the lungs. The frequency of respiration increased the circulation of the blood, more especially as the arteries on the surface of the body had not the pressure they were usually accustomed to. We were all in a feverish state, as will be seen in the sequel.

"While I remained perfectly still, I experienced but little uneasiness more than a slight oppression about my heart; but, on the smallest bodily exertion, or when I fixed my attention on any object for some moments together, and particularly when I pressed my chest in the act of stooping, I was obliged to rest and pant for two or three minutes. My guides were in a similar condition. We had no appetite; and our provisions, which were all frozen, were not well calculated to excite it: nor had we any inclination for wine or brandy, which increased our indisposition, most probably by accelerating the circulation of the blood. Nothing but fresh waster relieved us; and much time and trouble were necessary to procure this article, as we could have no other than melted snow. I remained on the summit till half past three; and though I did not lose a single moment, I was not able to make all these experiments in four hours and a half, which I have frequently done in less than three on the sea-side. However, I made with great exactness those which were most essential.

"We returned much easier than I could have expected; since, in descending, we did not experience any bad effects from the compression of the thorax; our respiration was not impeded, and we were not under the necessity of resting, in order to recover our breath and strength. The road down to the first plain was nevertheless by no means agreeable, on account of the great declivity; and the sun, shining so bright on the tops of the precipices below us, made so dazzling an appearance, that it required a good head to avoid growing giddy from the prospect. We pitched our tent again on the snow, though we were more than 400 yards below our last night's encampment. I was here convinced that it was the rarity of the air, and not the fatigue of the journey, that had incommoded us on the summit of the mountain, otherwise we should not have found ourselves so well, and so able to attack our supper with a good appetite. I could now also make my meteorological observations without any inconvenience. I am persuaded that the indisposition in consequence of the rarity of the atmosphere is different in different people. For my own part I felt no inconvenience at the height of 4000 yards, or nearly two miles and a quarter; but I began to be much affected when I was higher in the atmosphere.

"The next day we found that the ice valley which we had passed on our first day's journey had undergone a considerable change from the heat of the two preceding days, and that it was much more difficult to pass than it had been in our ascent. We were obliged to go down a declivity of snow of no less than 50 degrees of inclination, in order to avoid a chasm which had happened during our expedition. We at length got down as low as the first eminence on the side about half after nine, and were perfectly happy to find ourselves on a foundation which we were sure would not give way under our feet."

From the narrative, we learn, that the summit of the mountain is a ridge nearly horizontal, lying east and west: the slope at each extremity is inclined from 28 to 30 degrees, the south side between 15 and 20, and the north about 45 or 50. This ridge is so narrow as scarcely to allow two people to walk abreast, especially at the west end, where it resembles the roof of a house. It is wholly covered with snow; nor is any bare rock to be seen within 150 yards of the top. The surface of the snow is scaly, and in some places covered with an icy crust, under which the snow is dusty, and without inconsistence. The highest rocks are all granites; those on the east side are mixed with steatites; those on the south and the west contain a large quantity of schoerl, and a little *lapis corneus*. Some of them, especially those on the east, which are about 150 yards below

low the summit, seem to have been lately shivered with lightning.

M. de Saussure saw no animals on the mountain, except two butterflies, which he supposes must have been driven thither by the wind. Lichens are the only vegetables which are found on the more elevated parts of these mountains; the *silene acaulis*, which grows in great quantities on the lower parts, disappears at the height of about two miles above the level of the sea.

M. de Saussure has given us the height of the barometer on the top of Mont Blanc, August 3. at noon, 16 inches, 0 lines, and $\frac{144}{188}$ of a line, French measure (i. e. 16.181 English); and Reaumur's thermometer was 2.3 below the freezing point. M. Sennebier, at the same time, observed at Geneva the barometer 27.2$\frac{1085}{1800}$ (29.020 inches English); and the thermometer 22.6 above freezing. From these data he makes the height of Mont Blanc 2218 toises, or 14180 English feet (about 2½ miles), according to M. de Luc's rule; and 2272 toises, or 14525 English feet, according to M. Trembley's. To these heights 13 toises, or 83 feet, the height of M. Sennebier's room above the lake of Geneva must be added, to give the height of the mountain above the level of the lake, 14263 feet according to M. de Luc, and 14608 feet according to M. Trembley. Sir George Shuckburgh made the height of Mont Blanc, by trigonometrical measurement, 14429 feet above the lake, which is almost the mean between the other two. The result of the observations made at Chamouni, contemporary with those on Mont Blanc, agrees still nearer with Sir George's measurement. The general mean result makes the summit of Mont Blanc 2450 toises, 14973 English feet, or three miles nearly, above the level of the sea.

M. de Saussure found by his electrometer, that the electricity of the air on the summit of the mountain was positive. Water boiled at 68.993 degrees of a thermometer, which rises to 80 with the barometer 27 French inches high. The wind was north, and extremely piercing on the summit; but, southward of the ridge, the temperature of the air was agreeable. The experiments with lime-water, and with the caustic alkali, show that the air was mixed with carbonic acid or fixed air. See ATMOSPHERE.

BLANC-Manger, Fr. *q. d.* white food, is a preparation of dissolved isinglass, milk, sugar, cinnamon, &c. boiled into a thick consistence, and garnished for the table with blanched almonds. It is cooling and strengthening.

BLANCARDS, a name given to certain linen-cloths, thus called, because the thread used to weave them has been half blanched or bleached before it was used. They are manufactured in Normandy, particularly in the places which are in the district or under the jurisdiction of Pont-Audemer, Bernay, and Lisieux.

BLANCH-FERME, or *Blank farm*, a white farm, that is, where the rent was to be paid in silver, not in cattle. In ancient times, the crown rents were many times reserved to be paid in *libris albis*, called *blanch firmes*: in which case the buyer was holden *dealbare firmam*, viz. his base money or coin, worse than standard, was melted down in the exchequer, and reduced to the fineness of standard silver; or instead thereof he paid to the king 12d. in the pound by way of addition.

BLANCH-Holding, in *Law*, a tenure by which the vassal is only bound to pay an elusory yearly duty to his superior merely as an acknowledgment of his right. See LAW.

BLANCHARD, JAMES, an excellent painter, was born at Paris, and learnt the rudiments of his profession under Nicholas Bolleri his uncle; but left him at 20 years of age, and travelled into Italy. He staid two years at Rome, and from thence went to Venice, where he was so charmed with the works of Titian, Tintoret, and Paul Veronese, that he resolved to follow their manner; and in this he succeeded so far, that at his return to Paris he soon became generally esteemed for the novelty, beauty, and force of his pencil. He painted two galleries at Paris, one belonging to Perault, the first president, and the other to Bullion, superintendant of the finances; but his capital piece is a picture of the descent of the Holy Ghost, in the church of Notre Dame. He was seized in the flower of his age, with a fever and imposthume in the lungs, of which he died in 1683. Of all the French painters Blanchard was esteemed the best colourist, he having carefully studied this part of painting in the Venetian school.

Carte-BLANCHE. See CARTE.

BLANCHING, the art or manner of making any thing white. See BLEACHING.

BLANCHING of Iron Plates, is performed with aquafortis and tin.

BLANCHING of Woollen Stuffs, is done with soap, chalk, or sulphur. See BLEACHING *Index*.

BLANCHING of Silk, is performed with soap and brimstone.

BLANCHING of Wax, is by exposing it to the sun and dew. See BLEACHING *Index*.

BLANCHING, in coinage, the operation performed on the planchets, or pieces of silver, to give them the requisite lustre and brightness. They also blanch pieces of plate, when they would have them continue white, or have only some parts of them burnished.—Blanching, as is now practised, is performed by heating the pieces on a kind of peel with a wood fire, in the manner of a reverberatory; so that the flame passes over the peel. The pieces being sufficiently heated and cooled again, are put successively to boil in two pans, which are of copper: in these they put water, common salt, and tartar of Montpelier. When they have been well drained of this water in a copper sieve, they throw sand and fresh water over them; and when dry, they are well rubbed with towels.

BLANCHING, among gardeners, an operation whereby certain salads, roots, &c. are rendered whiter than they would otherwise be.—It is thus: After pruning off the tops and roots of the plants to be blanched, they plant them in trenches about ten inches wide, and as many deep, more or less as is judged necessary; as they grow up, care is taken to cover them with earth, within four or five inches of their tops: this is repeated from time to time, for five or six weeks; in which time they will be fit for use, and of a whitish colour where covered by the earth.

BLANCHING also denotes the operation of covering iron plates with a thin coat or crust of tin. See LATTEN.

BLANCO,

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BLANCO, a cape or promontory of Africa, in the Atlantic ocean. W. Long. 18. 30. N. Lat. 20. 0.

BLANCO, a promontory of Peru in South America, in the South sea. W. Long. 81. 10. N. Lat. 11. 50.

BLANDA, in *Ancient Geography*, a Roman city in the territory of Barcino in Hispania Citerior: Now *Blanes*, a sea-port town of Catalonia, situated near the river Tordara. E. Long. 3. 40. N. Lat. 41. 30.

BLANDFORD, a town of Dorsetshire in England. It is pleasantly situated on the river Store near the Downs, but has been subject to several dreadful fires, particularly in 1731, when almost the whole town was burnt down; but it has since been rebuilt finer than before. It has the title of a marquisate, and contained 2425 inhabitants in 1811. W. Long. 2. 15. N. Lat. 50. 50.

BLANDONONA, in *Ancient Geography*, a small city of Liguria in Italy: Now *Bron* or *Broni*. See that article.

BLANES. See BLANDA.

BLANK, or BLANC, in a general sense, signifies white; and *Blancus*, or *Blanca*, is more particularly used for a kind of white or silver money, of base alloy, coined by Henry V. in those parts of France then subject to England, valued at 8d. sterling. They were forbidden by his successor to be current in this realm. In some ancient charters they are called *solidi blanci, white shillings*.

BLANK also denotes a small copper coin, formerly current in France, at the rate of five deniers Tournois. They had also great blanks, or pieces of three blanks, and others of six, in respect whereof the single sort were called little blanks: but of late they are all become only moneys of account.

BLANK, or *BLANK-Ticket*, in lotteries, that to which no prize is allotted. The French have a game, under the denomination *blanque*, answering to our lottery.

BLANK, in coinage, a plate, or piece of gold or silver, cut and shaped for a coin, but not yet stamped.

BLANK-Bar, in *Law*, is used for the same with what we call a *common bar*, and is the name of a *plea in bar*, which in an action of trespass is put in to oblige the plaintiff to assign the certain place where the trespass was committed.

BLANKS, in judicial proceedings, certain void spaces sometimes left by mistake. A blank (if something material be omitted) in a declaration abates the same: and such a blank is a good cause of demurrer.

BLANK-Verse, in the modern poetry, that composed of a certain number of syllables, without the assistance of rhime. See POETRY, Part iii.

Point BLANK. See *POINT-Blank*.

BLANKENBURG, a town of Germany, in the circle of Westphalia and duchy of Berg. E. Long. 7. 18. N. Lat. 50. 54.

BLANKENBURG, a town of Germany, in the circle of Lower Saxony, and capital of the county of the same name, subject to the duke of Brunswic-Wolfenbuttle. The castle or palace is a modern building, and is the residence of the princess dowager. E. Long. 11. 20. N. Lat. 51. 50.

BLANKENHEIM, a small territory of Germany with the title of a county, which is part of that of Eyffel, near the archbishopric of Cologn and duchy of Juliers.

BLANKET, in *Commerce*, a warm woolly sort of stuff, light and loose woven, chiefly used in bedding. The manufacture of blankets is chiefly confined to Witney in Oxfordshire, where it is advanced to that height, that no other place comes near it. Some attribute a great part of the excellency of the Witney blankets to the abstersive nitrous water of the river Windrush, wherewith they are scoured; others rather think they owe it to a peculiar way of loose spinning which the people have thereabouts. Be this as it will, the place has engrossed almost the whole trade of the nation for this commodity; insomuch that the wool fit for it centres here from the furthermost parts of the kingdom. Blankets are made of felt-wool, i. e. wool from off sheep-skins, which they divide into several sorts. Of the head wool and bay wool they make blankets of twelve, eleven, and ten quarters broad; of the ordinary and middle sort, blankets of eight and seven quarters broad; of the best tail wool, blankets of six quarters broad, commonly called *cuts*, serving for seamen's hammocks. See HYKES.

Tossing in a BLANKET, a ludicrous kind of punishment, of which we find mention in the ancients under the denomination *sagatio*. Martial describes it geographically enough. *Ibis ab excusso, missus ad astra, sago.* A late writer represents it as one of Otho's imperial delights. But this is turning the tables: that emperor's diversion, as related by Suetonius, was not to be the subject, but the agent, in the affair: it being his practice to stroll out in dark nights, and where he met with a helpless or drunken man, to give him the discipline of the blanket.

BLANKOF, JOHN TEUNISZ, a painter of great abilities, was born at Alkmaar in 1628; and received his earliest instruction from Arent Tierling: but afterwards he was successively the disciple of Peter Scheyenburg and Cæsar Van Everdingen. When he had spent some years with these masters, he went to Rome, where during his continuance in that city, he was studiously diligent in copying the works of the best masters, and was admitted into the society of Flemish painters called *Bentvogels*, who gave him the name of *Jan Maat* (which in Dutch signifies mate or companion), and by that name he is most generally known. His subjects were landscapes, with views of rivers or sea shores, havens or ports, which he executed with a light free pencil; and in the representation of storms and calms (as nature was always his model) he described those subjects with great truth, exactness, and neatness of handling. The pictures of this master which are most commended are the Italian sea ports, with vessels lying before them. He possessed a lively imagination; nor was his hands less expeditious than his thoughts: and the connoisseurs agreed in opinion, that if he had bestowed more labour on his pictures than he usually did, or if he had finished them more highly, he would certainly have destroyed a great deal of their spirit, force, and effect. His most capital performance is a view of the sea shore, with the waves retiring at ebb tide; which is described by Houbraken as being wonderfully beautiful and natural. He died in 1670.

BLANQUILLE, in *Commerce*, a small silver coin current in the kingdom of Morocco, and all that part of the coast of Barbary; it is worth about three halfpence of our money.

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BLARE, in *Commerce*, a small copper coin of Bern, nearly of the same value with the ratz.

BLAREGNIES, a town of the Netherlands, in the province of Hainault, seated in E. Long. 3. 35. N. Lat. 50. 30. Near this place the English and their allies under the duke of Marlborough obtained a very bloody victory over the French in 1709. This is most commonly called the *battle of Malplaquet*. See MALPLAQUET.

BLASE, bishop of Sebasta in Cappadocia, in the second and third centuries, suffered death under Dioclesian by decapitation, after being whipped and having his flesh torn with iron combs. He is a person of great note among the vulgar, who in their processions relative to the woollen trade, always carry a representation of him as the inventor or patron of the art of wool-combing; though that art must have been known long before his time. It is difficult to say how the invention came to be attributed to him; but it had probably no better origin than the circumstance of his being tortured by instruments used in combing of wool.

BLASIA, LEATHER-CUP. See BOTANY *Index*.

BLASPHEMY (*blasphemia*, or *blasphemium*), in middle-age writers, denotes simply the blaming or condemning of a person or thing. The word is Greek, βλασφημια, from βλαπτω, *lædo*. Among the Greeks to blaspheme was to use words of evil omen, or that portended something ill, which the ancients were careful to avoid, substituting in lieu of them other words of softer and gentler import, sometimes the very reverse of the proper ones.

BLASPHEMY is more peculiarly restrained to evil or reproachful words spoken of the Deity. Augustine says, *Jam vulgo blasphemia non accipitur nisi mala verba de Deo dicere*.

According to Lindwood, blasphemy is an injury offered to God, by denying that which is due and belonging to him; or attributing to him what is not agreeable to his nature. By the Mosaic law, blasphemy was punished with death; Levit. xxiv. ver. 13—16. As also by the civil law; Novel. 77. In Spain, Naples, France, and Italy, the pains of death are not now inflicted. In the empire, neither amputation or death is made the punishment of this crime.

By the canon law, blasphemy was punished only by a solemn penance; and by custom either by a pecuniary or corporal punishment. By the English laws, blasphemies of God, as denying his being or providence, and all contumelious reproaches of Jesus Christ, &c. are offences by the common law, and punishable by fine, imprisonment, and pillory. And, by the statute law, he that denies one of the persons in the Trinity, or asserts there are more than one God, or denies Christianity to be true, for the first offence is rendered incapable of any office; for the second, adjudged incapable of suing, being executor or guardian, receiving any gift or legacy, and to be imprisoned for three years.

According to the law of Scotland, the punishment of blasphemy is death. The first species thereof consists in railing at or cursing God; and here the single act constitutes the crime. The second consists in denying the existence of the Supreme Being, or any of the persons of the Trinity; and therein obstinately persevering to the last. For reiterated denial does not fully constitute the crime, because the stat. of Charles II. 1661, admits of repentance before conviction, as a complete expiation.

This statute of 1661 is ratified by a statute of King William, whereby the calling in question the existence of God, or of any of the persons of the Trinity, or the authority of Scripture, or the Divine Providence, is made penal: For the first offence, imprisonment till satisfaction given by public repentance in sackcloth; for the second, a fine of a year's valued rent of the real estate, and twentieth part of the personal estate; and the trial in both these cases is competent to inferior judges. The trial of the third offence is death, to be tried only by the justices.

BLASPHEMY against the Holy Ghost. Divines are not agreed with respect to the nature of the crime thus denominated (Mat. chap. xii. ver. 31.), and the grounds of the extreme guilt ascribed to it. Dr Tillotson maintains, that it consisted in maliciously attributing the miraculous operations which Christ performed by the power of the Holy Ghost to the devil. Dr Whitby refers it to the dispensation of the Holy Ghost, which commenced after our Lord's resurrection and ascension; and those were guilty of the crime who persisted in their unbelief and blasphemed the Holy Ghost, representing him as an evil spirit. The crime was unpardonable, because it implied a wilful opposition to the last and most powerful evidence which God would vouchsafe to mankind, and preclude the possibility of a recovery to faith and repentance.

BLAST, *flatus*, in the military art, a sudden compression of the air caused by the discharge of the bullet out of a great gun. The blast sometimes throws down part of the embrasures of the wall.

BLAST is also applied in a more general sense to any forcible stream of wind or air, excited by the mouth, bellows, or the air.

BLAST is also used in agriculture and gardening, for what is otherwise called a *blight*.

Blasts or blastings are by some supposed owing to cold; by others to the want of a due supply of sap; by others to ascending fumes of the earth; by others to sharp winds and frosts, immediately succeeding rains. That species called *uredines* or *fire-blasts*, is supposed by Mr Hales owing to the solar rays reflected from or condensed in the clouds, or even collected by the dense steams in hop-gardens and other places. The effect of them is to wither, shrivel, scorch, turn black, and as it were burn up the leaves, blossoms, and fruits of trees, shrubs, herbs, grass, corn, even for whole tracts of ground.

Physicians also speak of a kind of blasts affecting human bodies, and causing erysipelas, palsies, &c.

BLASTS, among miners. See DAMPS.

BLASTED, something struck with a blast. Among the Romans, places blasted with lightning were to be consecrated to Jupiter, under the name of *bidentalia* and *putealia*. It was also a ceremonial of religion to burn blasted bodies in the fire.

BLASTING, among miners, a term for the tearing up rocks, which they find in their way, by gunpowder. The method of doing which is this: they make a long hole like the hollow of a large gun-barrel in the rock they would split; this they fill with gunpowder; they then firmly stop up the mouth of the hole

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hole with clay, except a touch-hole, at which they leave a match to fire it. A small quantity of powder suffices. See BLASTING, SUPPLEMENT.

BLATOBULGIUM, in *Ancient Geography*, (Antonine); a place of the Brigantines in Britain, having a camp of exploratores or scouts near Solway frith and promontory; now called *Bulness*, (Camden).

BLATTA, or COCKROACH. See ENTOMOLOGY *Index*.

BLATTARIÆ, (from *Blatta*, a moth or little worm), the title of Scopoli's 12th natural class, in his Flora Carniolica. It is taken from the *Blattaria*, which was Tournefort's generic name for the verbascum of Linnæus. See VERBASCUM.

BLAUBEUREN, a town of Germany, in the circle of Suabia, and kingdom of Wirtemberg. E. Long. 9. 57. N. Lat. 48. 22.

BLAVET, a sea-port town of Brittany in France, situated at the mouth of a river of the same name. It is one of the stations of the navy of France, and is sometimes called *Port Lewis*. W. Long. 3. 5. N. Lat. 47. 40.

BLAVIA, or BLAVIUM, in *Ancient Geography*, a town of Aquitain, on the bank of the Garonne, below its confluence with the Dordogne: Now *Blaye;* which see.

BLAYE, an ancient and strong town of France, in the department of Gironde. It is situated on the river Gironde, has a harbour much frequented by foreigners, and the ships which sail to Bourdeaux are obliged to leave their guns here. The river is 3800 yards broad at Blaye; for which reason a battery was built upon an island in 1689, to command the vessels that sail up. The city is built on a rock, and has a citadel with four bastions, which is called the *Upper Town*. The lower town is separated from the upper by a small river; and in the lower town the merchants reside with their magazines. The neighbourhood produces a great deal of corn. The town contained 4700 inhabitants in 1815. W. Long. 1. 23. N. Lat. 45. 6.

BLAZE, a white spot in a horse's face.

BLAZONING, or BLAZONRY, in *Heraldry*, the decyphering the arms of noble families. The word originally signified the blowing or winding of a horn; and was introduced into heraldry as a term denoting the description of things borne in arms, with their proper significations and intendments, from an ancient custom the heralds, who were judges, had of winding a horn at justs and tournaments, when they explained and recorded the atchievements of knights. See HERALDRY.

BLEA, in the anatomy of plants, the inner rind or dry bark. See PLANTS.

BLEACHING.

1. BLEACHING, or BLANCHING, (*Blanchiment*, Fr.) originally signifies the art of whitening any substance by other means than painting; but it is more particularly applied to a branch of trade or manufacture exercised by persons called *bleachers*, who, by certain processes of a chemical nature, give to woollen, linen, and cotton stuffs, &c. the greatest degree of *whiteness* of which they are susceptible.

2. Till lately this art had not occupied any considerable share of attention, except to those who were more immediately concerned in the practice of it. Its processes were few, and though exceedingly tedious, were simple and easily understood. The late rapid progress of chemical science, has however thrown so much light on the theory of the art, and contributed so materially to the improvement of its processes, that it is become a most pleasing field of investigation, and demands a much more considerable space in a modern encyclopædia than it has hitherto obtained.

3. We propose, therefore, to treat of bleaching in the following article more fully, and more in detail, than is usually done, and to bring, as far as possible, into one point of view, every thing of importance which has been lately written on the subject by Berthollet, De Charmes, Rupp, Kirwan, Higgins, Chaptal, O'Reilly, and other eminent chemists.

4. The improvements made by these gentlemen have been so rapid in their succession, and so important in their consequences, as to have rather created a new art than ameliorated the old. It will hereafter be scarcely credible, that in the space of about twenty years, the whole of an ancient system of bleaching, which had prevailed from time immemorial, should have been entirely overturned, and replaced by one of the most scientific accuracy, and expeditious management.

5. The origin of this art, like that of many others which are subservient to the comforts or conveniences of man, is involved in great obscurity. We find that a desire for rich and brilliant colours, and for garments of the purest white, has prevailed in civilized society from the earliest periods of which we have any accounts. This was more particularly the case in the eastern countries, as appears from the earliest writers, both of sacred and profane history. It is, however, probable, that the art of dyeing was antecedent to that of bleaching; but the effects of the sun and air in whitening garments, and in discharging the less permanent colours imprinted by the dyer, which must have been very observable in those climates, would soon lead an ingenious people to imitate or increase the action of the atmosphere, and turn to advantage as a luxury what in many cases must have been considered as an inconvenience. Of the methods employed by the ancients in whitening or scouring their various stuffs we are almost entirely ignorant; we know, however, that the Egyptians were accustomed to use some kinds of clay for these purposes, and that they availed themselves of the bleaching powers of the atmosphere. Pliny informs us, that a plant to which he gives the name *radicula*, was employed for scouring wool *; this is probably the same with what we call *soapwort*. The acrid juice of some species of euphorbia, especially the peplus, is said to have been used in France for whitening linen.

* Plin. lib. xix. c. 3.

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6. The art of bleaching is very extensive, and comprehends a variety of objects, whether we consider it as a distinct branch of trade, or as an art called in to the assistance or completion of several of our manufactures. It is essential to the perfection of the linen, the cotton, the silken, the woollen manufacture; it is in many cases a necessary step in preparing stuffs for the dyer and the calico-printer; and to it the paper-maker and the wax-chandler are indebted for the beauty of their productions. To this art belong the scouring of clothes and stuffs, the removal of colours, spots, and stains, the cleaning of books and prints.

7. We shall in the following pages describe the various methods employed to answer these several purposes, and shall endeavour to trace the steps by which bleaching has arrived at the high degree of perfection which it has lately attained. In detailing the processes of the artist, we shall, however, avoid as much as possible his technical language, so as to render this article not only a useful assistant to the practical bleacher, but an interesting object to the philosophic chemist.

8. As the methods of bleaching animal and vegetable substances are different, we may properly divide this article into two parts; in the first of which we shall describe the processes for bleaching wool and silk, and in the second the methods employed in the bleaching of linen, cotton, paper, and other materials furnished by vegetables.

PART I. BLEACHING OF ANIMAL SUBSTANCES.

9. THE substances which are derived from the animal kingdom, and which we more particularly employ as articles of clothing, differ essentially from those which are the produce of vegetables. The art of bleaching depends very much on an exact knowledge of those peculiar characters, which form the line of separation between these two classes of bodies, and it is therefore of importance to him who is desirous not only to be master of the several processes in this art, but to understand the theory of the subject, to be acquainted with the nature and properties of each.

10. The animals from whose spoils we obtain our principal clothing are nourished by vegetables, which as they pass through their organs lose their former properties, and acquire others more akin to animal bodies. In particular they are found to contain a new element, *azote*, which is but sparingly found in the vegetable kingdom, but constitutes one of the most abundant products of animal bodies. They also contain *sulphur* and *phosphorus*, as appears from the examination of those pestilential exhalations which always accompany the decomposition of animal matters.

11. It is found that animal matters are more easily separated into their component principles than vegetable, owing to the weaker degree of their mutual attraction. Hence the action of acids and alkalies is much more violent on the former than on the latter, and consequently much more caution is requisite in their employment.

12. In bleaching animal substances recourse must be had to the united action of the fixed alkalies, soap, ammonia or volatile alkali, and sulphurous acid, the choice, preparation, and uses of which will be presently described. The animal matters with which the bleacher is more immediately concerned are wool and silk.

CHAP. I. *Of Wool.*

13. WOOL, like hair, of which it is a variety, is composed of filaments or tubes filled with a substance of an oily nature. The surrounding surface of these tubes is pierced with an infinite number of small holes which communicate with the internal cavity. By chemical analysis wool is found to contain carbonat of ammonia, and a considerable quantity of oil. It is very little altered by exposure to the air, and undergoes no change from the action of boiling water. It is of great consequence that the bleacher should attend to this circumstance, as will appear immediately.

14. A solution of caustic alkali, or caustic ley, destroys it altogether, and forms with it a soap, for the discovery and application of which we are indebted to Chaptal; it is but little acted on by acids, but the application of a violent heat reduces it to a state of fusion. From all these circumstances it appears that wool is nearly allied to oleaginous substances.

15. The examination of these chemical actions is of consequence to direct the bleacher in his operations on this substance: the trifling action which acids exert on wool, and its inalterability in water, even when assisted by heat, show the necessity of having recourse to alkalies or soapy matters; while at the same time the violent action which these exert, will point out the propriety of being cautious in their use.

Of Bleaching Wool.

16. The wool as it comes into the hands of the manufacturer usually contains a large portion of the natural greasy matter, from which it must be purified before it can undergo the process of bleaching. Sometimes the farmer cleans it from most of its oil, so as to diminish its weight by 50 or 60 per cent. in order to enhance the value of the article; but care is taken to leave some portion, as the natural fat is found to be the best preservative against the attacks of moths and other insects.

17. The first object then is to carry off the whole of the oily matter, which is called the operation of *scouring*, and is performed by means of an ammoniacal ley, which is thus prepared. Five parts of river or other soft water are to be mixed with one part of stale purified urine, which is found to contain a large quantity of ammonia (A). This

(A) The detergent property of urine has been long known, and it is frequently employed in washing to save

This mixture is to be boiled for a short time, and into this, at about the heat of 56 degrees, or so that the hand of the workman can be easily held in it for a considerable time, the wool is to be thrown. Four or five pailfuls will generally be sufficient for 20 pounds of wool. After steeping for a short time, the wool is to be stirred about in the mixture continually for about a quarter of an hour or 20 minutes, according to the quantity of greasy matter. It is then to be taken out and drained into a basket, so that the drainings may drop into the vessel in which it was steeped, that nothing may be lost. It must now be completely rinsed by exposing it in baskets to a continued stream of clear water, while a workman is perpetually employed in stirring it with a pole, till the water passes off perfectly clear. The wool is then removed, and a fresh quantity put into the basket, which is to be treated in the same manner. The steeping and rinsing are to be repeated till the wool has attained as great a degree of whiteness as it is capable of receiving from this operation. It is necessary, in order to conduct this process to the greatest advantage, that the workmen should attend to the following circumstances.

18. *1st*, A quantity of fresh ley must be from time to time added to the bath, as the immersion of the wool is found to weaken its power; but it is better not entirely to renew the bath, as the grease abstracted from the wool, during its immersion, forms with the ammonia of the urine a kind of soap, which much increases the cleansing quality of the bath.

19. *2d*, Increasing the temperature of the bath will augment its deterging powers, and may sometimes supply the want of an addition of stale urine; but both these circumstances require caution, as too great a degree of heat hardens the greasy matter, and renders it more difficult of solution; and again, too much urine makes the wool harsh.

20. *3d*, After being much used, the bath becomes too foul, and must be entirely renewed.

21. The wool which has properly undergone the process of scouring should be white, soft, elastic, and open; whereas before it was hard, stiff, and greasy. By this operation the wool loses much more of its weight, so that 100 pounds of raw wool, when completely scoured, will not yield more than 30 or 40 fit for the manufacture of cloth.

22. After scouring, the wool is sometimes carried to the fulling mill, in which it acquires an additional degree of whiteness. The above is chiefly employed for the coarser wools, and wool that has yet to be carded for the making of broad cloth, but for the finer kind it is better to employ a bath in which soap has been dissolved. This method is more expensive, but the expence is compensated by the superior quality of the wool which is thus treated. This operation is performed by the comber, and is thus conducted. The wool is divided into parcels containing each about six pounds and a half. A bath is prepared with two pounds and a half of green or black soap dissolved in a sufficient quantity of boiling water; and in this bath a parcel of the wool is to be washed for a longer or shorter time according to its foulness. It is then wrung by means of a hook, and hung in the sunshine or air to dry. Before it is combed it must undergo a second scouring, which clears it of all the natural oily matter.

23. This quantity of wool is not to be washed all at once, but in successive portions, and fresh hot water is to be added from time to time in order to free the wool more easily from the grease. For wringing it there is a hook fixed at each end of the washing-tub, on which the wool is fastened and turned round by means of a handle or winch, fixed to one of the hooks. As economy should be consulted in every manufacture, a method of scouring wool without soap, would be of considerable advantage. Fullers have long been in the habit of employing a species of clayey earth, called from them *fullers earth*, which has the property of combining with the greasy matter and rendering it more soluble in water. A new earth has lately been found on an estate belonging to Lord Warwick, which by certain processes is made to answer the purpose of soap, and a patent for its preparation has been granted to Mr John Vancouver. It is not distinguished by any particular name, and is disposed or situated in the ground in different strata or layers. The first or uppermost layer is of a greenish or grayish colour; the second layer is of a beautiful lilac or light purple; and the third or undermost is generally white, although the white is found intermixed with the purple. The stratum on which the earth lies, is indurated red marl, and it is superinduced by a bed of gravel. The thickness of the entire stratum of this earth is from four inches to one foot, and its general position is very even, regular, and level. When first taken out of the earth, its colours are very fine, particularly the lilac, which, on exposure to the sun's rays, or to the influence of frost, soon becomes white. On chemical examination, it appears to contain clay, siliceous sand, and the oxide of iron; but a more studied examination would probably shew the existence of other peculiarities, from which the detergent property of this earth might be found to arise.

The processes for manufacturing this earth are performed as follows:—After digging it out of the vein, it is dried by means of stoves or otherwise; then pulverised, and sifted through fine sieves; a size is then prepared from white shreds of leather, and the dry sifted earth is beaten up with the size; after which it is formed into convenient parcels or cakes, resembling those of soap, and of such sizes, figures, and dimensions, as are best adapted to the purposes of its intended application. The use of the size is to keep the parts of the earth together, and to moderate the effect of its absorbent quality, which is so extreme, as to cause it to become pulverulent, like quick-lime, when water is added to the dried earth; and on this account the patentee does not confine himself to the use of

save soap. At sea, where fresh water cannot be spared for the purpose of washing, the sailors are accustomed to scour their foul linen in stale urine, which so far cleanses them that a subsequent rinsing in salt water renders them tolerably pure and sweet.

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of size made of leather, but applies other animal and vegetable mucilage to the same purpose, giving the preference to such, as by their cheapness and adhesive quality are best adapted to the purposes of the manufacture. The most distinctive property of this earth is that of cleansing wool in a manner much superior to soap; because it makes it equally white and clean, without robbing it of what manufacturers call its nature, as soap does; for, it is well known, that when wool is washed with coarse soap, it undergoes some change, either in the polish of its surface, or in the elasticity of its fibres, or in some other respects, which causes it to feel less full to the hand, so that it will not rise and spring up, after the pressure, in the same manner as it did before such washing. Whereas, on the contrary, wool, when treated with the washing-earth, becomes equally white and clean, at the same time that it remains in possession of all its original fulness and elasticity, which are of great consequence and value in the manufacture of this important article of produce *. Before the wool is quite dry it is combed, as this operation is found to succeed best when it is a little moist, it being then easier to form it into proper lengths of three or four feet. Considerable nicety is requisite in the conducting of these first processes, as much of the success of the succeeding operations depends on their proper management.

* Month. Mag. vol. xv. p. 354.

24. After combing, the wool sometimes undergoes two or three farther washings, especially when it is required of a very delicate white.

25. It is known that the wool has been properly scoured, by its filaments being smooth, long and slender, white, and perfectly free from foreign substances, and not having lost their natural tenacity. The Dutch wool is generally the purest: the English is next in quality, but is much harsher and fouler. The German wool is still harsher than the English, and the French is inferior to them all.

26. The loss sustained by the wools in scouring is proportional to their impurity. Thus the French and German lose about a third of their weight, while the Dutch and English do not lose above a fourth.

27. But this scouring, whether it be performed with urine, soap, or earth, is seldom sufficient to bring the wool to that brilliant whiteness which is desirable for some manufactures. This is given it by means of the vapour of sulphur, or by steeping it in sulphurous acid, which is called by the manufacturers *sulphuring*.

28. The usual method of sulphuring goods is to expose them in a very close apartment to the vapour of burning sulphur. The goods are hung on poles so disposed that the vapour can readily pass between the pieces, and when the chamber is filled, a quantity of sulphur, placed in very flat and broad dishes, is set fire to, and allowed to burn away gradually in the chamber, while every aperture by which the vapour could escape is carefully closed. The acid vapour generated by the combination of the sulphur with the oxygen of the air of the chamber, penetrates to every part of the cloth to which it can get access, destroys the colouring matter, and thus completes the bleaching. Every thing is allowed to remain quiet till it is supposed that the effect of the sulphureous vapour has fully taken place, which requires from 6 to 24 hours.

29. The action of the sulphureous vapour leaves a roughness and harshness on the cloth, which are removed by passing it through a bath slightly impregnated with soap.

Such was the usual method of *sulphuring* woollen cloth; but it was soon found to be very imperfect, as the effect of the vapour scarcely extends beyond the surface, and thus there is often a necessity for renewing the operation. O'Reilly has lately proposed to employ the sulphurous acid dissolved in water, and he thus describes the method of preparing and using it.

30. "The sulphurous acid, or that acid which is produced by the imperfect combustion of sulphur, differs from the sulphuric acid (oil of vitriol) in containing less of the acidifying principle, and constituting, as we may say, the mean between sulphur and sulphuric acid.

31. "Sulphurous acid combines very readily with water. In this state of combination it may be employed for the bleaching of wool and silk. We may procure it in this state by making the gas pass through water, in an apparatus similar to that which is employed for obtaining the *oxygenated muriatic acid*. The most economical mode of preparing this acid is by decomposing the sulphuric acid by means of some combustible substance which is capable of depriving it of a part of its oxygen. In the nice experiments of the laboratory, where the chemist wishes to have it in the greatest purity, it is obtained by means of metallic bodies, and especially mercury; but for our purpose, where we must consult economy, we shall recommend the most common materials.

32. "Take chopped straw, or saw-dust, and put it into a matrass; pour over it some sulphuric acid, and apply a moderate heat. Sulphurous acid gas, or sulphureous vapour, will be disengaged; which may be combined with water by means of the following apparatus.

33. "A matrass with a long neck is placed in a furnace, and made to communicate with a tubulated bottle in which a little water has been put to absorb the small quantity of sulphuric acid which might pass through the first reservoir without being decomposed. Care must be taken to place a small tube within the bottle, so that one of its extremities is immersed some way below the surface of the water to prevent absorption. A tube with a double curvature conducts the gas into the vessels in which it is to combine ultimately with the water. We propose to make a *hollow* cylinder of lead, or white wood, bound with varnished iron, of a pretty considerable height, and surmounted with one of Wolfe's bottles, the bottom of which has been removed, and which must be made to fit into a collar in the mouth of the leaden cylinder; and care must be taken to make it firm by means of wax, but so as to render the joining impervious to fluids. This capital of glass will allow us to see the number of bubbles which are disengaged on the surface of the water, and thus to ascertain the progress of the saturation, while the weight of this narrow and high column of water, pressing on the bubbles of sulphurous acid gas, as it is disengaged from the end of the tube at the bottom of the cylinder, will facilitate its combination with the water, and will accelerate its dissolution in that fluid. That nothing may be lost, we may have a series of two or three of these cylinders connected together, and

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and they will then comprise the whole of the apparatus which we are describing. A cock fixed in the bottom of each cylinder will facilitate the discharge of the liquor into the tub for immersion.

34. "The apparatus which we would recommend for the immersion of the woollen and silken goods in the ley of sulphurous acid perfectly resembles what will be described hereafter for the immersion in oxygenated muriatic acid, and which we have constructed after the principles of Rupp. From conversing on this apparatus with Cit. Widmer of Jouy, we have conceived the design of the present, which is now making at the manufactory of Essonne. Let us suppose an oblong box, divided by a partition in the middle; on each side of this partition is a large reel, on which the stuffs are to be rolled; at each angle is fixed a roller, over which the stuffs pass before they proceed through the partition to be drawn over a similar number of rollers which conduct them to the second reel. The object of this disposition is to make the stuffs pass through the bleaching liquor, and expose it to the greatest possible surface.

35. "For the purpose of turning this reel, we make use of an axis or column of glass which passes through a collar of leather, and has one of its extremities, which is square, fixed into the reel, while the other is fixed to a winch, which gives it the rotatory motion; and in this way we may entirely avoid employing any metallic substance within the vessel. To prevent the escape of the gas, the cover of the tub is made with a ledge which fits exactly into the rim of the box, and of which at least an inch should pass into the deterging liquor.

36. "I propose the following method of bleaching woollen stuffs: We are first to scour them by immersion in a ley slightly alkaline, in the proportion of a pound of potash to 50 pounds of wool. The bath is heated to the temperature of 30 degrees (B).

37. "The old method with stale urine may also be employed. Urine is preferred, because it holds in solution a quantity of salt, which is not sufficient to injure the wool.

38. "When the grease is dissolved, and the wool has been well purified, it is to be washed in warm soapy water. This part of the process is sometimes performed in the fulling mill, sometimes by beaters, and sometimes by treading in the tub. In every case the grease must be separated by repeated washing before the sulphuring is employed. If we wish to obtain a brilliant whiteness, it would be proper to make the stuffs undergo heat a second, or even a third time, always in water slightly impregnated with soap, in the proportion of two ounces of this substance to a pound of wool. It would be better to repeat this operation, turning the stuffs about with a stick for half an hour, than to endanger injuring the quality of the stuffs by employing too strong a ley.

39. "After scouring with the greatest care, the stuffs are carried to the tubs for steeping in the *liquid sulphurous acid*, or, as it may be called, *the sulphur water;* the pieces are rolled upon the reels, and by turning the winch, are made to pass through the acid, till it is observed that they are sufficiently whitened. They are then taken out, and suffered to drain on a table covered with a cloth, that the action of the sulphurous acid on the wood may not injure them; they are afterwards washed in river water, and, if necessary, Spanish white is used. This is done by steeping the pieces in a tub of clear water, in which about eight pounds of Spanish white have been diffused. Two sulphurings are usually employed to obtain a fine white; but in our process, a single immersion, with turning for two or three hours, should be sufficient.

40. "Before recommending the employment of the liquid sulphurous acid, I have made a great many experiments on woollen threads and stuffs, varying the manipulations, and always with the most complete success *."

* O'Reilly Essai sur le Blanchiment.

41. Besides the whiting mentioned in the above extract, it is usual to pass the stuffs through water impregnated with blue, or, what is generally practised, after the whiting has been used, the stuffs are taken out, and to the same bath of Spanish whiting and water is added a pail of water, in which about an ounce and a half of fine indigo, or of Prussian blue, have been diffused, the blue being pounded, sifted, and tied up in a little bag, which is stirred round in the water. When the blue water has been added, the bath is well stirred, and the piece of cloth is again passed through it. It is afterwards laid on a packing cloth, and subjected to the fuller's thistle, to raise the nap, it being wetted from time to time with the liquor of the bath. It is then dried, and well beaten with twigs, to carry off the superfluous whiting.

42. Manufacturers have an idea that bad smells, such as foul breath, are capable of producing some change on the bath of blue and white, and thus render a repetition of the process necessary. It is certain, that without attention the white and blue will not be intimately diffused, and that thus a kind of vegetation will be produced on the cloth. When this happens, it must be washed by plunging it into hot water, and then the bath must be repeated.

43. It is chiefly to cloths that are to be of the finest quality that all these processes are adapted. For ordinary flannels, especially such as are intended to be worn next the skin, sulphuring and soap baths are less proper; and the soap especially diminishes the absorbency, which is so desirable a property in these flannels. They are usually prepared by scouring with bran and water, and subsequent rinsing in fair water.

Chap. II. *Of the Bleaching of Silk.*

44. Silk is a substance possessing some degree of transparency, and is spun by a caterpillar from a matter contained within its body, which has the property of hardening when exposed to the air. The silk-worm is an inhabitant of the southern climates, being originally brought from Asia, and naturalized in the south of Europe about the period of the decline of the Roman empire.

45. The

(B) About 100 degrees of Fahrenheit.

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45. The filaments of silk, as left by the silk-worm, are rolled together into a kind of ball or clew, and in their natural, or what is called the *raw state*, are covered with a yellow varnish or gum, which obscures their lustre, and gives them an unpleasant roughness.

46. Water has no effect on silk at the boiling temperature, and no change is produced on it by alcohol; but alkaline leys, when tolerably strong, attack, and are capable of dissolving it. The yellow varnish is soluble also in alkaline leys, and it may even be separated by long-continued boiling of the silk. When the varnish is thus carried off, the silk is found to have lost about a fourth of its original weight.

47. Two methods are in practice for bleaching silk; the first, in which it is ungummed or deprived of the natural varnish; the second, in which this is retained, in order to give them that stiffness which is required for gauzes, blonds, &c.

48. In the first process, the silk is to undergo a scouring, similar to what we have described, as necessary for depriving wool of the natural oil. For this purpose, a quantity of water is put into a boiler over a fire, and for every hundred pounds of silk to be scoured, thirty pounds of very fine soap are dissolved. The solution is generally boiled, but before the silk is put into it, the heat must be lowered to about 90 degrees of Fahrenheit, and at this temperature it must be kept during the process. The silks are to be hung in the liquor upon rods or frames, and left till the gum is sufficiently destroyed, care being taken to alter their position now and then, so that every part may be exposed to the action of the bath. When perfectly ungummed, they are flexible and of a dull whiteness; in this state they are to be wrung with the pin to clear them of the soapy water, then well shaken, and put into coarse linen bags, in parcels of from twenty to thirty pounds each.

49. These bags are now to be steeped in a fresh bath, or, as the workmen speak, are to be baked. The bath is prepared in a manner and proportion much as before, except that the quantity of soap may be somewhat diminished, as the heat is to be increased; for the silk is now to be boiled for two or three hours, taking care to keep the bags from sticking to the bottom of the boiler, by frequently stirring them with a stick.

50. For silk that is intended to be dyed, the former steeping in the lukewarm bath is unnecessary, and the present boiling only is employed, using a greater quantity of soap in proportion to the fineness of the colour. Thus for the ordinary colours, the proportion above laid down, or even less, will suffice; but for the saffranum colours, and the poppy and cherry red, even 50 pounds are sometimes employed to the 100 pounds of silk.

51. After boiling, the silk is wrung as before, and then washed thoroughly in a stream of water; they are then examined, and if it appears that they are not sufficiently or not uniformly scoured, they must be submitted to a fresh bath.

52. The white silk usually sold has a bluish shade. This is given it by a bath impregnated with litmus, or indigo. This is prepared by dissolving a pound and a half of fine soap in about ninety gallons of water, in which a small quantity of litmus or indigo has been diffused. The bath is heated to about 90 degrees, and the silk is passed through it over rods or reels till it have acquired the requisite shade. Being taken out, it is wrung and dried.

53. From these processes, the silk acquires a tolerably clear white, but the highest degree is given to it by the action of the sulphurous acid, either in the state of vapours, as is usually practised, or by immersing it in the liquid acid, according to the method of M. O'Reilly.

54. From what has been said above of the action of various substances on silk, it will easily be conceived, that during scouring it must suffer considerably in its quality. To avoid this, a method has been lately proposed of carrying off the varnish by the aid of steam under an increased pressure. As this has been more extensively employed in the bleaching of cottons, we shall delay giving a detailed account of the process till a future part of this article. The following is the method proposed by O'Reilly.

55. "Take a solution of caustic soda, so weak that it indicates at most but a quarter of a degree of the areometer for salts, and fill with it the boiler of the apparatus for steam bleaching. Charge the frames with the skains of raw silk, and place them in the apparatus till it be filled, then close the door and cause the solution to boil; continue the ebullition for twelve hours; slacken the fire and open the door of the apparatus. The heat of the vapour, which is always above 100 degrees (c), will be sufficient to ungum and scour the silk. Wash the skains in warm water; wring them with the pin; and place them a second time on the frames of the apparatus to undergo another boiling. Then wash them in a considerable quantity of water, and if you desire the greatest degree of whiteness, rinse them in water slightly impregnated with soap, to give them a little softness.

56. "The last degree of whiteness is obtained by passing the skains through the sulphurous acid, using the method and apparatus which I have recommended for bleaching wool; and which here supersedes sulphuring. The incalculable advantage of that method over others, consists principally in the possibility of employing the operations in succession, without running the risk of injuring the quality of the silk by too strong leys*."

* O'Reilly Essai.

57. Such are the most approved methods of bleaching silk when deprived of the yellow gum; but when this is not required, the bleaching is to be performed by some substance which has the property of whitening the silk and its varnish without dissolving the gum. Of this description is alcohol, and two French authors have proposed a method of bleaching silk by means of this and muriatic acid. It was first proposed by M. Rigaud in 1778, and is thus shortly described by Pajot de Charmes.

58. "The silk intended to be bleached, is put into a glass vessel containing a mixture of spirit of wine and muriatic

(c) About 250 degrees of Fahrenheit.

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muriatic acid, in the proportion of a pound of the former to half an ounce of the latter, and in quantity sufficient to float the silk. The vessel is then closed with wet parchment, and exposed for 12 hours to the sun, or otherwise it may be left 24 hours in the shade, at a temperature of between 16° and 20° Reaumur. The silk is then taken out and pressed, and again macerated for the same time, and under the same circumstances, in fresh acidulated spirit of wine, in another similar vessel, closed as before. The silk is then taken out, pressed, and washed for four or five minutes in pure spirit of wine. In the next place, it is kept for 24 hours in the sun, or 36 in the shade, in a third vessel, containing pure spirit of wine, which is to be renewed at intervals; after which, the silk is to be taken out, pressed or washed two or three times in clear water, which is to be changed at each washing. Lastly, the silk is to be exposed to dry upon a frame, so contrived as to stretch it with considerable force, and prevent its curling up as it dries."

59. In 1795 M. Baumé proposed an improvement of this method, with the means of recovering the alcohol, which we shall give in the words of Mr Nicholson in his Journal.

60. "Berthollet, in his *Elemens de l'Art de la Teinture*, published in the year 1791, after describing the usual methods of depriving silk of its resinous or gummy matter*, proceeds to remark, that, in the manufacture of blonds and gauzes, the natural elasticity and stiffness of this article are required to be preserved: whence it has become a desideratum to render the yellow silk of Europe white like that of China, without depriving it of its gum. He adds, that M. Baumé has solved this interesting problem, but had kept his process a secret; but from the facts he had possessed the means of obtaining, it appeared liable to accidents, and that the chief difficulty consisted in giving an uniform white colour when large quantities were operated upon. He also mentions a difficulty in dressing the whitened silk so as to prevent its curling, and observes that it ought certainly to be kept constantly stretched during the drying. It is besides requisite that the spirit of wine should be recovered after the process, which would else be rendered too expensive. This author does not say whether the white Chinese silk is subject to the same inconvenience of curling when dyed, which, it may be remarked, is a property of no consequence where the material is to be applied in the manufacture of white goods. The motives which led M. Baumé to communicate his process to the world, originally retained by him as a lucrative secret, do not appear. Whether the mistakes of those who carried it into effect in the large way might have led him to vindicate the reality of his discovery by publication; or whether the commercial advantages derived from superiority of quality and cheapness in this article over the Chinese silk in the market of France, might in the end have proved of less value than the scientific reputation to be derived from its disclosure; are circumstances which will, no doubt, have their proper weight with such manufacturers as may be induced gradually to adopt this process.

* Tom. i. p. 146.; or p. 141. of Dr Hamilton's translation.

61. "The silk of Nankin is perfectly white, silvery, brilliant, and possesses all the elasticity of raw silk. Our author affirms, that the value of this article imported into Europe amounts to upwards of twenty millions of livres (about 830,000l. sterling), of which France consumes about four or five millions in gauzes, blonds, ribbands, &c. This was formerly supposed to be produced of a white colour from the worm. The late M. Trudaine, intendant of commerce, procured the eggs of silk-worms from China, and cultivated them. The produce consisted of yellow cocons, and others of the most perfect whiteness. The latter afforded silk equal in this respect to those of Nankin. But M. Baumé affirms, that most of the Nankin silk is bleached by art, and, as he thinks, by a process similar to his own.

62. "As it is impossible to wind off a large quantity of silk in the short time previous to that of the insects eating their way through the mass, it is usual, in the first place, to deprive them of life. This is commonly done by exposing the cocons, properly wrapped up, for two hours, to the heat of about 158 degrees of Fahrenheit in an oven; after which they are kept for a certain time in a mass to preserve their heat, and effectually destroy such of the insects as might have escaped the power of the oven. The effect of this process is, that the silk is hardened, and is more difficult to wind off than before. Hence the produce of silk is less by one-ninth part in quantity, and inferior in quality to what might have been obtained by winding off without this previous baking. M. Baumé, not only from these views, but likewise because the silk which has not been baked proves susceptible of a greater lustre, was induced to destroy the chrysalis by spirit of wine. For this purpose he disposes them in a wooden box in a stratum six inches deep: upon each square foot half a chopin, or somewhat more, of spirit of wine is to be sprinkled with a small watering-pot made for that purpose. This quantity answers sufficiently near to our half pint. The liquid is to be equally distributed, but it is not necessary that all the cocons should be wetted. They are then to be mixed by hand. In the next place, another stratum is to be formed over the first, nearly of the same depth, which is to be sprinkled and treated as before. By this method of proceeding, the box becomes filled, and must then be covered and left for 24 hours, during which time they become spontaneously heated to about 100 degrees, and the vapour of the spirit of wine exerts itself with wonderful activity. Five hundred French pounds (D) of the cocons require 10 French pints, which is nearly the same number of English quarts. After this treatment they must be spread out to dry, which happens in a short time, and is absolutely necessary previous to winding off.

63. "When the operator proposes in this manner to extinguish various parcels of cocons belonging to different individuals, each parcel may be tied up loosely in a canvas bag, and wetted on the outside previous to closing the box.

64. "The spirit of wine to be used in this operation, ought to be of the strength of 34 degrees of Baumé's hydrometer at the temperature of 55 degrees. It is of the

(D) The Paris pound is to the English avoirdupois pound as 756 to 700. These quantities are not reduced, because the operation requires no great precision.

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the greatest importance to use that spirit only which has been kept in vessels of glass, of tinned copper, or of pure tin. Leaden vessels are absolutely to be rejected; wooden vessels tinge the spirit, which gives the silk a degree of colour of considerable solidity, and very inimical to the bleaching process.

65. "With regard to the advantages of this method of extinction, in preference to that of the oven, the author remarks, that the cost of labour and fuel added to the loss of silk, and the probability of injury from too much or too little heat, constitute a sum of disadvantage much greater than the cost of the spirit of wine. It is besides a considerable advantage, that the spirit of wine renders more distinguishable such cocons as have perished previous to the application of the spirit. These afford a much worse silk, and must be picked out.

66. "The silk is wound off upon a reel, while the cocons are kept immersed in water almost boiling. Upon this part of the process M. Baumé remarks, 1st, That the dead cocons must be separated. These are known by the brown or black spots on their surface. 2. That well water, which on account of its clearness is almost universally used in the silk manufactories, mostly contains nitre, and is extremely prejudicial to the bleaching process. The presence of nitrous acid gives a yellow colour, which resists bleaching and even scouring; he therefore recommends river water. 3. In some countries a small quantity of alum is used. Neither this nor any other saline substance is of the least advantage to the colour, beauty, or quality of the silk.

67. "At the four places of contact of the silk upon the reel, all the threads stick together. It is absolutely necessary that this should be remedied. The method consists in soaking the silk in a sufficient quantity of warm water, at about 90 degrees, for about two hours; after which the threads are to be separated by opening the banks upon a pin, and lightly rubbing the parts which cohere. When the silk is dry, it is to be loosely folded in its original form, and is ready for bleaching.

68. "The silk while wet is soft, and part of its gummy matter is in such a state, that its threads would readily adhere, if wrung while warm for the purpose of clearing it of the water. After such improper treatment there would be no other remedy than to soak it again in warm water.

69. "The apparatus for bleaching the silk consists of a stone-ware vessel, nearly of a conical form, capable of holding about 12 gallons, having a large opening at the one end, and a smaller of about an inch diameter at the other end. Common pottery cannot be used in this operation, because it is soon rendered unserviceable by the action of the marine acid, and the stone-ware itself is not very durable. This vessel must be carefully examined, to ascertain that it does not leak in the slightest degree; after which the inside is to be rubbed with a pumice-stone, to clear it of asperities which might break the threads. A cover of the same material is to be fitted on by grinding; and the smaller aperture, which in the use is the lowest, is to be closed with a good cork, in the middle of which is thrust a small glass tube about a quarter of an inch in diameter; this is likewise stopped with a cork, excepting at the time when it is required to draw off the liquid contents of the jar. A small perforated false bottom is placed within the vessel, to prevent this tube from being obstructed.

70. "This jar, or as many of them as the purposes of the manufactory may require, is supported by a wooden frame or table, at such a height that a cask may be conveniently placed beneath to receive what may flow from the glass tube in the several periods of the operation.

71. "Six pounds of yellow raw silk are to be disposed in the earthen pot; upon this is to be poured a mixture, previously made, of 48 pounds (E) of spirit of wine at 30 degrees, with 12 ounces of very pure marine acid, absolutely exempt from all presence of nitrous acid, and of the strength of 14 or 15 degrees of Baumé's hydrometer. The pot is then to be covered, and the whole left in digestion till the following day, or until the liquor, which at first assumes a fine green colour, shall begin to assume that of a dusky brown (*feuille morte*).

72. "The acidulated spirit is then to be drawn off. To prevent evaporation, M. Baumé thrusts a cork in the bung-hole of the receiving cask, in which is a sliding glass tube. The use of this tube is completely to surround the small tube proceeding from the earthen vessel. When the whole of the fluid is thus almost entirely drawn off, clean spirit of wine is poured upon the silk, and drawn off repeatedly until it passes colourless. The silk is then suffered to drain without stirring it. In this state it is ready for a second infusion.

73. "Forty-eight pounds of spirit of wine acidulated with 12 ounces of marine acid is now to be poured on the silk, and the whole suffered to remain for 24 hours or longer, until the silk becomes perfectly white. The time required for this second infusion is commonly longer than for the first: it sometimes amounts to two, three, or even six days, according to circumstances, particularly the temperature and the nature of the silk. Silk which has been in the oven is in general more difficult to bleach.

74. "When the silk has thus obtained its utmost degree of whiteness, the acidulated spirit is to be drawn off into a separate vessel. This fluid is but slightly coloured, and may be used again in the first infusion of other yellow silk, with addition of six ounces more of marine acid. The receiving vessel is to be removed, and another clean vessel substituted in its place. The silk is then sprinkled with clean spirit, and occasionally pressed down with the hand. As soon as the spirit of wine comes off absolutely colourless, a third infusion is to be made, by pouring upon the silk 48 pounds of the pure spirit without acid, which is to remain till the following day: it is then to be drawn off, and

(E) The pound is nearly a pint, and is divided into 16 ounces.

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and reserved for washing other silk after the first infusion.

75. " After the silk has been left to drain, and affords no more spirit, it still retains its own weight of that fluid. This is recovered by the very simple process of sprinkling the silk with a small quantity of very clear river water at a time. While the water applies itself and subsides along the silk, it drives the spirit of wine before it, so that the first portions which flow from the tube are scarcely diminished in strength. The addition of water is to be continued until nothing but mere water comes off below.

76. " In this situation the silk is found to be well bleached, but still retains a portion of marine acid sufficient to render it harsh to the touch, and after a time brittle. It must be washed off with water. The best method is to put the silk loosely into a coarse woollen bag, which is to be secured closely in another cloth like a small bed or pillow, then placed in a basket and left in a running stream for five or six hours; but where the convenience of a stream is wanting, the earthen pot containing the silk is to be covered with a cloth, and water pumped through it for five or six hours, or until that which issues from the lower aperture gives no red colour to the tincture of tournsol. At this period the lower opening is to be closed and the vessel filled with water, which must be changed once or twice in 24 hours.

77. " The time required for washing was occasionally abridged by passing spirit of wine, or river water impregnated with a small portion of alkali, through the silk. The natural salt thus produced is, in fact, less adherent to the silk than the acid itself, but nevertheless requires to be washed off with a very large quantity of water.

78. " In these, as in every other process relating to the silk, great care must be taken to ascertain that the water made use of contains no nitrous acid, which would infallibly occasion imperfection of colour, or spots in the article. After this treatment the silk is ready for drying and lustering; previous to the description of which, the author makes several remarks to the following purport:

79. " Though the mineral acids are the most powerful and destructive of all saline substances, yet they may be applied to silk, when diluted with spirit of wine, in very considerable doses. In trials, made to ascertain the maximum, two ounces of marine acid were added to one pound of spirit of wine, without altering the silk. Two drachms of marine acid cause a very perceptible alteration in one pound of silk. I suppose he means pure acid, or perhaps diluted with water; for the passage as it stands is obscure. Numerous experiments have shown that the marine acid is preferable to any other. The proportions admit of much latitude, though he prefers the dose herein before described.

80. " Spirit of wine which has been mixed with nitrous acid, cannot be used in bleaching, even though afterwards rectified upon the alkali, because it still retains a portion of nitrous gas.

81. " Pure spirit of wine without acid extracts a fine yellow colour from silk, which does not separate for years, even though exposed to the sun's light. Yellow silk exposed to the sun loses its colour in a short time. The acidulated spirit which has been used in the infusion of silk, is changed by exposure to the sun, but not in such a manner as to be rendered fit for use a second time.

82. " In order to obtain a beautiful colour, it is essential that the silk should be immersed in a large quantity of the fluid, especially at the first infusion. Without this management it would become necessary to make three infusions in the acidulated spirit. When the first infusion is well managed, the silk will have lost all its yellow colour, and become considerably white, at the same time that the liquor will have begun to change colour a little. As long as it continues of a fine green, it is certain that it has not exhausted its whole action upon the silk.

83. " The duration of this first infusion may be longer or shorter, without inconvenience, according to the temperature. When the temperature is at 20 degrees of Reaumur, which answers to 77 of Fahrenheit, the first infusion is often made in 10 or 12 hours. In small experiments the heat of the atmosphere may be supplied by the water-bath; in which case, all the infusions are easily made in the course of a day.

84. " When the first infusion is finished and the liquor drawn off, the silk appears greenish: the subsequent washings in spirit of wine clear it of the liquor it retained. The sprinkling should be made with the watering-pot, otherwise the quantity poured will be greater, and the management more wasteful.

85. " The cocons may be bleached in this way, but the inconveniences are too great to render this process desirable.

86. " Pieces of gauze and entire garments of silk have been successfully bleached in this way.

87. " The finest natural white silks are rendered infinitely whiter by this process. Spirit of wine alone has the property of depriving yellow silk of its colour, which it brings to the state of the naturally white silk. In this state the silk is disposed to acquire a greater degree of brightness by a single infusion in the acidulated spirit. This process has its advantages over the other, to which it is also inferior in certain respects; concerning neither of which the author has entered into any detail.

88. " The colouring matter was found to be a resin perfectly animalized, affording by distillation the same products as other animal matters, and the concrete volatile alkali.

89. " Silk whitened by scouring may be dried freely in the air without affecting its lustre. This is not the case with the silk bleached in the gum: if it be left at liberty to dry in the air, it resembles white flax without any lustre. The beauty of this silk consists in its shining brilliancy; to secure which, it must be dried in a state of tension. M. Baumé has contrived a simple machine for this purpose. It consists of a strong square frame of wood standing upright upon feet: the upper horizontal bar is six feet long, and has six iron pins driven through it at equal distances, so as to project on each side for the purpose of receiving twelve bobbins. The lower horizontal bar is moveable up and down in a mortice by means of a screw at each end: it is furnished with six holes, adapted to receive as many pins to

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to correspond with those above. The skains of silk are to be dressed and arranged upon wooden pins, as they are taken out of the sack from washing. As soon as there are twelve together, they are to be wrung with a staff; after which the skains are to be hung one by one upon as many bobbins put upon the upper pins of the square frame. Another bobbin with tails is to be inserted in the lower loop of the skain, and fastened to the corresponding pin of the lower bar, by means of a strap and hook, which need not be described to such as are slightly acquainted with mechanical objects. When the machine is thus supplied with skains on both sides, the lower bar of the frame is to be pressed down by the screws until the silk is moderately stretched. When it is dry, the screws are to be equally slackened, the skains taken off, and folded with a slight twist, that they may not become entangled.

90. "After this description of the whole of his process, the author proceeds to make certain general remarks on the white China silk. He observes, that in his process the silks acquire the perfect whiteness without much handling, and consequently that there is little cause for them to become entangled. Accordingly the loss in unwinding is found to be no greater than when they are unwound in the yellow state: that is to say, from a drachm to a drachm and a half in the pound. This saving is of the greatest importance in the price of the silk.

91. "The silk of Nankin, which he supposes to be bleached by some process of the same nature, is probably handled much more. The loss is nearly twelve per cent. when it comes to be opened, and not unfrequently even 25 per cent.: a loss which cannot in any respect arise from the package. The quality of the Nankin silk differs much in the package; the external part being always of the best quality, and that which is packed within is of such an inferior quality as sometimes not to exceed half the value. On examining this silk, it not only exhibited unequivocal marks of alkali, but its imperfections were also of the same kind as those which had occurred to M. Baumé during the progressive improvement of his own manipulations. The best China silk was neither improved nor injured by the process of Baumé; whence he concludes that they are not naturally white, but have undergone a process similar to his.

92. "The result of the whole is, that the yellow silks of Europe may be bleached to equal or greater perfection than those of Nankin; and that these may be even greatly exceeded by winding the naturally white silk apart from the other, and bleaching it by itself.

93. "To complete the description of M. Baumé's process for bleaching silk, nothing more remains, than to shew in what manner he recovers the ardent spirit, and ensures the purity of the acid made use of. These circumstances are of essential importance to the art; for the process would be much too expensive if the spirit were lost, and it could not be made to succeed at all if the acid were impure.

94. "The alcohol which has been used in bleaching silk, is acid, and loaded with colouring matter. In this state it cannot be again used. There are two methods of distilling it; which have their respective advantages and inconveniences. By the first, the acid is lost; which is saturated with potash, in order that the distillation may be afterwards performed in a copper alembic. The second is performed by distilling with glass retorts, or an alembic of silver. In either of these vessels, which are not acted upon by the marine acid, the distillation may be performed, and the greater part of the acid recovered. The inventor most generally practised the saturation of the acid from reasons of convenience; but recommends the use of a silver alembic, as being most economical upon the whole, in a manufactory.

95. "A solution of potash is to be poured into the acid spirit, and stirred about to promote the saturation. Carbonic acid is disengaged with strong effervescence from the alkali, and the point of saturation is known by the usual test, that the fluid does not redden the tincture of tournsol. The distillation is then to be made in the copper alembic, and the alcohol reserved in proper vessels, as mentioned in the beginning of this memoir.

96. "If too much alkali should have been added, the liquor remaining in the alembic may be used in another saturation. The alkali in this process being an expensive article, M. Baumé endeavoured to supply its place by chalk, quick-lime, and lime which had been slaked by exposure to the air. But he found that the action of the spirit upon the calcareous earth, or perhaps the absence of water, prevented the acid from uniting with that substance. The union does not take place to perfect saturation in less than five or six weeks, even when the alcohol is diluted with upwards of 50 times its bulk of water.

97. "In the second process for distilling without alkali, the acid spirit is distributed into a great number of glass retorts, placed in the sand-bath, on the gallery of a furnace. The first product is scarcely acid; but what follows is more and more so, and must be kept in vessels of glass or stone-ware, which become embarrassing on account of their number. The fluid which remains in the retorts has the colour of beer slightly turbid, and contains the greatest part of the marine acid. It must be poured into one or more retorts, and concentrated by heat gradually applied. The first liquor which comes over is slightly red, turbid, and scarcely acid. This is to be thrown away, and the receivers changed. The succeeding product is the colourless marine acid, of an aromatic smell resembling the buds of poplar. The resin of the silk remains in the retort decomposed by the acid. The marine acid thus obtained is weaker than it originally was: which is in fact of little consequence, as it is pure, and may be safely used, either by increasing the dose proportional to its diminished strength, or by concentrating it, if required, in the usual way.

98. "If this distillation be made in a silver alembic, instead of retorts of glass, and a capital and worm of pure tin be annexed, the alcohol will be obtained so slightly acid as scarcely to redden the tincture of tournsol; but it is sufficiently acid to receive injury if preserved in a copper vessel.

99. "If a cucurbit of silver be prepared, of the capacity of three or four quarts, with a glass head, the residues of the first distillation may be treated in this vessel in the same manner as has been directed for glass retorts. M. Baumé affirms that he has practised all these

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these operations with glass retorts and a small silver alembic, with the most perfect success; but that he made use of potash to saturate the marine acid, because he had not a silver vessel of sufficient capacity. From the danger of distilling large quantities of ardent spirit in glass vessels, he is of opinion that no motives of economy are sufficient to justify the risk attending this method. In the use of tin, it is necessary to be careful that it contains no adulteration of lead, because the vapours of marine acid have sufficient power to alter this last metal very considerably.

100. "Upon the first intimation of this new process in France, manufactories were immediately established, to the number of twenty or more, without the concurrence of M. Baumé, by persons who consequently were not aware of the apparently minute but very important circumstances necessary to ensure its success. In particular, the inventor states that the marine acid of commerce is unfit for this purpose.

101. "This acid was formerly prepared with the marine salt of the saltpetre manufacturers; and even when it is made with good salt, the decomposition is effected with a small quantity of vitriolic acid which contains nitrous acid. Marine acid mixed with a small quantity of nitrous acid does not prevent the silk from being beautifully whitened: it even accelerates the process considerably, and in the most satisfactory manner. But the alcohol, every time it is used and rectified, becomes charged with the acid and gas of nitre, which assume the characters of the nitrous anodyne liquor. In this state, neither distillations nor repeated rectifications from alkali are sufficient to separate the nitrous matter from the alcohol. Then it is that the success of the operator vanishes, with a degree of rapidity equal to the advances which encouraged his hopes at the commencement. The same disappointments befel M. Baumé at the beginning of his labours; to prevent which, he directs the preparation of the vitriolic and marine acids to the following effect.

102. "The vitriolic acid of commerce is obtained by burning sulphur in chambers of lead, with the addition of saltpetre, either crude or of the second crystallization, and a small portion of flax. This acid is concentrated and rectified in France, at the place of its fabrication, to 66° of Baumé's hydrometer, or specific gravity in the usual form 1.848. It contains sulphur, lead, vitriolated tartar, Glauber's salt, alum, selenite, and particularly the nitrous and marine acid.

103. "To purify it, 100 pounds of this vitriolic acid is to be mixed in a large bason of copper with the same quantity of river water, and stirred with a wooden spatula. The mixture instantly becomes heated to the boiling-water point, and a great quantity of red vapour is disengaged, which has the smell of aqua regia, and arises from the nitrous and marine acids. When this mixture is made, it is proper to immerse the bason to a suitable depth in a large vessel of water, to hasten the cooling. As soon as it is sufficiently cooled it is to be drawn off into bottles, and left to become clear during several days. Great part of the sulphur falls down. The author obtained from four to six drachms.

104. "A gallery must be provided, on which two rows of iron pots of eleven or twelve inches in diameter are to be properly placed for separate sand baths, as M. Baumé always practised in the sublimation of sal ammoniac. By this means the retorts are isolated, and if one breaks, the acid cannot diffuse itself and break the others in its vicinity. An empty retort is then to be placed in each pot, and covered with sand. In this way they are much more convenient to arrange, and are attended with no risk.

105. "The acid is in the next place to be decanted and conveyed into the retorts by a syphon funnel, and the rectification proceeded upon until it becomes perfectly white. Towards the end of the operation a small quantity of sulphur sublimes in the neck of the retort. Instead of receivers, a small glass cup is placed beneath the aperture of each retort, in order to facilitate the dissipation of the nitrous and marine acids.

106. "When the acid in the retorts is sufficiently cooled, it is poured a second time into the copper bason, and mixed with 100 pounds of river water, as at first, and again concentrated in the retorts till it becomes perfectly clear. Sulphur has been afforded in some instances by the second rectification. The liquor which distils is received in the cups as before, and the acid in the retorts is then sufficiently pure: that is to say, it is purified from all volatile matter. The lead and neutral salt still remain combined with the acid, but fortunately they can in no respect injure the purity of the marine acid.

107. "This concentrated acid exhibits 68 degrees by the hydrometer, or specific gravity 1.896. It still contains a portion of gas, but so small in quantity as not to injure the purity of the marine acid, to which it only gives the property of crystallizing when the temperature of the air is near the freezing point.

108. "During the rectification of this acid, what first comes over is mere water, and must be thrown away; but that which succeeds is the aqueous acid. If this be set apart, and concentrated, a considerable quantity of vitriolic acid is obtained of the greatest purity. As it has been carried over in distillation, it contains no foreign matter.

109. "The author attempted, but in vain, to dissipate the nitrous acid from the acid of vitriol by ebullition in an open vessel without concentration. The experiment was made with 50 pounds of common vitriolic acid and 60 of river water. This was kept boiling in the copper bason for four days, water being added from time to time to supply the loss by evaporation. The copper bason, by weighing before and after the operation, had lost by solution no more than ten drachms of copper. The acid was blue, but became white as usual during the rectification in the retorts. From this experiment, as the author observes, it is seen not only that the nitrous acid cannot be dissipated by simple ebullition without concentration, but that the action of the vitriolic acid upon copper is extremely slight.

110. "The marine acid is to be disengaged from common salt by the application of this vitriolic acid in the usual manner. But as M. Baumé's experience led him to various simple manipulations and remarks of importance, and more especially as he considers the description of this process as part of the new art of bleaching silk, he has annexed it to his memoir.

111. "The vitriolic acid obtained by the foregoing process

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process being too concentrated, must be diluted in the copper bason as before with river water. It is convenient to add 18 ounces of water to each pound of the acid, because the marine acid is not wanted in a state of high concentration. This mixture ought to give 35 or 36 degrees by Baumé's hydrometer; which last answers to a specific gravity of 1.333. When it is cold it may be preserved in bottles for use.

112. "In the next place, four pounds of marine salt dried, because in that state it pours best, is to be put into a retort of the capacity of five or six French pints, or English quarts. This may be done by means of a paper funnel, or a long-necked funnel of glass, which must enter the body of the retort in order that the neck may remain clean. A number of these must be disposed on a gallery in two opposite rows, with the necks properly enclosed and enveloped in sand as usual.

113. "A bottle or gauge being provided of such a size as by previous experiment is known to hold four pounds of the vitriolic acid before mentioned; this quantity of the acid must be measured into each of the retorts by means of a curved funnel, the tube of which may pass into the body, to prevent the acid being spilled in the neck. If nevertheless a few drops should fall, no inconvenience will follow, as this pure acid is not detrimental to the bleaching process.

114. "The supports for the receivers are then to be placed, and the receivers applied, each being pierced with a small hole. The junctures are to be made good with pasted paper, and the distillation begun. A gradual heat is to be applied until the fluid boils gently. The marine acid which first rises is volatile and expansible (F), and requires the small holes of the receiver to be occasionally opened; but after one-fourth part of the time of distillation the acid comes over freely, and the vapours cease to be elastic.

115. "The distillation lasts two days: but it is practicable to avoid sitting up the intermediate night. The fire must be so managed that the contents of the retort may be very liquid in the evening: if it begins to thicken, there is reason to apprehend that it may be too hard the next day; in which case the heat will dilate the concrete matter before it liquefies, and break the containing vessel.

116. "Towards the close of the distillation the matter swells up considerably. When this happens, it is proper to empty the receivers, and raise the retorts, that more sand may flow in beneath them. When the matter is dry, and nothing more comes over, the operation is finished.

117. "Each retort affords five pounds of marine acid, of the strength of 14 or 15 degrees; specific gravity 1.114. When the retorts are half cooled, one pound of hot river water is to be poured into each, and the distillation being resumed affords 24 ounces of the same marine acid from each retort."

PART II. BLEACHING OF VEGETABLE SUBSTANCES.

118. THE composition of vegetable substances differs materially from that of animal bodies in the proportions of the three principles which are common to both, namely, oxygen, hydrogen, and carbon; and in wanting for the most part azote, which in the latter acts so conspicuous a part. The proportion of sulphur and phosphorus is also exceedingly small in vegetables.

119. As in animals, the substances derived from vegetable nature are formed by a peculiar process of secretion, from the nourishment which plants draw from the bosom of the earth, which after being absorbed by the roots, undergoes, in passing through the vessels of the plant, new modifications, and enters into new combinations.

120. By spontaneous decomposition the principles of vegetables, as of other organized matter, are separated and enter into new states. The hydrogen combines with part of the oxygen to form water, while the rest of this latter element, uniting with the carbon, generates carbonic acid.

121. These changes are the natural effect of exposure to moisture, heat, and atmospheric air; and upon the effect of these agents the chief dependence has been till lately placed in the processes for discharging the colour of vegetable substances. As the gradual improvement of the art of bleaching forms a pleasing object of contemplation both to the scientific manufacturer and the philosophic chemist, we shall, after saying something of the nature and previous preparation of the substances employed, endeavour to trace the steps which have led to the present improved state of bleaching, as it is in the linen and cotton manufactures that this is more peculiarly apparent.

122. The vegetable materials employed for clothing are usually distinguished into two kinds, linen and cotton, the former being derived from hemp and flax, the latter from the down of the cotton plant.

123. Of all the materials employed for clothing, wool seems to have been the most ancient; and indeed it was a natural and an easy step, from the skins of beasts, to the use of the detached hair. Silk seems to have been next in point of antiquity, and in a short time the fibres of hemp and flax were had recourse to for the same purposes. It is probable that the fibres of hemp were first applied to the service of man as cordage or sails, or to make tents for sheltering the inhabitant of the desert, or the soldier in the camp, as their coarseness and superior strength would point them out as

(F) It might be of advantage, even in the large way, to adapt a simple pneumatic apparatus to condense the marine acid air in water, as is usual in philosophical processes.

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as better fitted to these uses, and less adapted to the purposes of clothing than the finer and more delicate fibres of flax.

124. The use of flax appears to have originated in Egypt, and its introduction is attributed to Isis.

125. Cotton has probably been employed among the Asiatics for a very long time: in Europe it was the latest of all the materials of which clothing is manufactured.

126. On examining the stalks of hemp and flax when they are pulled, we shall find them composed of four distinct substances; a delicate bark, a green juice or sap, the fibres which are to be employed in the manufacture, matted or twisted together, and within these the wood of the plant. As the fibres are thus enveloped in useless matter, the first object is to separate them, to peel off the bark, wash away the sap, and strip the fibres from the wood. The two first of these are effected by water and fermentation. The plants tied in bundles are placed in water, and proper methods taken to prevent their being carried away, if it be a stream, which is frequently the case (G). In a short time a fermentation begins to take place, which acts both on the bark, which it loosens, and on the sap, which it decomposes. It is necessary to be attentive not to let the fermentation proceed too far, as we thereby run the risk of injuring the texture of the fibres. As soon then, as, on examining the plants, by rubbing them between the hands, it be found that the wood breaks easily, while the plants are still green, they must be removed from the water and spread out upon the grass to dry.

In this operation, which is called *watering* the flax or hemp, it is necessary to employ *soft* water; as it is found that in hard water the fibres are much more readily injured. To account for this, it must be remembered that these waters owe their hardness to their containing a quantity of an earthy salt *; and these salts are found to promote the process of putrefaction, particularly the sulphate of lime or gypsum, which is the most abundant of these salts contained in hard waters.

* See *Mineral Waters*, CHEMISTRY *Index*.

127. The process of watering destroys the sap of the plants by effecting its decomposition. This sap is found to be composed chiefly of water, and what modern chemists have called extractive: by fermentation this extractive is separated into carbon, hydrogen, and oxygen. It is probable also that the water of the sap, as well as that in which the plants are steeped, is decomposed. These principles uniting again in different proportions form carbonated hydrogen, which is the cause of the offensive odour, and carbonic acid, which is found to proceed from the plants. The exposure to the air which they undergo, after steeping, contributes to the speedier escape of these principles.

After the drying the plants appear of a grayish white colour, which is called by workmen a flaxen gray.

128. One of the greatest advantages which modern chemistry has conferred on the manufacturer, is the enabling him to do the same work more completely in a shorter time than by the usual processes. Of this the present state of bleaching affords innumerable proofs. Even this process of *watering* may be greatly improved and considerably hastened. Several days are required before the fermentation is carried to a sufficient length, and with every attention, there is a chance of injuring the material. But it is found that this process may be performed by means of a weak alkaline ley without this danger.

129. The method recommended, is to convey the steam of water impregnated with caustic soda, in the manner which will be described hereafter for the bleaching of cotton and linen, through the plants of hemp and flax contained in a chamber of twenty or thirty feet square. The expence is trifling, as the ley need not be stronger than what was recommended for ungumming and bleaching silk.

130. When the watering is completed, the plants are to be kiln-dried. There now remains only the woody part inclosed in the fibres: to separate these is the object of the processes of beating and heckling. This is either performed by mallets and a sort of wooden anvils, and in this way hemp is beaten in houses of correction; or in mills erected for this purpose. In either way the wood is broken so as to allow of its being more easily detached from the fibres by heckling.

131. This refuse should not be thrown away, as it may be without much difficulty converted into paper.

132. The fibres are now ready for spinning and weaving, operations which it belongs not to this article to describe: we shall therefore take up the cloth as it proceeds from the hands of the weaver, when it comes properly under the direction of the bleacher.

133. The pieces of hempen and flaxen cloth, as they come from the loom, are covered with a dry coating of paste made of flour and water, which is called the *dressing*. This paste is applied to the threads of the weaver, to render the stretching of them more easy; and its removal is the first object in every method of bleaching.

134. For this purpose, all that is necessary is to steep the pieces in water for about forty-eight hours. Some manufacturers boil the pieces in the water, but this is improper, as the paste is not soluble in that fluid, even at the boiling temperature, but must undergo a decomposition by fermentation. To effect this the water should be of a temperature from 60° to 75° Fahrenheit; the fermentation then proceeds gradually, and the cloth sustains no injury. After remaining for a sufficient time, the pieces are taken out, and well rinsed in running water, either by treading with the feet or passing them under a fluted cylinder of wood.

135. By this operation the cloth is not only freed from the paste, but it acquires a degree of whiteness, and becomes of a lighter gray than before it was subjected to the water; for by the fermentation the texture

(G) It is very usual in Scotland to steep flax in burns or rivulets, as these are commonly found most convenient; but as the smell of the putrifying plants is intolerably offensive, and even unhealthy, and as the process is found to destroy any fish that may inhabit the stream, the practice ought to be discouraged, and in some countries is forbidden by the laws.

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ture of the pieces is loosened, the threads swell, and part of the colouring matter is decomposed.

136. The gray substance, which it is the principal business of the bleacher to remove, is of a resinous nature; and as the theory of the processes which we are presently to describe depends on an intimate knowledge of its properties, we shall be somewhat particular respecting it.

137. Kirwan, to whom chemistry in all its departments is so highly indebted, has submitted this matter to a set of ingenious experiments.

He procured from the bleach grounds a quantity of what the workmen called *dead ley*, which is the alkaline ley in which cloth had been steeped, and is consequently charged in abundance with the colouring matter. He found this liquor to be turbid, of a bluish red colour, having a peculiar taste, and a strong odour. It possessed neither alkaline nor acid properties.

138. To five pints of this liquor he added two ounces of weak muriatic acid, or spirit of salt; no effervescence was produced, but a considerable quantity of greenish matter fell to the bottom, and the liquor above remained of a reddish amber colour.

139. He next day, by means of a syphon, decanted off the supernatant liquor from the green precipitate, upon which he poured two pints of distilled water, stirred them well together, and allowed the matter again to subside: he then decanted off the water, and added a like quantity of fresh. This water still exhibited strong marks of acidity, and was of a reddish colour. He could not believe that after the addition of so much water, this acidity could arise from the muriatic acid which he had employed, as this was scarcely more than sufficient to saturate the alkali, which the liquor had originally held in composition. He concluded therefore that the liquor had contained a peculiar acid, which from its weaker affinity with the alkali, had been separated from it by the muriatic acid. He set apart two pints of this for farther experiments.

140. After successive washings of the precipitate, till it no longer appeared to retain any acid, he threw it on a filter: after being dried for some time, it became a tenacious mass of a greenish colour.

141. A very small portion of it was thrown into 60 times its weight of boiling water, but not a particle appeared to be dissolved. The remainder was dried in a sand-bath, after which it was brittle, of a glossy black without, and internally of a dull green: it weighed about an ounce and a half.

142. From eight pints more of the dead ley, he obtained a larger quantity of this green matter, on which he made the following experiments:

1. A portion of it was digested with rectified alcohol; a reddish tincture was produced, and a considerable part of the matter was dissolved; but on the addition of distilled water, the solution became milky, and a white precipitate gradually subsided. The black mass obtained in the former experiment, gave the same results.

2. These two matters were digested for a long time in linseed oil and essential oil of turpentine, but were not dissolved in either.

3. The black matter thrown on red-hot coals, burned with a yellow flame, and emitted a black smoke, leaving behind a coaly matter.

4. The green matter exposed to the action of sulphuric, muriatic, and nitric acids, gave a brown tinge to the former, and a green to the latter.

143. It is pretty evident from these experiments, that the extractive matter of the fibres of flax, which is obtained from them by the action of alkalies, is a resin of a peculiar nature, differing from pure resins in its being insoluble in essential oils, and in this respect having some resemblance to lacs.

144. Kirwan thought it necessary to try the action of alkalies on this matter. Eight grains were digested in a saturated solution of crystallized soda, at the temperature of 60° Fahrenheit, which was immediately tinged of a deep brown colour. Two measures of this solution of soda, weighing each 265 grains, did not entirely dissolve the matter, but two measures of a solution of potash dissolved the whole.

A measure of caustic soda of the specific gravity 1.053, dissolved nearly the whole, leaving a small quantity of a white substance.

A measure of caustic potash of the specific gravity 1.039 dissolved the whole.

A measure of an alkaline sulphuret or liver of sulphur, of the specific gravity 1.170, also dissolved the whole.

A measure of ammonia dissolved a small portion of it.

145. These experiments were sufficient to satisfy Mr Kirwan; but, for the purposes of the manufacturer, he judged it proper to repeat them with the ordinary saline substances employed in bleaching, and with soap.

He therefore dissolved an ounce of the soda of commerce, and as much Dantzic potash, each in six ounces of distilled water; he added eight grains to an ounce measure of each solution, and allowed them to digest together in a temperature of 180° Fahrenheit for three hours and a half. At the end of this period it was found that more was dissolved in the potash than in the soda, and an ounce of this latter was required to complete the solution, whereas this was effected by the addition of half an ounce of the Dantzic potash liquor; thus shewing the superiority of the potash over soda.

An ounce of white soap was dissolved in eighteen ounces of distilled water; the solution remained turbid, and could be rendered transparent only by bringing it to the boiling heat, an operation which he found extremely difficult; for when the fluid was near boiling, it was thrown out to a distance of more than three feet from the matrass. After completing the solution, he found that three ounces of it were required to dissolve eight grains of the colouring matter.

146. In forming an accurate idea of the comparative effect of these solutions, it must be observed, that an ounce of the soda of commerce contains only 114 grains of pure soda, and consequently, supposing the solution to have been made as above, in six ounces of water, each ounce will contain 19 grains of soda, while an ounce of the solution of Dantzic potash contains fifty grains.

147. He tried the effect of lime on the colouring matter, on which it produced little effect; three ounces of water saturated with lime were employed, which contain at most three grains of that earth.

148. Having been so full on the nature and previous preparation of flax and hemp, it remains only to say something

something on cotton before we proceed to the bleaching of these substances.

149. Cotton is a filamentous substance or down, which is found surrounding the seeds of the cotton plant.

This substance, as it is first obtained from the plant, is covered with a brownish coloured matter, by which it is rendered dirty and opaque. This matter is of a greasy nature, in which it resembles the oil contained in wool, as is evident from the slowness with which raw cotton imbibes water, and the avidity with which it attracts it after having been scoured. Scouring, by removing this greasy matter, also renders it clear and transparent.

150. There is considerable variety in the quality of cottons, arising from their different kinds, the climate in which they were produced, and the degree of culture which they received. They are sometimes of a yellow colour, sometimes white, but most commonly their colour is a dirty yellow.

151. The bleaching of cotton does not call for those preparatory operations which we have described as necessary for hemp and flax. It is first to be scoured by steeping it in a slight alkaline solution, or, what is better, by exposing it to the vapour bath in the manner which we shall soon direct. After this operation, the cotton is to be placed in baskets in the stream of a river or other running water, so as to be well rinsed.

152. After the immersion of cotton in an alkaline ley, there is always left, however completely it be rinsed, a small quantity of an earthy sediment. This may be removed by the cautious use of acids. We know that cotton bears the action of acids much better than either hemp or flax, and that it may remain exposed to them for some time without injury. Advantage has been taken of so fortunate a discovery, and it is found, that by keeping the cotton for a short time pressed down in a very weak solution of sulphuric acid and subsequent thorough washing, to remove all the acid, this earthy sediment may be completely removed.

153. The methods which have been employed or recommended for the bleaching of hemp, flax, and cotton, may be reduced to five, viz.

1st, By the action of the atmospheric air, assisted by alkalies and soaps.

2d, By the action of water only.

3d, By the action of the oxygenated muriatic acid, or dephlogisticated marine acid of Scheele: and this method may be resolved into four; according as the acid is employed in its simple state of combination with water, or in combination with other matters.

a, By the action of oxy-muriatic acid alone.

b, By the action of oxy-muriatic acid combined with potash.

c, By the action of oxy-muriatic acid combined with lime or other earths.

d, By the action of oxy-muriatic acid combined with sulphuret of lime.

4th, By the action of diluted sulphuric acid.

5th, By the action of steam impregnated with caustic alkali, or by employing this alternately with the oxymuriats. Of these we shall treat in the above order.

I. *Of Bleaching by the Action of Atmospheric Air.*

154. This is the method which was commonly adopted till within these twenty years, and is still retained in some old manufactories. After steeping the cloth, as has been related (134.), to remove the weaver's dressing, the pieces are dried in the field, and then submitted to the operation of *bucking*.

For this purpose a ley is prepared by dissolving a quantity of potashes in soft water, and boiling it for about half an hour, when it is allowed to settle, and forms what is called the *mother ley*. For bucking, this mother ley is weakened by the addition of 16 or 18 times its bulk of water; and to this is generally added a quantity of soap, or, for the sake of economy, a few gallons of ley which has already been employed for the first buckings. This liquor, which has been called the *bucking ley*, is now heated to about 100 degrees, and poured on the pieces sorted according to their quality. After pressing the cloth well down in the ley, it is drawn off, heated a little higher, and again poured upon the cloth. This operation is repeated at intervals, allowing the ley to remain longer each succeeding time, and moderately increasing the heat to the bucking temperature, for five or six hours. Then the cloth is left steeping for three or four hours, when it is taken out, well rinsed, and carried to the field.

155. Here it is spread out upon the grass and secured by pins; water is sprinkled on it so as not to allow it to become dry for some hours. After it has lain about half a day the watering is less frequent, and at night it is left to the full action of the air and dews. On the succeeding days it is watered three or four times a-day if the weather be dry, and thus it remains on the field till the air seem to have less effect in whitening. It is then brought back to the coppers, and bucked again with a ley somewhat stronger than the last, rinsed, and again spread out on the field. It is thus alternately bucked and watered 10 or 15 times according to the weather, making the bucking stronger and stronger till about the middle, and then weaker and weaker till the last, after which it undergoes the process of scouring or steeping in some acid liquor.

156. The acid which has been usually employed in the process of scouring is generated by the fermentation of bran and water; or, where the bleachfield was in the neighbourhood of a dairy, sour whey was used for this purpose. It has been found that a very weak solution of sulphuric acid is more convenient and not more injurious than these, and this is now generally employed. The cloths are steeped in the souring for five or six days, if it be formed of milk or bran, or a less time where the sulphuric acid is used, and they are then given to the washers to be rubbed with soap, which is more particularly necessary to the selvages, as these resist the action of the air and alkalies longer than the rest of the cloth.

157. After being well soaped, the cloth is again bucked in a strong ley, rinsed, and again watered and exposed to the air, and all these processes are repeated in succession till it has acquired the requisite degree of whiteness. It must be observed that the strength of the acid liquors is diminished at each succeeding immersion.

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158. The theory of these operations was, till lately, very little understood, but it admits of an easy explanation by the principles of modern chemistry. It has been proved, as will be shewn in chemistry, that the air of the atmosphere consists principally of two airs or gasses, oxygen gas or vital air, and azotic gas, in the proportion of about .23 of the former to .77 of the latter. The only active principle in most of the operations of art and nature appears to be the oxygen, and this uniting with various inflammable bodies produces acids. Now the colouring matter of cloth is a compound inflammable matter or resin, composed chiefly of carbon (the base of charcoal), and hydrogen (the base of hydrogenous gas or inflammable air). As has been shewn, this is partly soluble in alkalies; hence the use of the alkaline leys in bucking is to dissolve as much as possible of the colouring matter; but, as the action of the alkali extends only to the surface of the cloth, it is soon over. The subsequent exposure to the air promotes the union of the carbon and hydrogen with the oxygen of the atmosphere, producing carbonic acid gas, or fixed air, and water.

When it was the fashion to denominate every combination of oxygen with an inflammable substance, combustion, this was considered as a species of burning*.

*Vide *Higgins's Essay on Bleaching*, p. 53.

159. The great objection to this method of bleaching is its tediousness, two or three months being requisite to give the cloth the necessary whiteness. The simplicity of it, and the little apparatus it requires, recommend it however on some occasions; and accordingly it is employed by those country people who make their own cloth, particularly in Scotland.

The bucking of coarse cloths is expedited by boiling them in the ley, but this is seldom required for the finer kinds.

II. *Bleaching by Water only.*

160. We have observed (135.), that during the process of steeping, the cloth acquires some degree of whiteness; and it was long ago remarked, that the pulp from which paper is formed, while acted on by the stampers, was rendered whiter than before; it is found too, when the stalks of hemp and flax remain too long in the water in which they are steeped, they become considerably whiter, while, however, their texture is much injured. A manufacturer of Amiens, M. Brasse, conceived that, by cautious management, he might turn these facts to account, and bleach by means of water alone, which would be certainly one of the most economical methods. He allowed the hemp (for to this his experiments seem to have been confined) to remain steeping till the bark was pretty much destroyed by the fermentation. He then drew it through the teeth of a heckle or comb, which easily tore away the half putrid bark, permitting the fibres to pass uninjured between the teeth. During this process the hemp was perpetually immersed in water, by which means the green bark was much more easily separated, and the fibres acquired a much greater degree of brilliancy. Indeed, the whiteness produced in this way is truly surprising, and it is much to be regretted, that this cannot be obtained without injuring the quality of the cloth, which is prepared from the hemp thus treated. By this operation, however, the hemp does not acquire so pure a white as to render unnecessary the other processes, but by it these would be greatly shortened.

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161. As it is a matter of the greatest consequence to the bleacher, to be perfectly acquainted with the nature of the substances which he employs, as well as the most economical and convenient methods of procuring or purifying them, we shall take an opportunity, in the course of this article, of treating these subjects pretty fully. There is no material which has been more extensively employed in bleaching than potash or potashes.

162. If a pile of wood, or a heap of land-plants tolerably dry, be kindled and burned in the open air till the whole is consumed, there remains a considerable quantity of ashes, which on being boiled in water, impart to this fluid a strong saline taste, and give it the property of tinging syrup of violets, or any blue vegetable infusion, of a green colour. It was long ago known, that this liquor, thus impregnated, possessed the valuable property of facilitating the removal of dirt and grease from cloth or linen, and with these views it has been employed from time immemorial; and is still used for this purpose by the country people. At length it was discovered, that by driving off the water by evaporation, the useful part of the liquor might be obtained in the form of a whitish solid substance, which being thus rendered capable of being carried to any distance, or kept in a dry place to any length of time, was much more convenient than the liquor itself. It is said that the Germans were the first who procured this salt in the solid state from the ashes of wood; and as it was prepared by boiling in iron pots, it received the name of *potash* or *potashes*.

163. Potashes have long been a considerable and lucrative article of commerce, and a great quantity is annually imported into the British empire, for the purposes of several manufactures, but particularly for the process of bleaching. The greatest quantity is brought from Russia and America, and of these the American is considered as the best. Good potashes should be very soluble in water, and should leave a small quantity of sediment, and they should have the property of easily *deliquescing* or becoming moist when freely exposed to the air. But as the sale of potashes is extremely extensive and beneficial, it has been found *convenient* to the vender to increase their bulk by the addition of some other substance which he can procure at a cheaper rate; it is therefore of much importance that the manufacturer should be able to detect this imposition, which he will not find a difficult matter.

164. The ashes of most plants, besides the alkaline salt, which is more properly called *potass*, and of which we shall speak presently, contain a compound salt, formed of this potass united to sulphuric acid, called sulphat of potass. This salt is an injurious addition to the potass, as it possesses no detergent properties, and is very little soluble in water, one part requiring 16 of water at an ordinary temperature to dissolve it. This salt is sometimes added to the potass by the merchant or the manufacturer to increase its bulk, and as it is a very cheap article in comparison with potass, the adulteration turns out very profitable.

"During a mineralogical excursion through England," says Mr Higgins, "in the summer and autumn of the year

year 1785, the different manufactures which fell in my way were not passed over. Upon inquiring of the distillers of aquafortis (nitrous acid) how they disposed of the large residuum left in the still, which is sulphat of potash, and which is of little or no use in the arts, they informed me it was bought up by the Irish merchants.

"Sulphat of potash, when ground down, cannot readily be distinguished as to its external appearance, from pearl-ash, and being so much cheaper than the latter, is well calculated for the above fraudulent purpose.

"By no means do I intimate that this is a common practice, as from experience I know the contrary.

"However, to pass it over in silence would be unpardonable, when it is considered that the bleacher is at the expence of an article of no use whatever in bleaching, and that, by the adulteration, the proportion best known by experience to answer his purpose, is varied; by which means his process, although not altogether frustrated, must be materially retarded *."

* Higgins on Bleaching, p. 14, 15.

165. The difficult solubility of sulphat of potash renders it easy to separate it from the pure alkaline salt. Higgins gives the following method.

"Three pounds of pearl-ash, and two quarts (a Scotch pint) of water, should boil together for a few minutes, then be removed from the fire and suffered to stand for twenty-four hours, when the clear liquor is to be decanted off. Half a pint more of cold water is to be poured upon the dregs, and this again drawn off when clear. The insoluble salt is afterwards to be well dried and weighed, which being a foreign salt, will give pretty nearly the quantity of impurities in the potash.

"I would recommend the above mode of analysis to the bleachers before they purchase or use this potash †."

† Ib. p. 16.

166. Though the potash in the state in which it is sold answers sufficiently well for many purposes, it is not, however, pure potash, but is a compound salt formed of this united to carbonic acid, or fixed air, and it is called by modern chemists *carbonat of potash*. It is necessary for some processes to have it in the pure and caustic state, in which it acts much more powerfully. The carbonic acid is carried off by means of lime, for which it has a greater affinity than for potash. For this purpose a quantity of quicklime fresh burnt is to be slaked with soft water in a wooden or iron pot, and afterwards the potash is to be added dissolved in water, after being purified in the manner above directed. They must stand together well covered from the air for some hours, frequently shaking the vessel, and then the fluid may be drawn off clear for use. This is commonly called soap-leys, as it is used in the manufacture of soft soap; it is called *caustic alkali*, from the violent action which it exerts on animal and vegetable matters, which it corrodes or burns very speedily; whereas the action of carbonat of potash is much less violent, and this is therefore distinguished by the name of *mild alkali*. The use of the caustic ley requires great caution, but when sufficiently diluted it is perfectly safe.

167. It is proper to remark here, for the sake of manufacturers who are not scientific chemists, that the lime is of no farther use here than taking the carbonic acid from the potash, by uniting with which it is converted into chalk or carbonat of lime. The effect which the lime has in rendering the alkali caustic, was long known to manufacturers, and they were led to suppose that it entered as an ingredient into the soap ley, and was itself useful as a detergent substance. This capital error led some into the employment of quicklime in bleaching without any addition, by which means the texture of the cloth was greatly injured.

168. As potash is the alkali which has been most employed in bleaching, we have mentioned it first; there is, however, another of still greater consequence in most manufactures, and which deserves our particular attention, from its being employed in the method of bleaching by steam, to be described hereafter. This is called *soda* or *mineral alkali*.

When sea-weed or wrack, and several plants which grow on the sea-coasts, particularly several species of salsola and salicornia, are burned, the ashes form an impure alkaline mass of a different nature from that produced by the burning of land plants. What is obtained on our coasts from the sea-weed is called *kelp*, and that which is brought from the continent, especially from Spain, is called *barilla*, or *barilha*. The latter is the purer of the two, and is generally employed in the manufacture of soap. When these masses are reduced to powder, boiled in water, and the liquor filtered, sufficiently evaporated and set by to cool, a quantity of large beautiful crystals are obtained, which are *carbonat of soda*, or *salt of soda*.

169. The soda, as contained in *barilla*, is in a much more caustic state, or less of it is combined with carbonic acid, than potash in the raw state; neither of these alkalies will crystallize in the caustic state, but by standing for some time freely exposed to the atmosphere, they imbibe from it carbonic acid gas, and are then capable of crystallization. It is therefore necessary to allow the solution obtained from barilla or kelp to stand thus exposed for about a week. It must then be evaporated to a proper degree, determined by experience or by the areometer for salts, and set by to crystallize. To make sure of obtaining crystals, which it is not always easy to procure, it would be better to evaporate to dryness, then dissolve the dry mass in the least possible quantity of boiling water, and, on cooling, crystals will be formed.

170. Soda, as existing in barilla and kelp, is sometimes contaminated by the mixture of muriat of soda, or common salt, from which it may be freed by careful evaporation. Carbonat of soda is less soluble in cold than in hot water, while the solubility of muriat of soda is much the same in both. After obtaining the first crop of crystals, therefore, which will be pure carbonat of soda, the remainder of the solution must be gently evaporated to about one half, when part of the muriat will separate and remain at the bottom of the vessel: the hot liquor is now to be poured off from it and set by to cool; when a fresh crop of crystals will be obtained, and thus the remainder is to be successively treated till all the soda is procured, and all the salt separated.

171. For most purposes of the manufacturer, soda is required in its caustic state, and for this purpose, the carbonic acid is removed by means of quick-lime. But as barilla contains most of it in a state sufficiently caustic for the ordinary purposes of the bleacher, he is seldom at the pains of purifying it. The usual way is to tie up a quantity of powdered barilla in a thick canvas bag, which is

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Vegetable Substances. is suspended in the copper in which the cloth is boiled. A sufficient quantity of the soda is thus dissolved in the water, and imbibed by the cloth, while the insoluble dregs remain behind in the canvas bag. For the finer cloths, however, and for the purposes of bleaching with vapour impregnated with caustic soda, it would be much better to obtain the soda in its purest form.

172. Soap is an article of the utmost importance to the bleacher, and which we are naturally led to consider after speaking of potash and soda.

These alkalies readily combine with vegetable oils and animal fat, and on this property is founded the manufacture of the detersive substances denominated *soaps*. There is a difference sufficiently marked between the soap produced by the union of fatty matters with soda, and that formed from their union with potash. The former combination produces a hard, the latter a soft soap. The invention of this valuable substance is attributed by Pliny to the Gauls. The original composition of soap seems to have been much the same in all ages, but the first attempts to make it appear to have been extremely rude. The ancients formed their soap of goats fat mixed with the ashes of beech. Various improvements have been successively and gradually introduced into the manufacture, in proportion as accident, the parent of the most important discoveries, pointed out their necessity.

173. In France two kinds of soap are manufactured; hard, formed of soda, combined with olive-oil, and soft, composed of potash and vegetable oils, of inferior quality.

In Hungary and some parts of Germany, soap is made of tallow and barilla. A hard soap is prepared in Russia of bad salt butter, but it is held in little estimation, as the rancidity of the butter, and the quantity of cheesy matter which it contains, contribute to render it of a very inferior quality. We are informed by Weiglib that they also form a very hard soap of yellow and white bees wax, which has a very agreeable smell of almonds.

174. In Britain, where vegetable oils are by no means plentiful, and are consequently expensive, they manufacture this soap entirely with animal fat, employing either tallow, fish-oil, kitchen grease, or stale butter. There are four kinds of soap manufactured here. 1. A hard white soap formed of soda of Alicant, and of Varech, combined with tallow. 2. A marbled soap, made of soda, tallow, and kitchen grease: the marbling is produced, not by a metallic oxide, as is the case in France, but by mixing a little ley towards the end of the boiling with the whole matter, drawing off the surplus to prevent the marbled part from setting, and then quickly conveying the soap into the frames to cool suddenly; this is at least the way in which the red marbled soap is made with us, but the motled appearance in the blue marbled wash-balls is said to be occasioned by indigo*. 3. A hard yellow soap composed of soda, tallow, and rosin, which last seems to be added to make the soap cheaper, as it certainly does not increase its detersive property; and indeed it is said that the use of rosin is very injurious both to the arms and hands of the washers who employ this soap, which it irritates exceedingly, and to the linen washed with it, to which it gives a yellow colour. 4. A soft soap, formed of whale or other fish oil combined with potash.

* Monthly Mag. for July 1803.

175. Attempts were long made to discover substances, which might supply the place of these fatty matters, in the manufacture of soap. It was reserved for Chaptal to point out the road to this valuable end, by introducing his soap formed of wool, and thus converting scraps of cloth and pieces of old woollen garments, into an excellent soap. He has been followed in Britain by Sir John Dalrymple, who conceived, that by a process similar to Chaptal's he might form a soap of the muscular parts of the fat fish. Some successful experiments completely proved the justice of the idea (H).

III. *Of Bleaching by the Oxygenated Muriatic Acid.*

176. The *muriatic acid* (see CHEMISTRY), or *spirit of salt*, is not proved to contain oxygen, to which most other acids appear to owe their acidity. It is, however, capable of combining with this principle, by the addition of which it acquires new and very extraordinary properties. It will take oxygen from most of the metallic oxides or calces, as red lead, or, what is more commonly employed, the black oxide of manganese. If the muriatic acid be digested for some time, over either of these oxides, it acquires a most penetrating and suffocating odour, and instead of reddening a blue vegetable infusion, it banishes the colour altogether. It is this latter property of destroying colours, which renders the oxygenated muriatic acid of such importance in bleaching.

For the discovery of this acid, we are indebted to the immortal Scheele of Sweden, who was also acquainted with its property of discharging vegetable colours. The true application of this property, however, to the purposes of bleaching we owe to M. Berthollet, of whose paper in the annals of chemistry, (*Annales de Chimie*,) we shall present a brief abstract, as this was the foundation of all those improvements which have been lately made in the art, and of which we are presently to speak.

177. The oxygenated muriatic acid is obtained in the form of an air or gas, and was procured by Scheele in the following manner. He put a quantity of black oxide of manganese reduced to powder, into a glass retort, and poured on it some muriatic acid. To the retort he fixed a receiver, capable of holding twelve ounces; but containing only two drachms of water. On placing the retort in a sand bath, so that any acid which came over unchanged might fall back, and applying heat, the receiver was soon filled with a yellow-coloured gas. Having filled one receiver, he applied others successively, till no more gas was extricated, or till he had obtained sufficient for his experiments.

178. The experiments made by Scheele to ascertain the nature and property of this acid were few and simple; he suspended several substances in the necks of the receivers, and observed the following facts.

1. The

(H) For a full account of the manufacture of this soap, vide *Annales des Arts et Manufactures*, par O'Reilly.

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1. The corks which closed the mouths of the vessels which contained the gas, were rendered yellow, as if they had been corroded by nitric acid (aquafortis). 2. Paper tinged blue, with infusion of litmus or tournsol, was rendered nearly white. 3. The red, blue, and yellow parts of flowers, as well as the green leaves of vegetables, were by the action of the gas rendered pale and colourless. 4. When those changes were produced by the action of water, by which this gas had been absorbed, the water was changed into very weak common muriatic acid. 5. Neither acids nor alkalies were capable of restoring the original colours thus changed.

179. Berthollet repeated and confirmed these experiments of Scheele's, and explained the theory of the changes produced by the action of this new substance. "I have shown," says he, "that one portion of the common muriatic acid employed in the preparation dissolves the oxyd of manganese, and displaces a part of the oxygen, or basis of vital air, which was, in that substance, combined with the metal in larger proportion than is necessary for enabling it to be dissolved in acids. This superabundant and now disengaged oxygen being in a non-elastic form, or, as Priestley calls it, *in a nascent state*, and being thereby greatly disposed to enter into new combination, unites itself to the other portion of the muriatic acid, and, in consequence of this union, the oxygenated muriatic acid gas is produced."

Having examined and explained the experiments of Scheele, Berthollet goes on to make others of his own.

180. His first object was to examine the degree of solubility of the gas in water, which he suspected to be greater than Scheele had supposed.

181. "He soon perceived, if a body with a recurved tube be filled with this water, impregnated with the dephlogisticated or oxygenated muriatic acid, and the outer extremity of the tube be immersed under a receiver filled with water; if, in this situation, the fluid be exposed to the light of the sun, bubbles are soon disengaged, which pass into the receiver, and are found to consist of pure or vital air. When the bubbles have ceased to be disengaged, the liquor is found to have lost its characteristic smell, colour, and all its distinctive properties; and is found to consist of mere water, containing a proportion of common muriatic acid. This simple experiment, M. Berthollet observes, ought to be sufficient to afford a conviction, that the oxygenated muriatic acid is really nothing but a combination of the muriatic acid with basis of vital air, or oxygen, which is found so abundantly in the black oxyd or calx of manganese, that nothing more is necessary than to urge this oxyd by a strong heat, in order to obtain a large quantity. Manganese, thus treated, is no longer proper to form the oxygenated muriatic acid; because it is deprived of that portion of oxygen which is required to combine with part of the muriatic acid.

182. "He remarks, that light possesses the property of disengaging the oxygen which was combined with the muriatic acid, by restoring that elasticity of which it was partly deprived; a restoration not to be effected by mere heat: he concludes therefore that the light combines with the oxygen, and that the elastic state of vital air is owing to this combination: which air, by losing a second time its elasticity in the process of combustion, that is to say, by a rapid combination with some other body, again suffers the principle of light to escape, at the same time that much heat is disengaged; the relation of which last substance with light is still an object for future discovery.

183. "If vegetable colours be plunged in the oxygenated muriatic acid, they disappear more or less speedily, and more or less perfectly. When the substance under examination possesses a mixture of different colouring parts, some disappear more readily, and leave only those which more effectually resist the power of this agent, but have nevertheless suffered a considerable alteration. The yellow colouring matters usually resist the most strongly, but at length they all disappear; and when the oxygenated muriatic acid has exerted its whole action, it is found to be reduced to the state of ordinary muriatic acid. Hence it follows, that the colouring matters have deprived it of its oxygen, or vital air; and have, by this combination, acquired new properties, at the same time that they have lost that of producing colours. This ingenious chemist declines entering, in his present memoir, into the properties of these oxygenated substances; and proceeds to observe, that the oxygenated muriatic acid owes its property of destroying colours to the oxygen, which not only is combined abundantly with it, but likewise adheres with very little force, and readily passes into a state of combination with such substances as have a certain degree of affinity with it. The habitudes of such a variety of colouring matters as exist in nature, with the oxygen, with light, with alkalies, and with other chemical agents, cannot but form a highly interesting, and almost entirely unexplored, part of natural philosophy.

184. "After having observed the action which the oxygenated muriatic acid exercises in general upon colouring matter, he concluded that it might produce the same effect upon those substances which colour thread and linen, and which the art of bleaching proposes to destroy. Without confining himself to describe the process as now practised, he enters into a concise detail of the imperfect essays he made at first, a detail which will be by no means without its utility to such as are desirous of carrying the process into execution.

185. "He at first used a very concentrated liquor, which he renewed when exhausted, until the thread or cloth appeared sufficiently white; but in this way, he soon perceived that their texture was considerably weakened, and that they were even entirely deprived of their solidity. He therefore slightly diluted the liquor, and succeeded in bleaching his cloth, without altering it; but it soon became yellow by keeping, and more especially when it was heated, or subjected to the action of an alkaline lixivium. He directed his reflections, therefore, to the circumstances of the usual process of bleaching, which he endeavoured to imitate; because he had adopted the opinion, that the oxygenated muriatic acid ought to act in the same manner as the exposure of cloth upon bleach-grounds; which exposure alone is not sufficient for the purpose, but appears merely to dispose the colouring matter to solution in the alkali of lixiviums. He examined the dew which is precipitated from the atmosphere, and likewise

wise that which is afforded by the nocturnal transpiration of plants; and observed that both the one and the other were saturated with oxygen to such a degree, as to destroy the colour of paper weakly tinged with tournsol; and he remarks that the ancient prejudices respecting May dew, which is the season wherein the transpiration of plants is abundant, might probably depend on some observation of this nature.

186. "He therefore employed, alternately, the lixiviums, and the action of the oxygenated muriatic acid; by which means he obtained a permanent white. And as it is the practice, in the ordinary way of bleaching, to pass the cloth through sour milk, or vitriolic acid, diluted with a large quantity of water, he made the trial likewise of passing his cloths through a very diluted solution of vitriolic acid, and observed that the white was much brighter.

187. "As soon as he had made use of the intermediate lixiviums, he found that it was not necessary to use a concentrated liquor, or to leave the cloth long in the fluid at each immersion. By this observation he avoided two inconveniences, which might have rendered the process impracticable in the large way: the first is, the suffocating smell of the fluid, which would be very incommodious, and even highly dangerous to be respired for a long time, and which has discouraged several operators from pursuing their attempts in this way: the second is, the danger of weakening the cloth. At this period of his experiments he likewise gave up the idea of mixing alkali with the oxygenated muriatic acid, as he had before done in most of his experiments *.

* *Journal de Phys.* 1785.

188. "This was the state of the experiments of this excellent chemist when he repeated them in the presence of the celebrated Mr Watt. A single glance, he observes, is sufficient to a philosopher whose abilities had been so long exercised upon the arts. Mr Watt soon afterwards wrote to him from England, that in his first operation he had bleached 500 pieces of cloth on the premises of Mr Grigor, who has large bleach-grounds at Glasgow, and continues to use this new process.

189. "In the mean time M. Bonjour, who had assisted M. Berthollet in his experiments, and who to a large share of sagacity has added a very extensive knowledge in chemistry, entered into an agreement with Mr Constant of Valenciennes to form an establishment in that town. The project was opposed by the prejudices and interest of the bleachers, who were apprehensive of the competition of a new method. Mr Constant could not even procure a piece of ground in the town of Valenciennes: but the Count de Belainge favoured this enterprise, and gave up a piece of ground which possessed every advantage; but, being at a certain distance from Valenciennes, would have the disadvantage of distance, if any manufactory should be established at Valenciennes itself. M. Bonjour had given up the well-grounded hopes which his knowledge and talents gave him reason to expect at Paris: and had in return found, in the enterprise to which he had devoted his attention, nothing but those disgusting circumstances which usually accompany new processes in the arts. He addressed himself to the Bureau de Commerce, not to reward his services, but to request that he might be defended from the disadvantages and obstacles which prejudice and an opposition of interest had created in Valenciennes, by granting to him a certain space of two leagues round Valenciennes and Cambray, in which he alone might, during a certain number of years, exercise this new art; without constraining in any respect those who might choose to adhere to the ancient processes, or attempt new processes, in which no use should be made of the oxygenated muriatic acid. He offered to instruct in his manufactory, in all the details of his process, all such as might be desirous of using it, and might obtain the sanction of the ministry. It is probable that, if his request had been granted, the establishment at Valenciennes might have produced a greater degree of confidence in those who had undertaken to make the necessary advances. It is probable, continues M. Berthollet, that they might have shortened their trials, instead of establishing the process at Courtray, as they have done; many artists might probably have been formed under the direction of M. Bonjour; and a great number of establishments might have been formed in the French provinces, by avoiding those fruitless trials which tend to throw discredit upon an useful art.

190. "As soon as M. Berthollet had reason to hope that the process might be executed in the large way, he endeavoured to diminish the price of the liquor, by decomposing the marine salt in the very operation which served to form it. His first trials were unsuccessful; but Mr Welter, a young ingenious chemist, to whom M. Berthollet had entrusted the management of the process, observed that it might be of advantage to dilute the vitriolic acid; and the operation then succeeded in the most satisfactory manner. He immediately wrote to M. Bonjour and Mr Watt, the latter of whom informed him that he had made this change from the first: and the operation was long afterwards described by M. Chaptal in a memoir forwarded by him to the Academy of Sciences. Mr Watt had likewise made use of a certain cask or butt, of a construction which M. Berthollet was not acquainted with; but, before this apparatus was mentioned, Mr Welter had constructed one, which is not only very proper to prepare the oxygenated muriatic acid, but very well calculated for several other chemical operations.

191. "The intention of this apparatus is to multiply the surfaces of contact between the gas and the water, as it is evident that the combination can take place only at their surfaces. That part of the gas which did not enter into combination in the lower space, where it is first conveyed, passes into a second cavity or space, which is above the tube intended to give it vent. The vessel which is intermediate between the pneumatic cask and the distillatory matrass, is designed to retain that part of the muriatic acid which is not oxygenated: a small quantity of water is put into this vessel, a glass tube being plunged therein, the height of which exceeds that of the column of water the gas must overcome in the cask. The gas which passes out of the matrass compresses the water in the intermediate vessel with a force equal to that opposed to its disengagement; so that the water rises in the tube of safety, and forms a column equal to the weight of the water which

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which presses on the tube through which the gas enters the cask. But if, during the operation, a sudden cooling or rapid absorption of gas should take place, the water descends again in the tube, the air of the atmosphere enters, and prevents a vacuum from being formed within, which would have been attended with a resorption of the liquor, and consequently break the distilling vessel by the sudden cooling.

192. "If the oxide or calx of manganese be of a good kind, in small crystals, and contain very little foreign matter, the proportions which M. Berthollet found best calculated for distillation, are the following:

193. "Six ounces of pulverized calx of manganese, one pound of pulverized sea salt, twelve ounces of concentrated vitriolic acid, and from eight to twelve ounces of water. If the calx of manganese contain foreign earth or metallic substances, the quantity must be augmented in proportion to its impurity. It will be known, after the operation, whether a sufficient quantity has been employed; because a small quantity ought to remain undecomposed, and of its original black colour: from this observation, the quantity proper to be used in the following operations may be ascertained.

194. "When the calx of manganese is found to contain calcareous spar, as may be known by its effervescing upon the contact of a small quantity of vitriolic acid, it is proper to wash it before the operation with diluted vitriolic acid, to separate the calcareous part, which might be troublesome on account of the effervescence it produces: the calx must be dried after this washing.

195. "M. Berthollet is of opinion, from his trials, that when the calx of manganese contains much phlogisticated air, it is scarcely proper to form the oxygenated muriatic acid: M. Fourcroy, however, asserts, that the phlogisticated air escapes in distillation from manganese by a degree of heat less than ignition, but that ignition is necessary to deprive it of its vital air. It might perhaps be found advantageous to make use of this information to purify such manganese as contains phlogisticated air, by distilling off this last aerial substance by a moderate heat before it is applied to the purpose of oxygenating the marine acid.

196. "A greater or less quantity of water must be added, not only according to the degree of the concentration of the sulphuric acid, but likewise according to the quantity of matter subjected to distillation. If this quantity be considerable, the acid must be more diluted than if it be small. It might be more advantageous to make use of an acid which had not been concentrated; because the operation of concentrating it adds to its price, and it is obliged to be again diluted with water. But M. Berthollet observes, that this saving can only take place when the manufactory of the vitriolic acid is near at hand; for in those situations where this acid is to be brought from a considerable distance, the expence of carriage of a greater quantity of fluid might exceed that of concentrating it.

197. "When the materials are prepared, the calx of manganese must be carefully mixed with the sea-salt, and the mixture introduced into the distillatory vessel, placed on a sand bath: the vitriolic acid must then be diluted, and suffered to cool; after which it is to be poured on the mixture, and the tube of communication between the matrass and the intermediate vessel quickly fitted in. A particular attention to the lutings is required in this operation. M. Chaptal takes notice that when the vapour is perceived to escape by the smell, it is sometimes difficult to ascertain the imperfect place; but that if a feather dipped in volatile alkali be passed on such occasions over the lutes, it will shew the faulty place, by the white cloud of ammoniac formed in consequence of the combination of marine acid with the volatile alkali.

198. "The size of the vessels ought to be such, that the matrass should be about one-third empty; and that, for the quantity here laid down, the casks should contain 100 pints of water, with an empty space of the bulk of about ten pints; because, when the gas comes to occupy the cavities designed to receive it, the water will require a space into which it may ascend.

199. "Before the operation is begun, the pneumatic cask must be filled. The mixture being made, the gas, which soon begins to be disengaged, first drives the atmospheric air out of the apparatus. As soon as it is apprehended that the atmospheric air has passed into the cavities, it is emptied out by means of a recurved tube, successively introduced beneath each; and in order to drive the water out which has entered into the tube, M. Berthollet recommends blowing strongly into it. The operation is suffered to go on without the application of heat, until it is perceived that the bubbles are more slowly emitted: at this period, a slight degree of heat is applied. It must not be strongly urged at the beginning; but by a gradual increase it is at last to be carried to ebullition, towards the end of the operation. It may be known when the operation is near its termination, by the tube of communication and intermediate vessel becoming hot.

200. "When the gas is no longer disengaged but in small quantities, the fire is to be put out, and a sufficient time must be suffered to elapse until the matrass is nearly cold. The tube of communication may then be removed, and hot water poured in to keep the matter in solution, that it may be more easily taken out: this residue is to be poured into a large vessel, intended to preserve it for a use to be presently mentioned. The operation lasts longer in proportion to the quantity of matter. With the before mentioned quantity, it ought to last five or six hours. It is proper not to be too much in haste, because a larger quantity of gas is by that means obtained. One single person may inspect and manage several of these apparatus, and the quantities may be much larger.

201. "The intermediate vessel gradually becomes filled with a fluid, which consists of pure but weak muriatic acid: several operations may, however, be made without taking it out; but when it is apprehended that there is not a sufficient space left empty, this acid is taken out by means of a syphon: and, when its quantity is considerable enough, it may be substituted instead of the mixture of sulphuric acid and muriate of soda, in a similar operation, if it be not wanted for another use. In order that the quantity of common muriatic acid which passes out of the matrass, may be inconsiderable, it is expedient that the first tube should make a right angle, or even a more obtuse angle, with the body of the matrass. During the operation, it is necessary to stir

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stir the water, from time to time, by means of the agitator, in the apparatus, to favour the absorption of the gas by the water. When this is completed, the liquor is sufficiently strong to be used in bleaching. A smaller proportion of water may be put into the cask, and the fluid may afterwards be properly diluted.

202. "In this state of concentration, though the liquor retains a considerably strong smell, yet it cannot prove noxious, or even very inconvenient, to those who use it. It is nevertheless proper to conduct it into the vessels in which the cloths are arranged, by wooden channels, fitted to the opening at the lower part of the cask. It is proper to draw off the liquor from the cask as soon as it is prepared, because it acts upon the wood, and not only becomes by that means weaker, but likewise hastens the destruction of the cask: but when it is conveyed into a vessel in which cloths are properly placed, these speedily weaken it to such a degree that it does not perceptibly act upon the wood.

203. "The cloths are to be prepared by leaving them 24 hours in water, or still better in the old lixivium, to extract the dressing; after which they must be once or twice well washed in alkaline lixiviums, because all that part which can be extracted by the lixiviums would have neutralized a portion of the liquor, which requires to be carefully used. After this the cloth must be carefully washed, and disposed upon sticks in such a manner that it may be impregnated with the liquor poured on it, without any part being compressed. The framing of the sticks, as well as the cask and vessel intended to contain the cloths, ought to be constructed without iron; because this metal becomes calcined by the oxygenated muriatic acid, and would produce iron moulds, not to be taken out but by means of salt of sorrel.

204. "The first immersion must be longer than the following ones; it may last three hours: after which, the cloth is to be taken out, lixiviated anew, and then put into a shallow vessel, in order that new liquor may be poured on it. It is sufficient that this immersion, and the following, should continue for the space of half an hour. The cloth is taken out, and cleared of the liquor by pressure; then lixiviated, and subjected to new immersions. The same liquor may be used until it is exhausted; and when it is found to be much weakened, a proportion of the liquor which has not been used may be added.

205. "When the cloth appears white, excepting at the selvages, and a few threads darker than the rest, it must be impregnated with black soap and strongly rubbed; after which it is to be lixiviated for the last time, and immersed once more in the liquor.

206. "The number of lixiviations and immersions which are necessary cannot be determined, because it varies according to the nature of the cloth: the limits of this number, however, are between four and eight for linen and hempen cloths. M. Berthollet expresses his inability to point out the best method of making the alkaline lixiviums; this useful art being still a matter of mere practice, and variously performed in different places. It appeared advantageous to him to render the alkali caustic, by mixing one-third of lime; but in this case care must be taken that the lixivium be strained through a cloth, in order that the calcareous earth may not mix itself with the linen, as its particles might corrode or wear it by their hardness. By this management the lixivium being rendered more active, does not require so large a quantity of alkali; and nevertheless, if the quantity of alkali be not too considerable, it produces no damage to the cloth, notwithstanding the contrary prejudice, which is very general. He has likewise remarked that it was of no advantage, and even prejudicial, that the lixiviations should be of long duration; but it is necessary that the fluid be very hot, and of considerable strength, otherwise the cloths bleached by the aerated marine acid would become coloured and ruddy when submitted to new lixiviations. This accident took place in the trials already mentioned. Cottons are much more easily and speedily bleached than linens: two lixiviums, or at most three, with the same number of immersions in the liquid, are sufficient; and as they are so much the more readily bleached, it is advantageous, when linen, hemp, and cotton, are to be bleached, to reserve the liquors for the latter, which have been already weakened by exerting their action on the former. Such liquors as are so exhausted as scarcely to act upon hemp or linen, will do very well for cotton.

207. "After the last immersion in the liquor, the cloth must be plunged in sour milk, or water acidulated with vitriolic acid. The true proportion is not well ascertained; but our author thinks, from his experiments, that one part of the acid by weight, with fifty parts of water may be employed successfully, and without danger. The cloths are to be kept about half an hour in this fluid, warmed; after which, they must be strongly pressed, or wrung, and immediately plunged in common water: for, if they were suffered to dry by evaporation, the vitriolic acid, becoming concentrated, would attack them. When the cloths are well washed, nothing more is necessary than to dry and prepare them in the usual manner.

208. "It is an obvious precaution, that this acid water be not too strong, as it would of course injure the texture of the stuffs.

209. "Fig. 5. Pl. XCI. exhibits the apparatus for preparing the liquid intended to be used in this new method of bleaching. ABC is a furnace; C is the matrass, or distillatory vessel; GHI the tube of communication with K, the intermediate vessel; L the tube of safety; M a tube communicating with the tub N, the section of which tub is exhibited in fig. 6. while the lower orifice of this tube is seen at y. In the tub N are fixed three inverted vessels, open beneath, as represented in fig. 7. and intended to contain the aeriform marine acid. PPP are agitators for the purpose of stirring the water by the rotation of the upright post OQ. The effect of this apparatus may be easily understood, by considering that the aeriform dephlogisticated marine acid, issuing from the tube y, passes into the vessel X, until it has excluded the water it may contain: after which the surplus issues through the tube Z, and runs into the second vessel; which, becoming also filled, affords its surplus to the third or uppermost vessel. Hence it follows, that three surfaces of the water are exposed to an atmosphere of dephlogisticated marine acid; and these surfaces must of course be changed by the rotation of the agitators. In this manner the water becomes impregnated, and may be drawn off at P. It is of consequence to ascertain its relative

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relative strength, in order that the experiments may at all times be equally successful. M. de Croisille makes use of a solution of indigo in the vitriolic acid; for which purpose he takes one part of finely-pulverized indigo, with eight parts of concentrated vitriolic acid. This mixture is kept in a matrass for several hours on the water bath; and, when the solution is complete, it is diluted with a thousand parts of water. In order to ascertain the force of the oxygenated muriatic acid, one measure of this solution is put into a graduated tube of glass, and the liquor or impregnated water is added, until the colour of the indigo is completely destroyed. In this way it is ascertained, by means of the graduations, how many measures of any liquor whose goodness has been ascertained by direct experiments upon linen or cotton, are necessary to destroy the colour of one measure of the solution of indigo; and this number will serve to ascertain the respective force of all the liquors which are required to be compared together. Mr Watt makes use of a solution of cochineal for the same purpose.

210. "In the sixth volume of the Annals of Chemistry, M. Berthollet has published some additions to the foregoing Memoir, which, on account of its extensive utility, I have scarcely at all shortened. They are the following:—Mr Welter finds that it is advantageous to terminate the process, by exposing the thread or cloth for three or four days in the field; during which they must be occasionally watered, and afterwards washed with pure water. He considers this exposition as indispensable. But M. Berthollet observes, that other persons have bleached to the perfect satisfaction of artists without it; though he admits that it may happen, in the large way, that certain pieces may not turn out perfectly white after the last operation, in consequence of some of their parts having suffered casual pressure; and he thinks that, although a continuance of the operation would remove these imperfections, it might, in such cases, prove more advantageous to remove them by exposure on the grass; very little loss of time, and no considerable extent of premises, being required for this purpose.

211. "M. de Croisille has excluded the use of wood in every part of his apparatus; and has applied the process not only to bleaching, but to the discharging of colours in dyed cottons or linens.

212. "M. Berthollet further observes, that the precaution of plunging the cottons in pure water, after they have been taken out of the acidulated water, is not sufficient; but it is necessary to plunge them into a weak caustic lixivium, moderately heated, and keep them there for a short time.

213. "When the liquor is suffered to run immediately into troughs, care must be taken to mix it well with the agitator; because otherwise the most saturated liquor, which occupies the lower part of the vessel, running first, would exert too strong an action; or if half or three quarters of the liquor be drawn off, and mixed with the proper quantity of water, according to the precautions before established, the rest of the fluid may be used together with the water for the succeeding operation: lastly, he observes that this process, simple as it is, can scarcely be carried into execution, without, in the first instances, being directed by a person to whom the operations of chemistry are familiar. He observes that a diminution, or even an equality of the expences, relative to the ordinary process, is not to be hoped for, excepting for the bleaching of fine cloths, unless the operator possesses a good process to extract the soda from the residue of the distillation; and without this condition the bleaching of coarser cloths ought not to be undertaken, excepting in those cases wherein the advantages arising from the speed of the operation, the facility of performing it in all places and at all times, and the diminution of the stock or capital, are sufficient to compensate for the excess of the price. These observations are perhaps applicable to linens, and not cottons. It is not possible, he continues to observe, to lay down principles applicable to every particular case; but he advises those who may undertake this object, to begin by trials, and by means of those trials to form calculations, without any allowance on the favourable side. On the other hand, he advises the operator not to suffer himself to be imposed on by those losses which arise for want of being familiarized with the operations: as there is no great expence incurred by making trials for a time, by which this advantage is derived, that the operator renders himself more expert for carrying more extensive processes into effect *."

* Nichols. Chem. Dict.

214. Such is the method of procedure recommended by M. Berthollet, which was soon found liable to many inconveniences; and various amendments and alterations have been suggested, the principal of which we shall relate. Pajot de Charmes was one of the first improvers of the new method. He states the following objections to Berthollet's process.

1. He thinks the furnaces recommended by Berthollet not well adapted to the purpose, as they are difficult to procure and expensive; as they will only contain each one matrass; as they are not calculated to shew the progress of the process, are too speedily heated, and consequently endanger the lutes; and lastly, as they will not always guard against absorption, notwithstanding the tube of safety in the intermediate vessel. The furnace which he would have employed in place of these is thus constructed:

215. The furnace is supported upon a frame-work of wood, between which and the hearth tiles are disposed in a bed of clay. The furnace itself is built of brick, which he recommends to be lined with plaster of Paris. It ought always to be double, and is divided by a partition in the middle. In the upper part at the front are two cavities intended to admit the vessels used in the distilling; they may be either round or square; and, as the latter is most convenient to the builder, they should perhaps be always square, provided with a ledge, and rounded at bottom. The combustible matter, which may be charcoal, is burned in a sort of chaffer, or in a portable grate, which is introduced by an opening in the side of the furnace: and this opening may be closed during the process by a door of plate-iron so as to prevent the too free access of air. From behind the distilling vessels and charcoal grate proceeds a funnel, through which the vapour and heat of the fuel is conveyed into a cavity with raised edges, over which is placed an oblong vessel of sheet iron, intended to be kept filled with muriat of soda, which may dry during the process. At each extremity of this cavity is a hole which may be opened or closed as required, so as to admit

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admit a greater or less quantity of air. Below the drying place, in the sides of the empty space at the back of the furnace, are places where boxes of sheet iron, containing the requisite proportion of manganese and salt, ready mixed, are kept for the purpose of keeping the materials dry.

In each of the square spaces is placed a capsule, which may be made either to contain sand or water, in which the distilling vessels are to be inserted. These capsules rest with their rims upon the edges of the cavities, and are supported below by a small bar. The furnaces, according to the directions of De Charmes, are made so as to be portable, an advantage which may perhaps, in most manufactories, be dispensed with.

216. 2. De Charmes next objects to the curved tube as being liable to be broken; and thus expose the workmen to the noxious gas, of which the accident will also cause a considerable loss. Berthollet's method of applying the tube is also objectionable from the destructible nature of the cork stoppers, and the difficulty of preserving the stability of the latter.

He proposes, instead of the matrass, tube, and intermediate vessel, to substitute tubulated retorts, furnished with curved necks of glass or lead; the beak of which is fitted by luting to a leaden support in the form of a funnel; and to that is adapted the end of a leaden tube which passes into the pneumatic tube, and has its lower extremity bent to a right angle, serving instead of the glass tube used by Berthollet.

217. 3. Berthollet's pneumatic tub was not provided with a cover close enough to prevent the escape of the gas; and his inverted vessels appear to De Charmes to be improper, from the difficulty there is of constructing their sides and borders so as to concentrate the gas in the best and most complete manner.

His pneumatic tub is conical, and divided into three parts by two false bottoms, which are made to rest on hoops or sliders within the tub, and kept firm by means of pins.

218. The distilling vessels employed by De Charmes are not high enough to prevent a portion of the sulphuric acid from passing over without combination; and they are besides too dear for ordinary use. In Ireland they employ leaden alembics of a sufficient height, and capable of containing 40 gallons of liquor, which is a capacity amply sufficient for allowing the swelling of the materials. These alembics are conical, have a broad bottom, which is supported in a vessel of water to regulate the heat; the neck is so long as to allow any sulphuric acid, which may rise, to fall back again, and the cover of it is perforated in two places; one of the perforations serving for the passage of a rod of iron with prongs entering within the alembic, but so covered with lead as to prevent the action of the sulphuric acid, and the handle passes through a leathern collar to prevent the escape of gas, the whole being intended for stirring the materials; the other hole intended to admit a leaden funnel carved like an S, to prevent the reaction of the gas on the diluted sulphuric acid which is to be introduced through it.

219. It is of the greatest importance to prevent the escape of the gas, as well to prevent danger to the workmen as loss to the manufacturer. "C. Widmer, at Jouy, has arranged his apparatus in such a manner as to lose the least gas possible during the condensation: he receives the gas under a capsule inverted at the bottom of the apparatus; above these are two *tours de goutiere* also inverted, then another capsule above these; then two more *tours de goutiere*, and then another capsule, which terminates the apparatus. The disposition of his tub is such, that he places around in his laboratory several distilling apparatuses, which are going at the same time.

"Apparatuses constructed on similar principles are also in use at Glasgow and Manchester. Bourbouleu-de-Bonneuil has likewise invented an apparatus, consisting of several matrasses, ranged as in an aquafortis manufactory, the tubes of which are conveyed into a chamber containing concentrating tubs. His apparatus for the bleaching of paper is very ingenious, and deserves to be described. In the last place, others have arranged five or six large casks, like Welfe's apparatus, in such a manner as to make each cask perform the functions of a tubulated flask *." * Phil. Mag. vol. x. p. 13.

220. Before we proceed to describe the most approved method of immersing the cloths in the oxygenated liquor, it will be proper to treat particularly of the materials employed in preparing this liquor, the mode of preparing them for the process, and the method of adjusting the apparatus and conducting the distillation.

221. The selection and preparation of the materials is of the greatest importance, as on them will depend in a very great measure the success of the operation.

The materials are either the muriatic acid and black oxyde of manganese, or this latter and sulphuric acid and muriat of soda, which are usually employed as being cheaper. There are, however, advantages in using the muriatic acid ready prepared, where the bleachfield is in the neighbourhood of such a manufactory, as the danger of breaking the vessels (where glass is employed) from the incrustation of the residuary salt is much less in this case.

222. The crystallized ore of manganese is to be preferred, such as appears to be composed of splendid needles slightly adhering to each other; this variety is generally purer, and much more easily reduced to powder, and a smaller quantity of it is sufficient. It must be reduced to a very fine powder, a short time before it is wanted, as if kept long in the state of powder, it is said to be injured.

223. The gray muriat of soda is employed in France as being cheaper than the white, but probably the present regulations of the salt duties in this country are such as preclude the manufacturer from employing it in this state †. The salt is to be dried on an iron plate in that part of the furnace described in 205, and then rubbed to a fine powder, and passed through a sieve; this is necessary, to mix it more intimately with the manganese, and to enable the sulphuric acid to act more uniformly and completely on it. † Nicholson's De Charmes.

224. In order to be more certain as to the proportion of the ingredients, the sulphuric acid should be procured in its concentrated state, and acid of the same specific gravity should always be employed. Before using, it is to be lowered with its weight of water, and it is proper to observe, that in making the mixture, the water should not be added to the acid, but the acid be poured in a gentle stream into the water, pouring it down the sides of the glass vessel in which the mixture

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ture is made, adding the acid by portions at intervals, and turning the head aside to avoid any drops which may fly up from the effervescence produced, which, however, is much less in this way than when the mixture is made in any other way. As a heat greater than that of boiling water is generated, it is better that the vessels have the form of jugs with spouts and handles, that the mixture may be more easily poured into the distilling vessels.

225. The proportions in which the ingredients are employed, are variously adjusted by different manufacturers. De Charmes recommends the following.

Oxyd of manganese crystallized, twenty ounces.
Muriat of soda, four pounds.
Sulphuric acid (at 60° of Massy's aerometer), 44 ozs.
Water, three pounds and a quarter *.

* De Charmes.

Mr Rupp of Manchester recommends the following, as affording him the strongest liquor.

Manganese, three parts.
Muriat of soda, eight parts.
Sulphuric acid, six parts.
Water, twelve parts †.

† Manchest. Mem. vol. v. p. 1.

Mr Higgins uses the proportions as under:

Manganese, sixty pounds.
Muriat of soda, sixty pounds.
Sulphuric acid, fifty pounds.
Water, about thirty pounds ‡.

‡ Higgins's Essay.

In Germany, and in France at present, the proportions are nearly as follows:

Manganese, twenty parts.
Muriat, sixty-four parts.
Acid, forty-four parts.
Water, fifty-four parts §.

§ O'Reilly Essai.

226. It would conduce much to the economy of this method of bleaching, if the manufactory of sulphuric acid could be carried on under the same roof with the bleaching process, or if some method could be devised to prepare this acid, without employing the nitrat of potass (saltpetre). The latter has been attempted by De Charmes, and as his experiment may afford a hint to manufacturers, we shall copy it.

"The present is certainly the place to speak of the attempt I have made, to procure the sulphuric acid without the intermedium of nitre, and to describe the apparatus I made use of for that purpose. It consisted of a pitcher or pot of stone ware, perforated at the bottom, the neck of which communicated with two small two-necked glass bodies connected together, and each half filled with water. Under each of these glass vessels was lighted charcoal, to keep the water in a state of evaporation, and under the earthen pot there was likewise fire to heat and inflame the sulphur, which was put into the pot through the opening opposite the neck. This opening, which draws in the external air for the combustion of the sulphur, was closed with a stopper, perforated like the nozel of a garden-pot.

"The sulphur, thus inflamed, soon filled the vacant part of the glass vessels with its whitish cloudy vapour. This vapour, meeting that of the water, combined with it, and fell in acidulous drops on the lower water, over which the vapour of the sulphur circulating for a time, does also probably combine with it to a certain point. Another proof that this condensed water did combine with the vapour of the sulphur is, that the same vapour received in drops beyond the second glass vessel by means of a recurved adopter, came out in the acid state, reddening the tincture of tournsol, and effervescing with alkalies when concentrated. I have twice repeated this experiment with success, and with scarcely any inconvenience.

"I likewise attempted to burn sulphur and heat water, in two separate vessels communicating with a third. The two vapours combining together in the receiving vessel, likewise produced by their condensation a fluid, which afforded the same indications of acidity as that of the former experiment.

"When sulphur was burned in an earthen vessel, and its vapour communicated into an earthen jar, in which water almost boiling was poured, the results were the same.

"It is probable that if these experiments were repeated more at large, with a suitable apparatus, a longer series of glass vessels, and proper furnaces, the success would be more complete. I intend at some future time to resume this process, and shall hasten to communicate my success to the public, if success should attend my endeavours (1) *.

* Nicholson's De Charmes.

227. The disposal of the apparatus for the distillation will next demand our attention; and as much of the success of this operation will depend on the goodness of the lute, it is proper to make a few remarks on this subject. The following is recommended by De Charmes (or rather M. Baumé) as a fat lute. Take any quantity of good gray or blue clay, or, what answers extremely well, fullers earth. Let it be dried in thin cakes in an oven after the bread is baked, then pounded or sifted; a certain quantity of this clay is to be mixed with a sufficient quantity of boiled linseed-oil, in an iron or bell-metal mortar, in which they must be well beaten together for a long time, so as to form a tenacious stiff paste of a uniform consistence, and perfectly free from lumps. A considerable quantity of lute is usually made at once; and, so far from losing any of its tenacity by being kept, it is asserted that lute which has been made a twelvemonth, provided that it has been preserved in a cool damp place, as a cellar, and in covered vessel, is more pliant and better than when first made. If too dry and hard, it may be easily rendered of a due consistence by being warmed and worked with the fingers, or beaten in a warm mortar.

The lute which has been used in one distillation must not be thrown away, as, with proper management, it may serve again, and is even better than before. It must be carefully freed from the burnt and hard parts, however, as these would render it crumbly.

228. "When the quantity to be mixed, or kneaded up

(1) Chaptal made a great number of experiments in the large way, for the purpose of discovering the means of acidifying sulphur, without the expence of nitre; but upon the whole they were unsuccessful.

up again, is very small, the trouble of beating it in the mortar may be avoided, because the operation is performed very well, by kneading the matter with the hands. For this purpose, a portion of the lute already kneaded in the mortar, and soaked with oil, may be taken and rolled in the vessel containing the pounded and sifted earth; the portion of earth which adheres may then be worked in; and, by a repetition of this manipulation, the mass will speedily become enlarged, and must be strongly compressed, rolled out, and doubled again, until it is found that it possesses the requisite softness and tenacity, and does not crack when doubled.

"If it should happen that the lute should become too soft by excess of oil, and clay is not at hand to correct this fault, the mass will soon acquire firmness by exposing it to the open air upon parchment, or upon a plate. It must not be laid upon paper, because it is very difficult to separate this material entirely; and if any particles should remain, there would be reason to fear that, when incorporated in the mixture, they would either prevent the perfect adhesion of the lute, or would allow the passage through that kind of void or pore, which the fragments of paper would form. It is, moreover, to be remarked, that this lute cannot be too smooth and uniform. It ought not to afford any perception of inequality when it is handled, or kneaded, nor indicate the presence of foreign substances, such as sand, straw, earthy particles, &c. which are capable of preventing the intimate connexion of its parts.

"I strongly insist on the perfection of this lute, because it is the soul of distillation.

229. "Boiled linseed oil is thus made: two pounds of common linseed oil being put into a saucepan, or proper vessel, of copper, iron, or pottery, add three ounces of red litharge, finely powdered and sifted; after stirring the whole well together, place the vessel on the fire, heating it gradually, until the litharge is completely dissolved. It is necessary to stir the mixture very frequently with a wooden spatula, until the whole solution, which at first acquires a brick-dust colour, is completed: it is then to be removed from the fire, and, when cold, transferred into a stone or earthen vessel, and kept well corked. This is the boiled linseed oil above directed to be used in making the fat lute.

"When this oil, which is blackish after boiling, is well made, it congeals in the vessel as soon as it is cold. When it is required to be poured out, it may be rendered fluid by bringing it near the fire. To save the trouble of heating it, it may be poured, as soon as made, into a plate or shallow vessel, or left in the vessel used for boiling it. It is seldom necessary to heat it for the mere purpose of mixture; the quantities required for this purpose may be taken up with the fingers, or in any other manner.

"It is proper to observe, that the vessel in which the oil is boiled must be sufficiently high, to afford a space for the swelling of the fluid; for, as soon as the heat begins to act, it will rise and overflow the vessel, if particular attention be not paid to it. As soon as this process begins, the vessel must instantly be taken off the fire, and the mixture strongly agitated by plunging the spatula in it, at the same time blowing strongly at its surface with the mouth; by which means the ebullition will be checked. After this event has happened two or three times, it may with certainty be concluded, that the oil will be sufficiently consistent to form a good fat lute. By cooling, it immediately congeals, as has been remarked, to the consistence of plaster, of a black colour, inclining to brown.

230. "The lute made of linseed oil cake is thus made:

"The cake is first to be broken and pounded in an iron or bell-metal mortar, and afterwards sifted through a silken sieve: starch is then to be boiled up, to the consistence of size or glue; a small piece of this, being powdered with the flour of the oil-cake, is to be worked in a plate, or with the hands; more of the flour may then be added, and the kneading continued until the mass is absolutely without any lump, or inequality, and its consistence has become nearly the same as that of the fat lute; after which it is to be kept in a plate, or covered wooden bowl, in the cellar, for use. The same care must be taken with this, as with the fat lute, not to wrap it in paper, but in parchment, if thought necessary.

"This lute dries and hardens much on its outer surface, which remains uninjured at the place where it is applied; but it is decomposed more speedily than the fat lute, on account of its peculiar property to become hard and shrink with a strong heat. In this state, in consequence of the action of acids, it assumes a yellow colour, and is then good for nothing: it must be renewed.

"A very good lute is likewise made with equal parts of the flour of almonds, of linseed, and of starch, kneaded together. It must be understood, that the latter is to be boiled to the consistence of starch.

"To these different lutes we may add that which is composed of lime and white of egg, which has the property of acquiring a considerable degree of hardness.

"Among all these lutes, that to which I have constantly given the preference, and is always kept in sight in the present work, is the fat lute. The lute of white of egg and lime, retained by a cloth and a bandage, may be advantageously used as a covering to the fat lute.

"The fat lutes adhere very much to the hands, during the kneading or working; but it is not difficult to wash off the remains after the operation: nothing more is necessary, than to use warm water and soap, or soap leys, after having previously wiped off the greater part with blotting paper *."

* Nicholson's De Charmes.

231. As the directions given by De Charmes for disposing the apparatus will, with a few modifications, apply to every case, it will be proper to give them without abridgment.

"Our distillation may be performed either in a retort, or a tubulated body or bottle. There can be no difficulty in properly placing these vessels. The junction of the neck or tube, communicating with the pneumatic vessel, is the only object which requires particular care. The manner of joining these two parts, by means of lute alone, will be explained below.

"As the use of the retort requires more attention with regard to its form, and the application of the additional part, the following details will be of use to prevent accidents.

232. "When the retorts are new, and have not before

fore been luted to any additional part, it is advisable either to rub a small quantity of warmed wax on the parts where the lute is to be applied, that is to say, the neck of the retort, as well as the correspondent part of the additional piece, or to suffer a small quantity of starch or paste to dry upon those parts; without this precaution the lute could not be easily applied; it would slide and roll upon the glass instead of adhering.

"Care must afterwards be taken to fix round the neck of the retort a mass of lute, somewhat greater than is supposed to be necessary to fill the additional part to the place where it is to be fixed, in order that by the forcing of that piece upon the neck of the retort, the lute may extend and apply itself more intimately. The same attention must also be paid to the mass of lute, which is required to secure the beak of the additional piece in its connection with the pneumatic apparatus. These observations are of more importance, in order that the two pieces may, by this compression, be made to operate as if they formed one entire vessel.

"To apply these lutes with ease and convenience, the retort is to be held in one hand, in such a manner as that its belly or lower part may not touch or rest upon any thing whatever, because the slightest blow upon this very thin part will break it.

"Before the lutes are applied, care must be taken to introduce the neck of the retort into the additional piece, and mark with lute or wax upon the additional piece the place where the extremity of the retort touches it internally; and, in like manner, on the retort itself, the place where the extremity of the additional piece touches its neck. By means of these marks it is easy to estimate the thickness of the masses of lute, by placing the two vessels near each other in the respective positions they ought to have been fixed. Lastly, they are united together by sliding the recurved additional piece upon the neck of the retort, which is to be held firmly by its neck, resting the hand on the surrounding part, if the retort is small; or holding it by the recurved part, if it be large, or the additional piece should be too long and heavy. The greatest attention must be paid not to turn the parts round, during this operation, more than is absolutely necessary to bring them together; and if this can be done without any turning at all, it will be still better, as the lute will hold more effectually. The neck of the retort must be entered into the additional piece as far as it is capable of compressing the lute, or nearly to the marks made upon the pieces before they were put together. In this situation the lute, which forms a mass round the edge of the additional piece, must be raised so as to cover both surfaces, after having first pressed it as firmly as possible into the joint; smoothing it upon the two pieces, so as to prevent the smallest opening or crack. It is advisable after all to spread a thin coating of the boiled linseed oil over the lute, which not only renders it smoother and more perfect, but by the density it acquires from evaporation, it forms a kind of varnish or pellicle, which supports the lute, and prevents the fissures which might be formed during the actual operation. Whenever in the course of the work the lute should appear too dry, it must be supplied with a thin coating of oil.

"While the lute is thus spread and applied on the external part of the additional piece and the neck of the retort, the compound apparatus is to be held by the additional piece only, and the retort left to be supported, untouched, in the air, by its insertion at the neck only.

"Instead of luting the additional piece to the retort, simply at the extremity of the neck of this last, and at the place where the wider part of that piece touches the retort, we might apply the lute upon the whole surface comprehended between those parts. But I have found that it is sufficient if these two parts be made secure. A retort luted in this manner forms one single and entire body with its additional neck; and with very little care and attention, the lute will seldom or ever have occasion to be renewed before one or two months service.

233. "The tube on which the recurved additional piece rests during the distillation, and through which the gas is introduced into the pneumatic tube, is, as I have remarked, entirely of lead. If it be not cast, it ought to be carefully joined with strong solder; and for fear this last should fail, it will be prudent to cover it with a coating of yellow wax, pitch, or melted pitch.

"That part of the tube, (if soldered as before mentioned) which passes under the lower false bottom, ought to be carefully bended with a round corner, before it is coated with the wax or pitch; and in the bending it is safer to cause the soldered part to lie within the angle. It is likewise proper to stop the mouth of the tube with paper, or a cork, during the time of waxing or tarring, in order to prevent any introduction of those substances into its cavity, taking care to withdraw this temporary stopper before the apparatus is applied to actual use. It is not absolutely necessary to coat any other part of the tube, but that which is to be placed within the pneumatic apparatus, because it is easy to stop any other part, out of which the gas might issue, with soft wax or lute.

"The extremity of this tube, in which the recurved neck of the additional piece is to be inserted, must have the form of a small funnel, not only for the purpose of affording the most convenient support, and the more ready adaption to the various sizes of those necks, but also because it more readily supports the only kind of lute which in this work we suppose to be used. This lute is never deranged, if care be taken to press it against the internal surfaces of this small funnel, and of the glass or lead of the additional piece, so as to unite them as much as possible, it being always understood that the lute is good, and possesses the properties before described in treating of that substance.

234. "I have remarked, that the use of the retort with its additional neck might be dispensed with, by simply using a body or bottle with a neck (even a wine bottle may be used in case of necessity, provided its bottom be either very thin, or very gradually heated). In the orifice of the neck of these vessels, is to be adapted a tube of lead, properly bended, and of a due size. This method is in fact very advantageous and economical; but care must be taken to join the tube, if it be of sheet-lead, particularly in the parts below the bottle which are liable to become heated, a short time before the end of the distillation; to join it I say, without solder, by fusing the two edges together. For in process of time the solder, though ever so strong, yet

Vegetable Substances.

yet because it contains tin, is liable to excessive corrosion by the oxygenated muriatic acid, which, notwithstanding its heat, is not found to attack lead in any perceptible degree.

"But it may, perhaps, be more convenient to cast such a tube at one heat, as well as the additional piece in the apparatus, with the retort; unless, indeed, it should be practicable to have it made of stone-ware or porcelain, the latter of which is the least permeable to the gas. Or we might, with more advantage, make use of a thick tube of common glass, which might be easily bended in a charcoal fire, and might be adapted to the tubulated bottle, as well as the leaden tube. But the danger of its breaking, and the difficulty of procuring others in case of need, together with the expence, have led me to reject this, as well as the tubes of pottery or porcelain.

"In order that the tube adapted to the neck of the bottle may accurately fit, and prevent all escape of the oxygenated muriatic acid, it is defended by lute in such a manner, that it shall not be thrust into the neck of the bottle, without extruding a portion of that substance; and a border of luting must then be applied round the place of junction, which will effectually prevent the escape of any vapour which might issue through the first luting. Lastly, the whole surface of this external luting is to be smeared with boiled linseed oil; after which the distillatory apparatus may be considered as perfectly secure.

"If a tube of glass be used, it may be so adapted by grinding with emery as to fit the neck of the glass body, and require no luting. The same might be done with a tube of porcelain, if the material were sufficiently fine.

235. "With regard to the other neck which I have recommended, as well in the bottle as in the retort, it serves not only to introduce the materials when the leaden tube is previously luted in, but likewise to admit the external air, if by chance an absorption should be perceived to take place; that is to say, if the water, by diminution of the heat, which leaves a kind of vacuum, should rise from the pneumatic apparatus into the body: though even in this case there would be no reason to fear its breaking, notwithstanding its being considerably heated, as at the end of the operation. I have expressly made the trial several times, and always without any accident. The fluid becomes gradually heated in its passage along the sides of the tube or neck of the distilling apparatus, before it enters and mixes with the matter in the body itself; and again, if the tubulated bottle and tube be made use of, the water rising through the latter, and falling in the middle of that contained in the vessel, cannot directly touch the sides before it becomes mixed, But, at all events, if the smallest absorption be feared, it will be sufficient to raise the stopper, and return it to its place the instant after the introduction of the atmospheric air. Instead of a glass stopper, a cork may be used, which must be carefully luted round the neck, if there be any reason to think that the vapour should find its way through, in consequence of the neck being perfectly round.

236. "With regard to the pneumatic vessel, the following is the method of placing and fixing the false bottoms:

"A common wooden hoop is plained flat on the side which is to bear the false bottom, and fixed within the cask with pegs which do not pass quite through the staves. The false bottom, secured together by two dove-tails is placed upon this hoop, and fixed there by similar pegs, which penetrate part of the bottom itself, and by that means prevent it from either rising or turning. The cavities between the false bottom and the sides are then to be closed round with caulker's stuff (*brai sec*), or melted pitch. It must be remembered, that the vertical axis with its cross-arms is to be placed beneath each false bottom. The arms are fixed in a mortice by means of two pins, which prevent them from vibrating or getting loose. The leaden pipe in which the extremity of the additional neck is to be inserted, is not to be put into its place till the first false bottom is immoveably fixed. A notch is supposed to have been cut in this bottom to admit the tube; and when it is duly placed, the vacant space is to be made good, first with tow and then with melted pitch.

"Instead of the wooden hoop, which affords a solid support for the false bottom, it may answer the purpose very well, if cleats or blocks of wood, three inches thick, be pinned on, at different parts of the circumference; or, which is still better, if the trouble be taken to fit the false bottom so well, that it may bear simply upon the inclination of the staves, which naturally oppose its descent. This method would certainly be the quickest, and is not very difficult to be done.

"When the false bottom is thus fixed, it must be retained in its place by pins placed at certain distances, and afterwards made tight by caulking.

"In order that the tube may not be exposed to vary in its position, a mark must be made on the edge of the funnel which terminates one of its extremities, by which it is easy to ascertain the position of the bended part below, and place the same in the most favourable situation. It will be convenient to fix the pipe in this proper situation, by means of two pegs, which must be drawn out previous to the last fixing of the false bottoms.

237. "When the first or lowest false bottom is secured in its place, the second arm of the agitator is to be fastened to the axis, and the other false bottom is to be placed and made fast in the same manner as the first.

"It is particularly necessary to place these two partitions in such a manner, as that the holes of communication may not be in the same vertical line, but as far as possible from each other; that is to say, diametrically opposite. This disposition is necessary in order that the gas may have time to concentrate in one part, before it escapes to the other. For the same reason, it is proper to direct the lower opening of the leaden tube to that extremity of the diameter which is opposite the pipe of communication from the first to the second bottom, in case one distilling vessel only is used. If two or more communicate with each pneumatic apparatus, the openings of the tubes must be respectively disposed at equal distances, as far as possible from each other, and from the opening in the false bottom next above them.

"If instead of false bottoms the preference should be

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be given to inverted tubs (*cuvettes*), the following method may be used to make the rims or sides, and to fix them immoveably.

"The rim may be made in two ways; either by short staves, fixed with wooden hoops as usual, scarfed or hooked together at their two extremities, or else, by simply fixing a broad wooden rim, like that of a sieve, round the bottom of this inverted vessel, by means of small wooden pins with heads.

"Both these methods are good. The second has the advantage of taking less room and being cheaper. If this method be used, the point of the pins must be made a little thicker than the stem, in order that they may be less disposed to draw out of the holes bored in the bottom. With regard to the joining of the two ends of this kind of broad hoop, it may be effected very firmly by sewing them together with a flat strip of osier, as is done in the better sort of chip boxes, or it may be very well managed by means of two pins with heads, which may be driven through the overlapping part, and secured at the other side by driving a small wedge into the tail of each pin. With regard to the empty spaces or openings which may be between the rim and its bottom, they must be stopped with glaziers putty (*mastic du vitrier*), which may be smoothed with oil. This putty is of excellent service when the muriatic acid is used without potass; but it is soon destroyed if potass be put into the pneumatic vessel. In this case the internal part of the places of junction must be pitched or caulked, as has been already shewn.

"The method of making these inverted vessels with staves and hoops, has the advantage of being close, and not requiring any particular caulking.

238. "Lastly, Instead of these inverted vessels, the operation may be performed merely by flat boards without rims, provided, however, that the upper board be some inches broader on every side than the lower, in order that the bubbles of gas may be forced in their ascent to strike each board in succession, and remain for a short time in contact with it. The essential circumstance in this arrangement will be to keep the upper part of the vessel well closed, which is to be defended at the hole which admits the axis of the agitator by a central tube to retain the gas; and the partial escape which might take place between that axis and the covering, must be more effectually prevented by a cloth soaked in alkaline leys. This method, besides its convenience, requires less care in fixing, but it renders it necessary to work the agitator more frequently, in order to hasten the absorption of the gas in the water. I have determined to relate all the methods which I have successfully practised, in order that those who may undertake any work of this nature, may determine for themselves, not only with regard to general motives of preference, but likewise the facility with which their own situation or circumstances may enable them to carry the same into execution.

239. "The next object is to fix these inverted vessels in the pneumatic apparatus. This is a very simple operation, and consists merely in fixing pieces of wood or brackets, three inches in length, under each of the two bars which connect the pieces of the bottoms of the inverted vessels together. The bracket pieces are fastened to the side of the vessel with oak pegs, and the cross-bars which rest upon them are secured by pins of the same material driven above them and on each side, in such a manner that the central perforation is in its true place, and the whole is incapable of being removed or disturbed.

"In this operation, as I have already recommended with regard to the false bottoms, it is advisable to place the revolving axis in its proper situation, in order to ascertain that it is not likely to be impeded in its action. It is best, indeed, to avoid fixing either the two inverted vessels or the two false bottoms, if these be used, until the clear movement of the agitator has been ascertained; without which precaution, there might probably be occasion to displace them, either in whole, or in part, to remove the impediments which might prevent the free motion of the parts.

"From the description I have here given, it may be seen that my pneumatic vessels have only two false bottoms or inverted vessels. I think it advisable not to use more, because I have remarked that three of these vessels requiring a greater depth, the distillation became much more laborious, particularly when I made use of the intermediate apparatus. 1. The lutes did not so well resist the pressure of the vapour. 2. It was not disengaged with the same speed, and consequently the operation was more tedious. It is better, therefore, to use shallower vessels, and enlarge their dimensions in the diametral direction, as I have constantly found. The proportions which have appeared to me to be advantageous for a small common workshop, are $1\frac{3}{4}$ foot in height, 32 inches in diameter below, and 36 inches diameter above, all inside measure.

240. "With regard to the kind of wood for constructing the vessels, it has appeared to me to be almost a matter of indifference. I used fir, oak, and chesnut, without observing that either the one or the other was productive of any inconvenience to the quality or clearness of the liquor, unless that, at the first or second distillation, the degree of force was a little altered, by soaking into the wood. That kind of wood may, therefore, be used which can the most readily be procured. I must, however, observe, that the large casks in which oil is brought from Languedoc, which are mostly made of chesnut-tree, are very convenient when cut in two to form the pneumatic vessels. They have even an advantage over the oak and fir casks, because they are closer in the joints, better hooped with iron and wooden hoops, and impregnated with the oil, in consequence of which they are not subject to become dry, how long soever they may be out of use, provided they are kept in a close place; whereas the tubs of fir wood require to be almost constantly filled with water. Oak does not contract so soon as fir.

"It must also be observed that the white deal must not be used, because it transmits water like a sponge. The yellow deal is to be preferred, because it undergoes less alteration from the fluid, no doubt on account of the resin it contains. But if the use of the white deal, or any other spongy wood cannot be avoided, it will be proper to paint the vessel within and without with one or two good coatings of white lead. I have had the great satisfaction to observe, that this treatment not only prevents the water from passing through, but likewise that the oxygenated muriatic acid

acid does not attack this colour, or, if it does attack it, a long course of time must be required for that purpose. Melted pitch or tar likewise afford a good defence for such wooden materials as have this defect. A mixture of yellow wax and resin is likewise of excellent service as a coating for the whole internal surface of the pneumatic vessel, including the inverted vessels and the agitator.

241. "Besides the false bottoms, or inverted vessels we have described, each apparatus must likewise have its cover chamfered, to fit the circumference, with apertures to admit the tubes and the central axis; together with two others, namely, one of considerable size, to receive a funnel through which water is poured as occasion requires, and the other smaller, to be opened on such occasions, in order that the air may escape. The cover being nailed, or rather fastened with wooden pins, in its place, is afterwards secured by glueing slips of paper over the line where it is applied to the vessel.

"Instead of the wooden pneumatic vessel, it might be more advantageous to use similar vessels of gritstone (*grès*), rolled or cast lead, or cement of loriot (K). Manufacturers must form an estimate of the advantages to be derived from the expences they incur. If leaden vessels be used, it will be proper to defend the soldered places with one or more coats of white lead, or putty, or resin, or pitch mixed with bees-wax. I have tried these preservatives against the destruction of the solder, and found them answer very well.

242. "As it is useful to possess a knowledge of the height and quantity of water contained in the tub, there is a tube of glass fixed against its outer side, the lower end of which is bended and enters the vessel about five or six inches from its bottom. This part, into which the tube is stuck by firm pressure, is to be previously defended by lute, which is afterwards trimmed and laid smooth upon the sides of the tube and the vessel.

"Lastly, As it is essentially necessary to ascertain, from time to time, the strength of the liquor, and to draw it off upon occasion, I have usually availed myself of a brass cock, covered with several coatings of white lead for this purpose. By means of this cock, it is easy to draw off any small quantity of the fluid at pleasure. It has likewise the advantage of readily filling the narrow-mouthed stone-ware or glass vessels, in which the liquor may be kept when there may be any to spare, or in case it is thought fit to preserve a quantity always in readiness.

"When it is required to draw off the acidulated water with speed and in abundance, it is convenient to use one or more wooden tubes or spigots, which may be opened separately, or all at once, into appropriate vessels. But it is most convenient that they should have stoppers of cork only, because those of wood, though covered with tow, are very apt to burst the wooden tubes by their swelling; besides which they very seldom fit with accuracy, unless turned with extraordinary care.

243. "With regard to the intermediate vessels mentioned in the *Annales de Chimie*, in case the operator is determined to use them, it is proper to avoid using stoppers of cork to close the orifices, and support the tubes at the same time. For this substance being very speedily acted upon by the corrosive gas, exposes the lutes and closures to frequent derangement, as well as the tubes which pass through them. At the beginning of my operations, I supplied the place of these stoppers as follows, when the necks were of a larger diameter than the tubes. I made stoppers of glass, with flanches on the sides. These were ground with emery upon the necks themselves, and they were perforated quite through with a hole, no larger than was proper to admit the passage of a glass or leaden tube. This tube was coated with lute of sufficient thickness, that it could not pass through the hole without forming a protuberant piece, which I pressed and smoothed against the tube as well as the orifice. Or if the stoppers of cork should, nevertheless, from convenience be chosen, the necks may be covered with lute, and the stoppers forced in. In case the interval be small, the parts may be heated a little, covered with virgin-wax, and then forced into the neck, and the small vacuities which may remain may be filled up with the same wax, melted and poured out of a spoon. Instead of lute, yellow wax may also be used to fix the tube of safety; and the same operation may be performed with regard to the glass or leaden tube, which communicates from the tube to the intermediate vessel. Stoppers and tubes luted in this manner, are, in some measure, fixed for ever; for when the wax is once hardened, they are in no further danger.

244. "If the operator be so situated, that he can order the intermediate vessels of whatever form he chooses, it will be advisable to have the orifices of no greater diameter than just to suffer the tubes to pass through. No other defence will then be necessary, than that they should be covered with lute at the time of placing them, which will render them sufficiently firm. The rim, or border of these orifices, ought likewise to be large enough to support the mass of lute which it is proper to apply round the tube *."

* Nicholson's Dic. Chemist.

245. Having adjusted the several parts of the apparatus, we proceed to prepare for the distillation, by filling the pneumatic tub with water, or such fluid as it is intended should be impregnated with the gas, and introducing the materials into the distilling vessels.

The cover of the tub is first to be properly secured by pegs and slips of paper, pasted over the joinings. The tub is then (if not done before) to be filled to within

(K) The author does not appear to speak from experience in this place. It is not probable that any manufacturer would be tempted to incur the expence of stone vessels; but it is nevertheless proper to remark, that every stone which could with facility be wrought, contains lime or clay, or both; the former of which would no doubt be speedily corroded by the liquor, on which it would also have a pernicious effect. It is not likely that clay would be more durable. So that on the whole there is no temptation to use, and many reasons to reject, the earths.

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within an inch and a half of the top, with soft water. Care must be taken to leave open the orifice, by which the air may be allowed to escape on pouring in the water, as, were this close, the water would insinuate itself under the paper, and destroy the luting.

The distilling vessels are now to be placed in the capsules, or the vessels of water, and firmly secured. De Charmes directs the mixture of manganese and muriat of soda to be introduced at this time; but perhaps it would be better to have this ready done before fixing the vessels, and then nothing remains, but to add the sulphuric acid, which is best done by means of the crooked funnel. This being done, the stoppers are to be well secured, and the various jointures closed up with lute, where this has not been done before.

246. All these steps (except the addition of the acid) should be executed the evening before the distillation; and the next morning, the acid just distilled may be added, if the leaden alembics are used, but if glass retorts or bottles be employed, it is safer to allow the acid to cool before it is poured in.

"If the acid has been poured in warm, and the muriat is very dry, and well mixed, the sulphuric acid not more diluted than has been prescribed, and the manganese of a good quality, bubbles of air will be heard to pass into the wooden vessel, through the leaden tube, at the end of two or three minutes. If the above requisites be wanting, the escape will not take place till somewhat more than a quarter of an hour. In either case it is necessary, a few instants after the pouring of the acid, to place a chafing dish with lighted charcoal beneath the vessel which holds the retort.

247. "About half an hour after the pouring of the acid, a considerable effervescence takes place, which sometimes swells the materials as high as the neck of the retort, if this last be too small for its charge. The bubbles of the froth are large, and covered with a kind of pellicle, formed by a portion of the mixture carried up during the agitation. This intumescence lasts about two hours, during which time the bubbles of oxygenated muriatic acid gas are most abundantly disengaged in the water. They even succeed with such rapidity, that the intervals are not distinguishable, and an incessant noise is heard in the pneumatic vessel, which very often lasts three or four hours, according to the management of the fire, and the goodness and accurate mixture of the materials. The agitation produced by this rapid escape is commonly such, that it is scarcely necessary to move the agitator.

"The fire is not to be renewed till the expiration of two hours, even though it may have gone out in the mean time. After this, it is not to be renewed till the end of an hour and a half, and after that period, at the end of an hour, and so forth, without any perceptible increase of its intensity. It will be sufficient after these periods to keep up the fire, excepting that during the last two hours the fire must be maintained without suffering the charcoal to be almost burned away, as in the former cases, before it is renewed. The chafing dish must be raised upon bricks, to bring it nearer the retort, during the last hour. I must observe, with regard to this chafing dish, that the grate must not be too open, lest the charcoal should be too rapidly consumed. After the intumescence of the mixture has ceased, the rapid escape of bubbles does not diminish for a long time, in consequence of an effervescence which constantly proceeds. It is true that this continually diminishes, and towards the end of the distillation the bubbles, which pass into the tube appear only at intervals, notwithstanding the matter in the retort may, by the gradual augmentation of the heat, be brought into the state of ebullition. The heat is such, that eight or nine hours after the commencement of the operation, the hand can scarcely be endured near the aperture, or the neck of the retort, or other distillatory vessel, though between the fourth and sixth hours the same parts are scarcely warm. The distillation of one or more retorts or bodies into a single vessel, according to the doses before mentioned, takes usually eleven or twelve hours, and even less; the time for stopping the distillation is known from the escape of the bubbles being very slow, and the noise less perceptible. This slight noise is even a mark to form a judgment of the concentration of the gas, and the degree of saturation of the water. In order to hear the bubbles, it is often necessary to apply the ear against the tub. Moreover, the adopter of the retort begins to be heated, and the lute upon its neck becomes a little softened. Another indication that the process is near its termination, is had from the long vibrations of the water in the indicatory tube, placed on the outside of the tub, and likewise in the tube of safety, when an intermediate vessel is used.

248. "If a proper regard be not paid to the signs here enumerated, and the distillation be not stopped, there will not only be a loss of time and fuel, and a distillation of mere water; but the steam, when an intermediate vessel is used, will drive the water through the tube of safety, and itself immediately follow, if not instantly remedied by diminishing or removing the fire, and cooling the neck of the retort and its adopter with a wet cloth, or, which is better, by drawing the stopper of the retort for an instant.

"As soon as the distillation is stopped, the impregnated fluid of the pneumatic vessel is to be drawn off into tubs or other vessels, proper to receive the goods which are previously disposed therein. If it be not convenient to use it immediately, the liquor may be left in the tub without fear of any perceptible diminution of its virtue, provided the cover and its joinings be well closed with lute and stripes of paper pasted on, and likewise that the space between the axis of the agitator and the cover be similarly secured. It may likewise be drawn off in stoneware bottles well closed with corks, covered with lute at the place of their contact. In this manner the liquid may be preserved till wanted. I have kept it for several months without its goodness having been impaired.

249. "I must observe in this place, that if it be wished that the liquor at the upper part of the vessel should be equal in strength to that of the lower, without regarding the distillation (which may be uselessly prolonged for upwards of twenty-four hours, by an effect of the concentration of the gas in the bottom of the vessel, and the resistance it then opposes to its introduction, which singularly contributes to increase the heat of the retort); I have found no better method than that of drawing off the liquor, either into earthen pitchers or vessels filled with merchandise ready for immersion. I have done this after a limited time,

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time, and repeated proofs of the good quality of the fluid. At the end of eight hours distillation, I drew off one fourth of the contents of the vessel; a second fourth two hours afterwards; a third fourth after ten hours and a half, or eleven hours; and the rest after twelve hours distillation, which formed the conclusion.

"When the liquor is entirely drawn off from the vessel, it must again be immediately filled with water, or at least to the height of five or six inches above the return of the leaden tube, otherwise the gas, which continues to escape from the distilling vessel, and then affords no resistance, might attack the pneumatic vessel itself.

250. "The fire must be taken from beneath the retort as soon as the distillation is finished, not only to prevent the effect of the gaseous vapours, which still continue slowly to escape, from acting on the sides of the tub, but likewise to dispose the retorts or bodies to receive a quantity of warm water, which is to be poured in up to the neck. There is no reason to fear an excess of quantity, and the hotter the vessels are, the better. It is essential, however, that it be not poured in cold, for fear of breaking the glass. The adopter is then to be unluted from the neck of the leaden tube, if the operator chooses; and in order that no vapour may escape into the workshop, a bit of lute or a cork may be applied to the beak of the adopter. The sand bath easily permits the retort to be raised and returned again to its place, as well as the application of the lute or stopper to the neck of the adopter, this last being raised with one hand while the cork is put in with the other.

"Nevertheless, as the lutes which connect the adopter with the retort are somewhat softened towards the end of the operation, it would be more prudent to leave every thing in its place, for fear of deranging those lutes. This danger is greater when the adopter is of lead, because the great length of this additional piece tends to force the luting still more on that account. If it be required to proceed immediately to a new distillation, the retort or bottle with its capsule or pan must be immediately taken from the furnace, and another substituted in its place ready prepared during the former distillation. This necessarily requires a double set of vesels.

251. "When the distilling vessel is cold, or nearly so, the whole of its contents must be shaken, by holding this vessel by the neck with one hand, and applying the other to its bottom. The stopper must then be taken out, and the vessel speedily inverted, shaking the residue to facilitate its escape. In this last situation the retort is to be held by the neck with one hand, and its side gently resting against the other. The vessels into which the water and residual matter of the retorts are poured, should rather be of stoneware, pottery, or lead, than of wood, unless these last be oil vessels, which are less subject to dry in the part above the fluid. If this circumstance be not attended to, there will be danger of losing great part of the contents.

"It is most convenient to disengage the retorts or bodies while they are still warm, which continues to be the case the next morning after distillation, in consequence of the heat of the sand bath. If they be left to cool entirely, the sulphate of soda will crystallize, and it will be necessary to dissolve in hot water such larger portions as cannot pass through the neck. But this inconvenience is not likely to happen, unless the quantity of water last added be too small, and the residues have been left undisturbed for several days. The same observation is applicable to that kind of incrustation which is formed by the muriat, if not properly pulverized, dried, or mixed; this cannot be separated from the bottom of the retort, but by means of hot water poured at different successive times. It is likewise essential to leave no crust or deposition of muriat, or other matter, in the vessels which are emptied, unless the same be moveable, in which case the risk is less. But if the urgency of business should then require that the same vessels be used without entirely clearing them, it will be necessary to range this residual matter on one side, where it will be less exposed to the heat, and will afford a greater degree of facility for the nitric acid to act upon it.

"In order that the vapour which exhales from the distilling vessels may not prove inconvenient, it is necessary to pour in a small quantity of alkaline lixivium in the first place, which instantly destroys the smell. This may be done immediately after the end of the distillation, and the weak alkaline solution may supply the place of the water used for diluting the residues. At the instant of pouring this lixivial water, a strong effervescence takes place; for which reason it is proper to pour it in by several successive portions, waiting a little between each time *."

252. The oxygenated liquor prepared in this way is very effectual in bleaching the stuffs which are immersed in it; but at the same time possesses an odour so suffocating as to render its use unpleasant and even injurious to the workmen employed in the process, should any of it escape. "I have witnessed, (says O'Reilly) in an extensive manufactory near Paris, the cruel sufferings experienced by the wretched workmen, from these suffocating vapours; I have seen them rolling on the ground in the excess of agony. Frequently even severe disorders are the consequence of the first effects produced by the oxygenated liquor †." De Charmes gives a long account of the sufferings which he underwent in his course of experiments with this acid. It produces symptoms completely resembling those of a violent cold, but which go off in a day or two after having desisted from the use of the liquor.

This inconvenience may be avoided in two ways:

1. By rendering the vessels for immersion so tight as to prevent the possibility of the escape of the gas.

2. By dissolving in the water some substance which has the property of so far neutralizing the acid as to correct its odour, without destroying its bleaching quality to any considerable degree.

253. Mr Rupp of Manchester contrived a tub for immersion, which is admirably adapted to answer the first purpose. Its construction is simple, and not expensive.

"It would therefore, be desirable to have an apparatus for the use of the pure oxygenated muriatic acid simply dissolved in water, which is at once the cheapest and best vehicle for it. This apparatus must be simple in its construction, and obtainable at a moderate expence; it must confine the liquor in such a manner as to prevent the escape of the oxygenated muriatic acid gas, which is not only a loss of power, but also an inconvenience

* Nicholson's De Charmes.

† O'Reilly, Essai.

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nience to the workmen and dangerous to their health; and it must, at the same time, be so contrived, that every part of the stuff which is confined in it, shall certainly and necessarily be exposed to the action of the liquor in regular succession. Having invented an apparatus capable of fulfilling all these conditions, I have the pleasure of submitting a description of it to the society, by means of the annexed drawing.

Plate XCI. "Fig. 4. is a section of the apparatus. It consists of an oblong deal cistern, ABCD, made water-tight. A rib, EE, of ash or beech wood, is firmly fixed to the middle of the bottom CD, being mortised into the ends of the cistern. This rib is provided with holes, at FF, in which two perpendicular axes are to turn. The lid, AB, has a rim, GG, which sinks and fits into the cistern. Two tubes, HH, are fixed into the lid, their centres being perpendicularly over the centres of the sockets, FF, when the lid is upon the cistern. At I, is a tube by which the liquor is introduced into the apparatus. As it is necessary that the space within the rim, GG, be air-tight, its joints to the lid, and the joints of the tubes, must be very close; and, if necessary, secured with pitch. Two perpendicular axes, KL, made of ash or beech wood, pass through the tubes, HH, and rest in the sockets, FF. A piece of strong canvas, M, is sewed very tight round the axis K, one end of it projecting from the axis. The other axis is provided with a similar piece of canvas. N, pieces of cloth rolled upon the axis L. Two plain pulleys, OO, are fixed to the axes, in order to prevent the cloth from slipping down. The shafts are turned by a moveable handle, P. Q, a moveable pulley, round which passes the cord, R. This cord, which is fastened on the opposite side of the lid (see fig. iv.), and passes over the small pulley S, produces friction by means of the weight T. By the spigot and fausset V, the liquor is let off, when exhausted.

"Fig. iv. A plan of the apparatus, with the lid taken off.

"The dimensions of this apparatus are calculated for the purpose of bleaching twelve or fifteen pieces of $\frac{7}{8}$ calicoes, or any other stuffs of equal breadth and substance. When the goods are ready for bleaching, the axis, L, is placed on a frame in the horizontal position, and one of the pieces, N, being fastened to the canvas, M, by means of wooden skewers, in the manner represented in fig. 4. it is rolled upon the axis by turning it with the handle, P. This operation must be performed by two persons; the one turning the axis and the other directing the piece, which must be rolled on very tight and very even. When the first piece is on the axis, the next piece is fastened to the end of it by skewers, and wound on in the same manner as the first. The same method is pursued till all the pieces are wound upon the axis. The end of the last piece is then fastened to the canvas of the axis K. Both axes are afterwards placed into the cistern, with their ends in the sockets FF, and the lid is put on the cistern by passing the axes through the tubes HH. The handle P is put upon the empty axis, and the pulley Q upon the axis on which the cloth is rolled, and the cord R, with the weight T, is put round it and over the pulley S. The use of the friction, produced by this weight, is to make the cloth wind tight upon the other axis. But as the effect of the weight will increase as one cylinder increases and the other lessens, I recommend that three or four weights be suspended on the cord, which may be taken off gradually, as the person who works the machine may find it convenient. As the weights hang in open hooks, which are fastened to the cord, it will be little or no trouble to put them on and to remove them.

"Things being thus disposed, the bleaching liquor is to be transferred from the vessels in which it has been prepared into the apparatus, by a moveable tube passing through the tube I, and descending to the bottom of the cistern. This tube being connected with the vessels, by means of leaden or wood pipes provided with cocks, hardly any vapours will escape in the transfer. When the apparatus is filled up to the line *a*, the moveable tube is to be withdrawn, and the tube I closed. As the liquor rises above the edge of the rim G, and above the tubes HH, it is evident that no evaporation can take place, except where the rim does not apply closely to the sides of the box: which will, however, form a very trifling surface, if the carpenter's work be decently done. The cloth is now to be wound from the axis L upon the axis K, by turning this; and when this is accomplished, the handle P and pulley Q are to be changed, and the cloth is to be wound back upon the axis L. This operation is, of course, to be repeated as often as necessary. It is plain, that, by this process of winding the cloth from one axis upon the other, every part of it is exposed, in the most complete manner, to the action of the liquor in which it is immersed. It will be necessary to turn, at first, very briskly, not only because the liquor is then the strongest, but also because it requires a number of revolutions, when the axis is bare, to move a certain length of cloth in a given time, though this may be performed by a single revolution when the axis is filled. Experience must teach how long the goods are to be worked; nor can any rule be given respecting the quantity and strength of the liquor, in order to bleach a certain number of pieces. An intelligent workman will soon attain a sufficient knowledge of these points. It is hardly necessary to observe, that, if the liquor should retain any strength after a set of pieces are bleached with it, it may again be employed for another set.

"With a few alterations, this apparatus might be made applicable to the bleaching of yarn. If, for instance, the pulley O were removed from the end of the axis K, and fixed immediately under the tube H; if it were perforated in all directions, and tapes or strings passed through the holes, skains of yarn might be tied to these tapes underneath the pulley, so as to hang down towards the bottom of the box. The apparatus being afterwards filled with bleaching liquor and the axis turned, the motion would cause every thread to be acted upon by the liquor. Several axes might thus be turned in the same box, and being connected with each other by pulleys, they might all be worked by one person at the same time; and as all would turn the same way and with the same speed, the skains could not possibly entangle each other †."

254. As far as respects the confinement of the gas, this apparatus of Mr Rupp is extremely well contri-

† Manchest. Mem. vol. v. p. 1.

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ved, but in his method of rolling up the stuffs, there is an inconvenience which M. O'Reilly has corrected. The inconvenience arises from the axis being vertical, as when several pieces are rolled upon the same axis, some parts of them are liable to sway down, and thus render the action of the bleaching liquor unequal. He proposes to remedy this inconvenience by making the axis horizontal, and to make the passage of the stuff through the liquor more complete, he places a roller at each end of the vessel, above and below, and three others in the middle, as will be explained when we describe the apparatus.

255. Soon after the appearance of Berthollet's paper in the *Annales de Chimie*, it was proposed to employ the oxygenated muriatic acid, in the state of gas applied immediately to the cloths previously moistened, and we believe that it has been so employed by some bleachers. We are, however, disposed to consider the method as highly injurious to cloth so bleached, although the danger to the workmen might be avoided, by the use of the immersing vessel above described.

256. In employing the simple oxygenated liquor, it is of consequence to possess some criterion, by which we may ascertain its comparative strength. The method contrived by M. Descroizilles has been described in paragraph 209. Mr Rupp has improved on this, by employing the acetite of indigo, prepared by pouring acetite of lead (sugar of lead) into a solution of indigo in sulphuric acid, as long as any precipitate appeared.

257. The second means of avoiding the unpleasant effects of the suffocating gas, we have said, consist in dissolving in the water through which the gas is passed, some substance which is capable of mixing with, and correcting it.

Two substances may be employed with this view, potash and lime.

258. When potash is employed, a quarter of a pound of the common potash, purified as directed in 165: is to be used for every pound of muriat of soda introduced into the distilling apparatus. This is to be dissolved in the water with which the pneumatic tub is filled. It is most convenient to dissolve the potash in a small quantity of water, and add the solution to the water in the tub; but care must be taken to stir them well together with the agitator, that the potash may be equally combined with the water.

But, although this weak solution of potash certainly renders the bleaching process much less inconvenient to the workmen employed, it is yet much more expensive than the simple oxygenated liquor, and more of it is necessary to perform the same work than is required of this latter. Mr Rupp has completely proved this by a set of ingenious experiments which he made, comparing the quantity of colouring matter in the acetite of indigo, and in an infusion of cochineal, destroyed by the same quantity of the two liquors. His experiments are highly interesting, and are thus related by himself.

"*Experiment* I.—To half an ounce of oxygenated muriatic acid, I added a solution of indigo in acetous acid (L), drop by drop, till the oxygenated acid ceased to destroy any more colour. It destroyed the colour of 160 grains of the acetite of indigo.

"*Experiment* II.—A repetition of Experiment I. The colour of 165 grains of acetite of indigo was destroyed in this experiment.

"*Experiment* III.—A repetition of Experiments I. and II. The colour of 160 grains of the acetite was destroyed.

"*Experiment* IV.—To half an ounce of the oxygenated muriatic acid, were added eight drops of pure potash in a liquid state. This quantity of alkali was about sufficient to deprive the acid of its noxious odour. This mixture destroyed the colour of 150 grains of the acetite of indigo.

"*Experiment* V.—A repetition of Experiment IV. The colour of 145 grains of the acetite was destroyed.

"*Experiment* VI.—To half an ounce of the oxygenated muriatic acid, ten drops of the same alkali were added. It destroyed the colour of 125 grains of the acetite of indigo.

"*Experiment* VII.—A mixture of half an ounce of the oxygenated acid, and 15 drops of the alkali, destroyed the colour of 120 grains of the acetite of indigo.

"Though I had taken the precaution of avoiding the sulphuric acid, for the reason stated in the foregoing note, I was not quite satisfied with these experiments, on account of errors which might have taken place through a double affinity. I therefore made the following experiment, in which I employed a decoction of cochineal in water, instead of the acetite of indigo.

"*Experiment* VIII.—To half an ounce of the oxygenated muriatic acid, a decoction of cochineal was added till the acid ceased to act on its colour. It destroyed the colour of 390 grains of the decoction.

"*Experiment* IX.—A repetition of Experiment VIII. The colour of 385 grains of the decoction was destroyed in this experiment.

"*Experiment* X.—To half an ounce of the acid, six drops of the liquid alkali were added. This mixture destroyed the colour of 315 grains of the decoction.

"*Experiment* XI.—Eight drops of the alkali were mixed with half an ounce of the acid. This mixture destroyed the colour of 305 grains of the decoction.

In order to shew the usefulness of this apparatus still more clearly, I request the society to attend to the following statement of the expence of a given quantity of bleaching liquor, with and without alkali, but of equal strength.

With

(L) It has been usual to estimate the strength of the oxygenated muriatic acid by a solution of indigo in sulphuric acid. This method was inadmissible in these experiments on the comparative strength of the bleaching liquor, with and without alkali; because the sulphuric acid would have decomposed the muriat of potash, and thereby produced errors. I therefore added to a solution of indigo in sulphuric acid, after it had been diluted with water, acetite of lead, till the sulphuric acid was precipitated with the lead. The indigo remained dissolved in the acetous acid.

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With Alkali (M).

	L.	s.	d.
80 lb. of salt, at 1½d. per lb. -	0	10	0
60 lb. of oil of vitriol, at 6½d. per lb.	1	12	6
30 lb. of manganese, - -	0	2	6
20 lb. of pearl-ashes, at 6d. per lb.	0	10	0
	L. 2	15	0
But it appears, by the foregoing experiments, that the liquor loses strength by an addition of alkali. The value of this loss, which on an average amounts to 15 per cent. must be added to the expence, - -	0	8	3
	L. 3	3	3

Without Alkali.

	L.	s.	d.
80 lb. of salt, - - -	0	10	0
60 lb. of oil of vitriol, - -	1	12	6
30 lb. of manganese, - -	0	2	6
	L. 2	5	0

"It appears from this calculation, that a certain quantity of the liquor, for the use of my apparatus, costs only 2l. 5s.; but that the same quantity of the alkaline liquor costs 3l. 3s. 3d. which is 40 per cent. more than the other. The aggregate of so considerable a saving must form a large sum in the extensive manufactures of this country †."

† *Manchest. Memoirs*, vol. v.

259. "Indeed, that the addition of potash should diminish the bleaching power of the oxygenated muriatic acid might easily be inferred, from knowing that the oxygenated muriat of potash, or rather the hyperoxygenated muriat of potash, does not in any degree possess the power of destroying vegetable colours, and consequently, the more completely the acid is saturated with the potash, the more completely is its bleaching power destroyed.

260. The method of employing lime in correcting the oxygenated acid was first used in Ireland; and some years ago, there were not less than thirty apparatus for preparing this mixture established in the northern parts of that kingdom ‡. It has been also employed at Glasgow; and a patent, which is now set aside, was obtained by a manufacturer there for preparing the liquor, and a solid oxymuriat of lime, which might be employed at all times, and conveyed to any distance.

‡ *Higgins's Essay.*

The pneumatic tub should be of such a capacity as to hold 800 gallons of water; and to this is to be added eight pounds of slaked and well sifted lime, which is to be well mixed with the water by means of the agitator, both at the time of making the mixture and during the distillation.

Between the tub and the distilling vessel is placed a leaden receiver capable of holding eight gallons, which is to be two-thirds filled with water, intended to retain any common muriatic acid which may come over. For this purpose a leaden tube, three inches diameter in the bore, proceeds from the alembic, and passes nearly to the bottom of the receiver, and another tube of the same diameter passes from the upper part of this latter to the pneumatic tub. It is known that the limed water in the tub is saturated with acid, when on drawing off a portion of the liquor and adding lime to it, the lime sinks to the bottom. The liquor is then to be drawn off and mixed with thrice its bulk of water, when it is fit for bleaching.

The oxymuriat of lime is found to be superior to the oxymuriat of potash in bleaching, and it is certainly far less expensive. Barytes (ponderous earth) and strontites might probably be used with still greater advantage, from their greater solubility in water, and could be procured at a cheaper rate.

261. Previous to immersing the stuffs in any of this oxygenated liquor, they are to be steeped and fulled in the same way as in the old method, to deprive them of the weavers dressing, and the saliva of the spinners. For this purpose it is proper to employ a weak alkaline ley.

In Britain and Ireland machinery is commonly employed in the fulling process, but it is generally so constructed as to wear the cloth. O'Reilly has proposed the following machine for this purpose.

He constructs a circular platform, which revolves about a moveable axis, and is supported at the extremities of the spokes by rollers of cast iron, the circumference of the platform is indented to receive a paul or catch, which makes it recede one notch at each stroke produced by the motion of the mill-tree. To the axis of the mill-tree are fixed spokes which raise several wooden beaters, which falling on the platform loaded with cloth or thread, rinse them more completely than can be effected in any other way, water being constantly supplied from gutters which are filled by buckets attached to a water wheel.

Cotton, thread, and stuffs, more particularly require this preparation, as without it the ley cannot penetrate the substance of the cotton, because of the resinous matter with which it is impregnated.

In some manufactories a bath of soap is employed; but this is unnecessary, as all that is requisite is to form a combination of the oily matter of the cotton with an alkali in order to render it soluble in water, and afterwards to submit the colouring matter to the action which another part of the alkali may exert on it. The preparations which the stuffs must undergo previous to their immersion in the oxygenated liquors consist therefore in steeping in an alkaline ley, rinsing in water, and subsequent pressing and wringing.

262. In disposing the apparatus for the immersions, regard must be had to the objects on which we are to work. Skains of thread are to be suspended in the tub which is intended to receive them; and the stuffs are to be rolled round the rollers of the immersing tub which we have described. The method of doing this is as follows: A piece of cloth is to be fastened to one of

(M) I make no mention of the expence attending the preparation of the liquor, it being the same in both cases.

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Vegetable Substances. of the horizontal axes which correspond to those of Mr Rupp, and is to be rolled round by means of the handle till the whole is upon the axis; to this is fastened a second piece, which is rolled on in the same manner, and thus as many pieces as required are rolled upon the axis. The end of the last piece is then made to pass over the roller *h* at the upper part of the extremity of the tub next *to g;* is carried down below the roller *h* at the lower part of the same extremity; is carried along the bottom of the tub under the next roller up to the roller at the upper part of the partition; passes over this to the roller at the bottom of the tub on the other side of the partition; so on below the lower roller at the other end of the tub, over the upper roller of the same end, from which it passes to the other horizontal axis, and is there secured.

Plate XCI. fig. 3.

When the pieces are thus fastened, the immersing tub is filled with the liquor intended to be used from the pneumatic tub; and this, if it be the oxymuriat of lime, may be done by a funnel, but if it be the simple oxygenated liquor, it is best done by a stop-cock passing from the pneumatic tub into the immersing vessel: when this is filled, the handle of the axis to which the last end of the cloth is fastened is turned till the whole of the cloth is unrolled from the first axis round the second, and then again the handle of the first is turned to reverse the situation of the cloth. Thus the cloth is made to pass to and fro through the liquor till the strength of this is exhausted.

263. This is discovered by drawing off a little of it, and adding to it a portion of the acetite of indigo; if the colour of this is not diminished, the liquor has lost its bleaching power, and the cloth may be removed, and the water, if the simple oxygenated liquor was employed, may be used for a new impregnation.

264. After the stuffs or thread have been removed, they must be well rinsed and again subjected to an alkaline ley. The lixiviations and immersions are repeated as often as is requisite till the bleaching is completed.

The number of lixiviations and immersions differs according to the articles. Cotton cloth requires only two operations of each; cotton-thread three; fine flax will require four; and articles of hemp five or six alternations.

265. "As it is of essential consequence to be aware of certain events, or facts, by which the progress of the bleaching may be ascertained, I shall here point out the gradations of colour, which the pieces assume after each immersion in the oxygenated muriatic acid without smell, made according to the proportions here described. The first immersion gives the thread, or piece-goods, a reddish colour, slightly inclining to yellow; the second, a colour inclining to ruddy yellow; the third, a whitish yellow; the fourth, a white, slightly inclining to a ruddy tinge; and by the fifth and sixth, the white becomes clearer and clearer. These are very nearly the shades which are assumed by coarse goods, for the fine goods frequently pass to the second or third gradation by one single immersion.

"When the liquor is strongly concentrated in potash, such as that which is denoted in the Annals of Chemistry by the name of *javelle*, the goods immediately, and without previous lixiviation, assume the third colour; but I have observed, that it is difficult to bleach them further without using the sulphuric acid, to remove the lees with which they are loaded. It must, moreover, be remarked, that in order to obtain this tone of colour, it is sufficient that the lixivium be diluted with water, so as to mark two or three degrees only on the aerometer, instead of eighteen or twenty, which it may mark after it is prepared by distillation.

"There are some who do not approve the colour which the thread acquires after the first immersion; but it may immediately be reduced by steeping the goods in cold or hot lees. The latter produces its effect more speedily; and after subsequent rinsing and drying, the goods retain a gray white colour, more or less deep according to the shade it has received. Many venders prefer this gray, or reduced colour, on account of its preferable sale in certain markets.

"With regard to the bright and perfect white, there are very few persons in the provinces who care for it, or appear to give it an exclusive preference. Two reasons may be given for this: first, because a prejudice is unfortunately established against the speed with which the new invented method of bleaching operates: and secondly, the consumer is constantly persuaded, whether the bleaching may have been performed in this manner or in the field, that when the goods have attained an extreme degree of whiteness, they cannot be so durable as such as are less white. It is thought to be rotten, or burnt; and this opinion leads to a preference in favour of such linens, and even cottons, which preserve after bleaching a solid shade of gray, or dulness in the white.

"From a prejudice of the same kind, it is, that in many countries, the women, particularly the peasants, prefer their linen, whether for clothing or household use, simply cleared without bleaching. The orders of proprietors, or purchasers, must therefore be attended to, and the number of immersions and lixiviations regulated accordingly.

"It may be considered as a rule, that when the goods no longer communicate a perceptible colour to new lees, they are entirely finished, and consequently, that every subsequent lixiviation, or immersion, will be attended with absolute loss, unless the immersion is necessary to clear off the last lees, on the supposition that simple rinsing in a large quantity of water may not be sufficient.

"I must, nevertheless, remark, that thread bleached by the oxygenated muriatic acid, may be used by the sempstress with much more speed and briskness than thread of the same quality bleached in the field; it is less brittle, and, on that account, is better for the weft, as well as the warp. It likewise may be struck much more effectually home to its place in weaving, and does not afterwards move. I received this valuable observation from impartial and unprejudiced manufacturers, for whom I bleached thread according to this method for making handkerchiefs *."

266. The theory of these operations is simply this. The oxygenated liquor supplies to the cloth the place of the oxygen of the atmospheric air, and this in greater abundance, and in a state which renders its action on the cloth more expeditious and more complete. By the union of the oxygen with the carbon of the colouring matter of the cloth, carbonic acid is formed, to produce and carry off which is the object of the several processes which we have described. It is carried

* Nicholson's Dr Chem.

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ried off by the subsequent lixiviations, in which the alkali answers two purposes; part of it combining with the carbonic acid forms carbonate of potass, while another portion acts on the remaining colouring matter, and dissolving part of it prepares it for another immersion in the oxygenated liquors.

267. The expence of potash soon suggested to scientific bleachers the importance of endeavouring to discover a substitute for it which might render their process more economical. Kirwan with his usual ingenuity, discovered, that saline sulphurets would answer the purpose, and Mr Higgins has lately much improved on the discovery by bringing into use the sulphuret of lime, which he has fully proved may be employed as a substitute for potash with the greatest advantage. His account of his views, and of the method of preparing and using this substance are too interesting not to find a place in this article.

268. "Since I had the honour of being appointed chemist to the Linen Board, which is now more than three years, I have allotted a considerable portion of my time and attention to the investigation of the principles of that science, applicable to the art in which I am thus more particularly interested. It appeared, that until potash could be dispensed with, we must for ever remain in the power of foreign nations as to our staple commodity; observing also, that all the late improvements in bleaching were exclusively confined to the one object, that of imparting oxygen to the cloth, in a safe and expeditious manner, but that there had been no effort made to supersede the necessity of potash, by far the most extensive and uncertain article employed by the bleacher, and for which he is entirely dependent upon foreign markets; I directed my attention chiefly to discover a substitute for potash; which, provided it should be of Irish production, though it might be equally expensive, I conceived would be of the utmost national importance. Impressed with these ideas, I undertook a series of experiments with that view.

269. "To enumerate the many disappointments and failures I experienced during my investigation, would be endless, and an unnecessary intrusion upon my reader. Knowing, from an important observation of Mr Kirwan, that saline hepars, or the combination of an alkali with sulphur, might, from its detergent properties, be advantageously employed in bleaching, as a substitute for mere alkali, by an obvious analogy I was led to expect a similar effect from calcareous hepar, or, more properly speaking, sulphuret of lime, being a combination of lime and sulphur.

270. "In these expectations I was not disappointed, but at that time (about three years since) I contented myself (rather through necessity, for large cities are very unfavourable to experiments on bleaching by exposure to the atmosphere), with pointing it out to some of the principal bleachers from the north then in the town, earnestly recommending it to them to give it a fair trial with and without potash. Since that time, alkaline salts having become progressively dearer, and in consequence of a late proposal of substituting lime for potash, in condensing the oxymuriated gas, I was instigated to resume the subject, and make further and more varied trials. The result of which has been, that the use of the sulphuret of lime may be most advantageously combined with that of the oxymuriated lime, and that thus cloth may be perfectly whitened without the use of a particle of alkali. This then alone would seem to give it a decided preference over the methods at present in use, while at the same time it possesses peculiar advantages, and is exempted from the principal objections to which other substitutes are liable: for, 1st, Quicklime and sulphur, the materials of which the calcareous hepar consists, are both articles of trivial expence, especially as the latter enters but sparingly into the composition; 2dly, Their combination is effected in the easiest and most expeditious manner possible, and perfectly level with the capacity of the meanest workman; 3dly, As the manner of its application is, by steeping the cloth in it cold, the saving of fuel is a matter of great magnitude; and, lastly, There is no danger to be apprehended in the use of it, from the unskilfulness or negligence of the workman, as it appears to be incapable of injuring the texture of the cloth.

271. "The sulphuret of lime is prepared in the following manner: Sulphur, or brimstone in fine powder, four pounds; lime well slaked and sifted, 20 pounds; water, 16 gallons: these are all to be well mixed and boiled for about half an hour in an iron vessel, stirring them briskly from time to time. Soon after the agitation of boiling is over, the solution of the sulphuret of lime clears, and may be drawn off free from the insoluble matter, which is considerable, and which rests upon the bottom of the boiler (N). The liquor, in this state, is pretty nearly of the colour of small beer, but not quite so transparent.

"Sixteen gallons of fresh water are afterwards to be poured upon the insoluble dregs in the boiler, in order to separate the whole of the sulphuret from them. When this clears (being previously well agitated) it is also to be drawn off and mixed with the first liquor; to these again, 33 gallons more of water may be added, which will reduce the liquor to a proper standard for steeping the cloth.

"Here we have, (an allowance being made for evaporation, and for the quantity retained in the dregs) 60 gallons of liquor from four pounds of brimstone.

272. "Although sulphur by itself is not in any sensible degree soluble in water, and lime but very sparingly so, water dissolving but about $\frac{1}{7..}$th part of its weight of lime; yet the sulphuret of lime is highly soluble (O).

273.

(N) Although lime is one of the constituent principles of the sulphuret, yet being so intimately united to the sulphur, it has no longer the property of lime; upon the same principle that sulphuric acid in sulphat of potash, has not the property of that acid.

(O) When the above proportion of lime and sulphur is boiled with only 12 gallons of water, the sulphuret partly crystallizes upon cooling, and when once crystallized, it is not easy of solution.

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273. "When the linen is freed from the weavers dressing, in the manner already described, it is to be steeped in the solution of sulphuret of lime (prepared as above) for about twelve or eighteen hours, then taken out and very well washed; when dry, it is to be steeped in the oxymuriate of lime for twelve or fourteen hours, and then washed and dried. This process is to be repeated six times, that is, six alternate immersions in each liquor, which I found sufficient to whiten the linen.

"When I submitted the linen to six boilings in potash, and to six immersions in the oxygenated liquor, it was not better bleached than the above.

"The three first boilings in potash, it is true, produced a somewhat better effect than as many steeps in the sulphuret; but towards the conclusion, that is, when the linen was bleached, the smallest difference was not observable as to colour. The linen bleached with the potash was thinner, or more impoverished than that treated with sulphuret, and the latter stood the test of boiling with soap much better than the former, although it did acquire a slight yellowish tinge, which I should suppose a week's, or at most, a fortnight's grass, as they term it, would remove.

274. "I contrasted the effects of hot and cold sulphuret in various temperatures, and although the difference appeared in favour of the hot liquor, yet it was so trifling as not to deserve consideration, or the expenditure of the smallest quantity of fuel.

275. "When I steeped the linen in the sulphuret first, and afterwards boiled it in potash, and then immersed it once in the oxygenated liquor, a better effect was produced than from two previous boilings in potash, or from two steeps in the sulphuret; so that the two substances seem to co-operate with each other.

"Indeed, from what I have seen, two successive steeps in fresh sulphuret, previous to the immersion in the oxygenated liquor, seemed to afford very little better effect than a single one, which is not the case with respect to potash.

276. "It was observable, that the cloth was invariably thicker or more swelled coming out of the sulphuret, than after being boiled in potash, and remained so even when washed and dried.

"It appears to me, that the sulphuret opens the fibres of the linen more speedily and better than the latter, by softening and swelling, rather than dissolving, the resinous or colouring matter. This accounts for the better effect of potash upon the linen when previously steeped in the sulphuret, than when used by itself.

277. "Probably those bleachers who do not at present find it convenient to use the oxygenated liquor, but continue to bleach by exposure to air, may derive some advantage from this, by using the sulphuret and potash conjointly or alternately.

"Mr John Duffy, of Ball's bridge (who from his knowledge of chemistry is very well acquainted with the principles of bleaching), was kind enough to repeat the above experiments, and his report to me corresponded with my own observations.

278. "It is almost impossible to ascertain to the full extent, more especially by small experiments in an elaboratory, the many advantages any substance not hitherto used in bleaching, will afford by varying the mode of application.

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"The experimenter does a great deal by discovering the efficacy, proving the practicability, and ascertaining the safest and most economical method of directly using it, and also the best proportion of it. Before he can arrive at any one of these, many a round of changes are necessary; indeed a greater number than any man who is not used to experiments can be aware of. But I should hope that the bleacher need not hesitate to use it in the state in which I present it to him, more especially as he runs no risk of injuring the cloth with it. If he can make more of it hereafter, I shall feel happy upon the occasion; no discovery was ever brought to perfection at once.

"How gradually, and yet how progressively, the steam engine, from its first invention by the marquis of Worcester, was brought to its present degree of perfection! Undoubtedly, it was just so with respect to alkalies, the substances now used by the bleachers; it must have taken a considerable time after their first application in bleaching, before they could be made the most of.

279. "I will now conclude by pointing out the advantage likely to accrue from the use of the sulphuret, to the nation, and also the saving to the individual.

280. "Hence it seems, that the quantity of foreign alkalies imported into the kingdom every year, amounts to 265,968 pounds; and that the quantity used in bleaching alone, amounts to about 215,307 pounds annually.

"The average price of brimstone for the last three years, is about 25l. a-ton, which is at the rate nearly of 2½d. a-pound; four pounds of brimstone, and twenty pounds of lime, as already observed, will produce 60 gallons of liquor. In this country twenty pounds of lime may be valued at about 4d. so that the bleacher may have the 60 gallons at the expence of 1s. 1d.

281. "By what I could learn from different bleachers, the common allowance of alkali for 60 gallons of water is six pounds of barilla or four pounds of potash at the very least, and most bleachers use more than this. The price of four pounds of potash at the rate of 65l. a-ton, is about 2s. 4d. which is 2d. more than double the price of the sulphuret; but as the brimstone must be ground, an allowance should be made for it; and being easy of pulverization, a farthing per pound is an ample consideration for the expence attending it.

282. "The saving of fuel only remains now to be taken into consideration; and as this cannot be calculated with any degree of accuracy, I shall content myself by particularizing facts. In the first place, but 16 gallons of liquid are to be boiled in preparing 60 gallons of the sulphuret, while the whole 60 gallons must be boiled when the alkali is used; hence it might appear that two-thirds of the fuel are saved in the quantity of liquor, but it is not quite so much, suppose we estimate it at one half, which is rather under-rating it. Let us add to this the time necessary to boil the different liquors; the sulphuret requires but about half an hour, and the alkaline lixivium at the very least seven hours, to boil the linen in it, which is in the proportion of one to fourteen.

283. "The saving altogether to the bleacher from this

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Vegetable Substances. this statement, is obviously very considerable; and as the Wicklow copper mines are sufficient to supply the whole kingdom, or indeed two such kingdoms, with abundance of sulphur, let the consumption be ever so great, the entire of the alkali, or 215,307 pounds, must be annually saved to the nation.

"But suppose two-thirds only of the quantity of alkali generally consumed in bleaching were dispensed with by the use of the sulphuret (which is a supposition not warranted by my experiments), still the saving to the nation, and to the individual, must evidently be great indeed *."

* *Higgins's Essay.*

284. The goods which have been bleached in the methods above described, require to undergo what are called dressings, to give them a clear and bright white. This is particularly necessary for the finer piece goods, sewing thread, stockings, gloves, and all cotton articles.

After the last immersion, the goods are to be pressed or wrung, and then immersed in a bath of water, holding in solution about a hundredth part of its weight of sulphuric acid. The acidulous bath may be employed cold, but it is better to heat it so moderately, that the hand may be borne in it. The best way to make the mixture of sulphuric acid and water, is to invert the bottle containing the acid in the water, when the acid by its greater specific gravity quits the bottle, and by agitation for a considerable time combines with the water.

It is usual to leave the goods for some days in the bath, but it is safer to allow them to remain only a few hours, and to renew the bath till they are sufficiently white. Too many articles must not be crowded together, nor too much pressed, that the acid may exert its action equably.

After removing the goods from the acid bath, they must be wrung, and washed repeatedly in fair water till they no longer retain any marks of acidity.

285. It is customary to give to linen cloth a bluish shade: this is produced by dispersing through the water in which it was last rinsed, a little indigo or Prussian blue; or it may be given by a solution of white or motled soap, in which the cloth is washed, while it still retains a little acid.

286. As accidents are apt to occur during these processes, it is proper to inform the artist how these may be remedied.

287. "*Accidents in the distillation.*—The principal accident which is capable of interrupting the distillation, is when the lutes of the adopter suffer the gas to escape. The most speedy remedy, in this case, to prevent the exhalation of the acid, which cannot be retained but with difficulty, seldom for any length of time, and then very imperfectly, in consequence of its great expansion; the shortest method, I say, at least if the distillation be not near its conclusion, is to remove the fire immediately from beneath the capsule of the retort, and to suffer this last to cool for a certain time, by raising it a little in its sand bath. If it be not possible to take it out of the furnace, together with its capsule, on account of the heat, or its sticking too fast, the adopter must be united from the funnel of the leaden tube, and the aperture of this tube closed with a cork, or lute, to prevent the gas of the pneumatic vessel from evaporating; after which the retort must be raised, and placed gently upon a bag of straw, or on coarse cloths folded together; and then holding the retort by its neck, near the flexure, the adopter must be entirely unluted, by twisting it round and drawing it off. The orifice of the neck of the retort is then to be closed with a cork stopper, but not so closely but that a very small portion of gas may be suffered to escape, for fear of an explosion. The stopper of the neck may, for greater safety, be slightly raised. This precaution is necessary, on account of the great expansion of the muriatic acid gas. The old lute must then be taken off, as well from the adopter as the retort, and the places to which they were applied must be well cleaned, in order to receive fresh lute, after having carefully wiped off the moisture with a cloth or a sponge. If the lute which comes off be still good, it may be kneaded again, adding, if required, a small quantity of boiled oil, or it may be mixed with new lute, if it be burned or decomposed. This decomposition in the fat lute may be known by the white or reddish colour which it acquires, and the facility with which it breaks, on account of its having lost the gluten which afforded it that toughness and tenacity, on which its goodness chiefly depends.

288. "With regard to the lute of linseed cake, it must, in almost every case, be totally renewed, particularly when internally applied, because the heat hardens it too much to admit of its being kneaded again, with any moderate degree of facility; the decomposition of this lute is known by the yellow colour it acquires, and the contraction it undergoes from the effect of the heat. The lutes being kneaded to a proper consistence, and duly placed according to the direction laid down in (232.) the adopter is to be fixed, previously removing the stopper from the mouth of the retort, and placing another in that of the small end of the adopter, to prevent any inconvenience from the vapour which might issue out during the time of fixing it. This vapour is likewise condensed within the adopter, in consequence of its coldness. The retort is then to be placed, as before, on the furnace, the adopter uncorked, and its beak luted into the tube of lead; after which, the fire is to be replaced beneath the capsule, and distillation very speedily recommences, and proceeds as usual. The operation is a work of some delicacy; it requires to be performed with speed, and great care must be taken while placing the lutes and the adopter in their proper situations, to stand always in such a position, that the current of the external air may drive the vapour from the operator himself.

289. "If the accident here described should take place towards the end of the distillation, as it may sometimes happen, in consequence of the strong heat which, at that time, may soften the lutes, it will be sufficient if the fire be taken from beneath the capsule. The distillation soon ceases when this is done, particularly if care be taken to condense the gas, by the prudent application of wet cloths on the neck of the retort, as well as of the adopter.

290. "This inconvenience would not take place, if the workmen in those glass-houses which are principally employed in the fabrication of chemical vessels, could make retorts with necks recurved in the form of the adopter. These kind of vessels may be assiduously supplied by making use of a tube of lead, so formed as to

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to serve instead of the adopter, as I have already observed, with regard to the tubulated bottles or bodies (P). If, by accident, the lute which is adapted should fail, or suffer the gas to pass through, it may easily be stopped, by applying a new lute to the place of junction. Instead of the leaden tube, we may substitute, with still greater convenience (the danger of breaking excepted), a tube of glass, of which the end nearest the bottle, or tubulated body, should be ground with emery. By these means there would be no application of lute, and consequently no danger to be feared with regard to the filtration of the gas, the escape of which is easily perceived by the smell which diffuses itself through the workshop, and is more particularly perceived when the nose is applied near the vessels, or the lute. But as this last method of discovering the place where the lute has failed may be attended with the most serious consequences, if the greatest precaution be not used, it is more prudent to apply an open bottle of ammoniac near the suspected place; at the instant that it is presented, a white fume is formed, which immediately points out the defective spot. The bottle must be presented above the current of air, which takes place near the lute, or in the workshop. If this precaution be not attended to, the operator might be induced to remove a good lute, instead of one which was really defective.

291. "On the other hand, if in the course of the distillation, and for want of keeping up the heat, the fluid in the pneumatic vessel should be absorbed and rise into the distilling apparatus, it is necessary the instant it is perceived to withdraw for a moment the stopper out of the neck of the retort, where, as I have already had occasion to observe, the absorption instantly ceases. Nevertheless, if, for want of being observed in time, the water should rise so far as partly to fill the retort or body (for it never entirely fills it), the distillation will be stopped, from the coldness of the water, and its too great quantity. The shortest remedy is to draw out the excess of water, which is thus introduced into the distilling vessel, by the assistance of a glass pump, or syphon, and afterwards to heat the same vessel, first returning the water into the pneumatic vessel, if thought expedient: but if the distillation be properly attended to, this accident can never happen.

292. "*Accidents in the lixiviations and immersions.* I place the accidents arising from these two operations in the same class, because they can scarcely take place, but by the joint operation of both.

"Any article which is badly cleared of the lixivium, and afterwards immersed in the oxygenated muriatic acid, becomes almost immediately of a nankeen colour, particularly in the folds, either in spots where certain parts have not been sufficiently rinsed, or else the colour is general, if the whole has not been well rinsed.

"The same accident happens if soot has fallen on the linen or thread. The difference is simply in the colour, which approaches more to brown. The colours are capable of becoming more and more deep if the mismanagement be not remedied as soon as perceived, and that before the goods are subjected to other immersions in the alkaline lees, or of the oxygenated muriatic acid. The same accident is to be expected, if the goods, though white at the time of their immersion, are suffered to remain too long in the bleaching liquor. This does not fail to happen, particularly if the articles which are suffered to remain even in a weak solution, are kept in that state the whole night. The next day they are found to be yellow, or charged with lixivium.

293. "The only method of remedying these accidents consists in the use of water, slightly acidulated with sulphuric acid, no matter whether cold or hot, but the hot solution operates more speedily. The spotted or tinged goods are to be soaked in this water for a few minutes, or a quarter of an hour, accordingly as the colour may be more or less deep, in consequence of a series of lixiviations or immersions, more or less repeated. In this situation the offensive colour is seen almost immediately to disappear.

294. "Instead of making a sulphuric solution expressly for that purpose, that which has served for the dressing may answer very well: neither of these need be stronger than has been there directed, unless the goods be considerably charged with colour, and there be a great quantity to immerse at once. The acidulated water is tried by the aerometer, and if, in consequence of having been used, it should not be sufficiently strong, it may be restored by adding the requisite quantity of acid for that purpose. It is necessary, when any new acid is poured in, to mix it well with the water before any goods are immersed therein.

"It must, in this place, be observed, that though the thread and piece-goods may become charged with a foreign colour, in consequence of the accidents here pointed out, both these articles are frequently very well bleached at the under surface. It is even a proof that the muriatic acid has operated effectually, in causing the lixivium to produce such an effect: but these accidents are difficult to be observed on objects simply cleared, or in the crude state. In the latter case, a permanency of the original colour may alone shew the necessity of using the sulphuric acid, particularly when the lees and the muriatic acid which have been used are not at all exhausted.

295. "*Accidents attending the preparation or dressing.* When the piece-goods are immersed in a solution of soap, after having been taken out of the sulphuric acid, while they are still too strongly acidulated, or instead of rinsing them they be immediately conveyed from the acid into the solution of soap; this last solution is subject to curdle, or become immediately decomposed; whence the operator has the mortification to observe the whole surface of the goods covered with an infinite number of small spots of oil, in the form of clots, of a yellowish colour, and very tenacious, particularly on stockings or cotton goods, because they incorporate as it were with the nap or texture of the goods: they disappear

(P) This last method appears to be preferable to every other; because it requires only a slight attention to the lute, and can never produce those dangers which arise from the use of retorts.

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appear in consequence of much washing or rinsing. I must particularly mention an accident which may happen to any one, namely, that of placing by mistake stockings or other bleached objects, which have received their first treatment in the solution of soap, upon articles which have been exposed to the vapour of sulphur. I have placed stockings upon gauze, which had been whitened by sulphur, and found, that after they had remained in this situation for the course of a night, they became entirely of a brown red at the place of contact. They appeared as if burnt or marked with a hot iron. This colour, which, no doubt, was produced by the combination of the volatile sulphuric acid, with the alkali of the soap, with which the stockings were still impregnated to a certain degree, immediately disappeared upon exposing them, first, to the action of a bath of the odorant oxygenated muriatic acid, and afterwards to another of water, slightly acidulated with the sulphuric acid.

296. " Every salt with excess of acid, such as the salt of sorrel, removes the ruddy spots here mentioned with equal ease. It is true, that this salt cannot with convenience be used, on account of its dearness; but the residue of the distilling vessels, that is to say, the water which holds in solution the residue of the distillation of the oxygenated muriatic acid, is very serviceable in this process, and may be advantageously used either hot or cold, to remove those very tenacious spots, which are not at all capable of being removed by soap or alkaline leys.

297. " When the spots of oxide of iron, commonly distinguished by the name of ironmould, are small, they may easily be taken out with the salt of sorrel in powder, laid upon the spot itself, which is afterwards to be moistened with a small quantity of water; or the part which is spotted may be steeped in a solution of the same salt. It soon becomes fainter, and at length disappears, after which the place must be very well rinsed. The sulphuric acid may be usefully applied instead of the salt of sorrel, as Berthollet seems to affirm in his memoir; and I have proved with success, that, though the spots may penetrate quite through the cloth, and be very broad, yet if they be soaked in a bath of sulphuric acid, either warm or cold, when the goods are taken out of the bath of muriatic acid, the effect will be that the spots insensibly disappear. If the goods be of close texture, the operation of the acid is slower (Q).

298. " With regard to the spots of rust which are frequently seen on thread or cotton stockings, they are produced by the needles of the engine, and commonly disappear during the dressing, that is to say, in the bath of sulphuric acid. The same observation is true of the spots of rust which sometimes appear on the piece-goods, in consequence of their having been in contact with iron. In general, the older any ironmould may be, the more tenacious it is, and the more difficult to be effaced; but every spot may be made to disappear in time.

299. " It frequently happens that piece-goods are spotted with tar, during their carriage by water, in boats, where they are liable to be placed upon the pitchy parts of the vessels, or in contact with tarred ropes. These spots may be soon taken out, by rubbing them with oil of olive, which dissolves the tar; or still better, by holding the part in spirit of wine, if this process should be thought more convenient. The latter method operates by the complete solution of the tar.

300. " With regard to spots of wine, cyder, or any kind of fruit, they may be effaced by dropping a few drops of the oxygenated muriatic acid upon them, which causes them almost instantly to disappear. But there are certain fruits, such as plums, of which the spots are more difficult to efface; they requiring one or two lixiviations. Those that are gray, or reddish, at first, assume a fine yellow colour in the muriatic acid, which does not disappear during a subsequent lixiviation, but requires a second immersion in the bleaching liquor.

301. " I must not omit a second very simple and economical method to take out every kind of spot occasioned by fruits, such as strawberries, gooseberries, &c. It consists in causing the spotted part to imbibe water, and afterwards to burn one or two common brimstone matches over the place: the sulphurous gas which is discharged soon causes the spot to disappear.

302. " There is a kind of indelible spot which is produced from red ochre and the charcoal black, with which the weavers mark the turns of the beam, in order to ascertain the length of the chain of piece-goods. This kind of mark, which is impressed on the goods at equal distances, is so far from being effaced, that it seems, in some measure, to receive strength from the oxygenated muriatic acid, notwithstanding the intermediate action of the leys."

Use of the Oxygenated Muriatic Acid in discharging the colours of dyed or printed goods.

303. There are several processes allied to bleaching, which depend on the agency of the oxygenated muriatic acid, and of which we shall therefore treat before proceeding to describe the remaining bleaching processes. These are the discharging of dyed or printed colours; the bleaching of paper; the cleaning of books, maps, and prints; and the bleaching of wax.

304. White silk and wool, on being steeped in oxygenated muriatic acid, acquire a yellow colour; hence this acid is of no use in bleaching these animal substances. It readily discharges the simple colours with which silk has been dyed, such as, indigo blue, gray, lilac and crimson, and gray, orange, green, Saxon blue, apple green, fawn colour, brown lemon, and dipped blue, with which wool has been dyed. It leaves the goods, however, of the same yellow cast as it imparts to white wool and silk; but this yellow colour is readily altered to a clear white, by immersion in the sulphurous acid, as described in the bleaching of these substances.

Silk dyed with some compound colours, as violets, greens, browns, blacks, acquires the same yellow colour,

(Q) The salt of sorrel is sold in London, in small bottles, by the perfumers and apothecaries, under the name of *salt of lemon*. The sulphuric acid, as prescribed above, must of course be diluted.

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lour, but not so speedily, two immersions being usually found necessary to discharge the colours completely. In the brown violet and puce colours, which are composed of blue and red, the blue commonly first disappears, and by a subsequent immersion the red is discharged. The same happens with the yellow, which forms a part of the composition of green and orange, the blue of the former, and the red of the latter remaining. In blacks which are composed of brown laid upon a blue or a root colour, the brown first vanishes.

When more than one immersion is required, it is proper to use a bath of sulphuric acid between them; and this is particularly necessary where iron has entered into any of the colours.

These effects of the oxygenated muriatic acid serve to explain the action of the air in discharging the less permanent colours of woollen and silken goods, and in giving to white clothes a yellow colour. It is evidently oxygen which is in both cases the active principle, but its action is more speedy in the acid than in the atmosphere, from the facility with which the former is decomposed.

305. The colours employed in dyeing or printing cottons or linens are of two kinds; chemical, or, as they are sometimes called, false colours, and fast or true colours. The former disappear in a very short time upon one immersion in the acid, except one description of yellow, which contains in its composition sulphate of copper (blue vitriol), sulphate of iron (green vitriol or copperas), and acetite of lead (sugar of lead). Goods which have been dyed with this colour must first be well scoured with soap, which so far separates or decomposes the colour, that a subsequent immersion will readily discharge it, whereas, without this previous scouring, the acid would have completely fixed the colour.

Several of the fast colours, as the blues, yellows, and blacks, require a lixiviation before immersion; and two, or sometimes three, immersions, with intermediate baths of sulphuric acid, are necessary completely to remove them. Most other fast colours yield to a single immersion. A peculiar exception to this is the Adrianople red, which never becomes entirely white, however numerous the lixiviations, immersions, and acid baths employed.

306. "There is another thing no less worthy of remark, with regard to the black colour, which forms the outline or border of designs, namely, that if the muslin, or cleared fine piece, upon which the different flowers were designed which have been discharged, be folded together in several folds, or placed upon a dark-coloured ground, the effaced outline becomes visible according to the exposure of the piece under a certain obliquity of the light, exhibiting the appearance of a slight trace. The kind of outline which, under these circumstances, becomes visible, cannot be compared to any thing better than the embroidery of muslins placed on a coloured ground. This trace seen at a certain distance has the same effect, and even when closely observed, it is impossible to determine what it is, because it is not visible, except under a certain reflection of the light; nevertheless the whole piece appears white, and of a very superior quality. I have remarked, that this effect does not take place excepting with regard to the old prints of flowered designs of the true India calicoes imported from that part of the globe. For in the printed goods of our manufactures, such as those of Paris, Joly, St Denis, and Beauvais, all the traces of the designs completely disappeared, to my great surprise. It must, therefore, necessarily be admitted, that the difference in these results depends on the qualities of the mordants, which are more or less oily, or the manner of striking the blocks in the act of printing.

"If this effect were produced by the mordant with the outlines of the designs in the pieces of printed goods, it might, perhaps, be of advantage to take the same method of obtaining a substitute, instead of the rich expensive embroideries with which the fine muslins of India and Switzerland are covered. These designs likewise do not appear in their full effect, but when they are placed upon a transparent stuff of a deep colour, which exhibits all the outline. This method of producing so rich an effect would be extremely simple, singularly permanent, and highly economical. I think, however, that I may add, that, after many trials, I have at last succeeded in discharging this mordant, sometimes by a bath of sulphuric acid, rather stronger than usual, and at other times by soaping the goods before and after the bath. This management is very essential to be known, in order that the operator may not be exposed to the mortification of seeing the same designs return again by the second action of the madder applied to the same bleached piece in a subsequent printing process. To obviate every accident of this kind, it will be proper to inform the owner which of the methods have been used to bleach their goods, and in case the new method may have been used, it would then be prudent to pass them previously through a good bath of sulphuric acid *."

307. Colours laid in oil, which do not contain madder, must be first heated in an alkaline ley, and then scoured with soap.

* Nicholson's De Charmes.

Bleaching of Paper.

308. The bleaching of paper has been rendered considerably more expeditious by the use of the oxygenated muriatic acid. The following processes are given by De Charmes, as extracted from different French memoirs.

Bleaching of old printed Papers, to be worked up again.

309. "1. Boil your printed papers for an instant in solution of soda rendered caustic by potash. The soda of varech is good.

"2. Steep them in soap water, and then wash them, after which the material may be decomposed, or reduced to a pulp, by the machinery of the paper-mill. The washing with soap may be omitted without any great inconvenience.

Bleaching of old written Papers, to be worked up again.

310. "Steep your papers in a cold solution of sulphuric acid in water, after which wash them before they are taken to the mill. If the acidulated water be heated, it will be so much the more effectual.

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Bleaching of printed Papers without destroying the texture of the Leaves.

311. "1. Steep the leaves in a caustic solution of soda, either hot or cold. 2. And in a solution of soap. 3. Arrange the sheets alternately between cloths, in the same manner as the paper-makers dispose thin sheets of paper when delivered from the form. 4. Subject the leaves to the press, and they will become whiter, unless they were originally loaded with size and printers ink. If the leaves should not be entirely white by this first operation, repeat the process a second, and if necessary, a third time. The bleached leaves, when dried and pressed, may be used again for the same purposes as before.

Bleaching of old written Papers without destroying the texture of the Leaves.

312. "1. Steep the paper in water acidulated with sulphuric acid, either hot or cold. 2. And in the solution of oxygenated muriatic acid. These papers, when pressed and dried, will be fit for use as before.

The method of bleaching Rags of the natural brown colour for the Manufactory of white Paper.

313. "1. Let the rags be opened or separated from each other, after previous soaking or maceration for a longer or a shorter time, according to their texture and quantity. 2. Give a lixiviation in caustic vegetable or mineral alkali. 3. Pass them through the oxygenated muriatic acid, more or less concentrated with alkali. 4. Let the mass be then worked for a sufficient time in the apparatus of the paper-mill, and it may be advantageously substituted instead of that which is afforded by white rags.

"The white colour will be still better, if, after the maceration, the rags be opened, and subjected, as usual, to the action of the mill; after which the paste itself must be subjected to one lixiviation, one immersion, and a bath of sulphuric acid. The mass being then well washed and pressed out, may be thrown into a trough to be manufactured.

Method of bleaching Rags, of all Colours whatever, in order to make white Paper.

314. "1. Let the rags be opened, as before. 2. Steep them in the oxygenated muriatic acid. 3. If, as it commonly happens, the colour is discharged by this first immersion, let these bleached and decomposed rags be immersed in water acidulated with sulphuric acid. 4. Complete the disorganization by the mallets or cylinders of the mill, after having previously well washed them.

"If the colour should not be sufficiently discharged by the first immersion in the oxygenated muriatic acid, which is very seldom the case, give them another alkaline lixiviation, and after that a second immersion in the oxygenated muriatic acid; after which steep them in water acidulated with sulphuric acid, either hot or cold, the latter of which is the most active and effectual; and, lastly, let them be subjected to the action of the mallets or cylinders.

"Red and blue colours are most tenacious. With regard to black, it will be sufficient if they be steeped after opening their texture, 1. In a diluted solution of sulphuric acid; and, 2. In a solution of the oxygenated muriatic acid. If the operator could know that these rags had been dyed in the raw state, a still more brilliant white might be obtained by following the second method described in the preceding article. But it very seldom happens that coloured rags have not been bleached before they were dyed. The manipulations may be performed with sufficient speed to bleach at least three thousand pounds weight in the course of the day, without appropriating any extraordinary edifice or workshop to this purpose *."

* Nicholson's De Charmes.

315. But by far the best method of bleaching paper, is by applying the gas to it while in the state of paste; the method of doing which, with the steps which led to it, are thus related in a Memoir of C. Loysel, in the *Ann. de Chimie*, as translated by Mr Nicholson, in his valuable Journal, from which we have extracted it.

316. "The process of bleaching the paste of the paper-maker, even when produced from the most common rags, will communicate to it the quality of the best sort. By these means our paper manufactories may supply our wants in fine white paper, and even obtain the preference in foreign markets. The result of this operation would be, that a greater number of workmen would find employment, and the advantages of this increase of industry would be of still greater national value, than even the foreign export which might be expected.

"The success of bleaching the paste of paper by the method of Citizen Berthollet is no longer problematical. The application which has been made to the paper used in making assignats, has placed this question beyond all doubt as to its solution.

317. "It was at the commencement of the year 2, that the committee of assignats and moneys of the national convention, of which I was a member, resolved to employ this method, together with that of stereotypage, which had been adopted, to oppose new obstacles to the practice of forgery.

"We particularly consulted Citizens Berthollet, Fourcroy, and Guyton on this enterprise. Their approbation of the project, and the information they afforded us, soon gave us the power of realizing it. We were also assisted with the knowledge of Citizens Welter, Athenas, Alban, Carny, Marchais and Ribaucour, who with great zeal communicated their processes, and permitted us to inspect their several manufactories.

318. "Our first processes were executed precisely according to the method of Citizen Berthollet. The rag was subjected in succession to different leys, to baths of the bleaching liquor and sulphuric acid pointed out in his memoir. Berthollet had shown, and we were also convinced by our own experience, that the gas is less confined in the simple fluid, prepared without addition of fixed alkali, than it is in that which contains potash or soda; and that it is consequently more disposed to separate and enter into new combinations. We therefore at first made use of this simple liquor; but the workmen soon exhibited a strong repugnance to its use on account of the fumes it emits, which are extremely inconvenient, even when chalk is diffused in the liquor. This inconvenience forced us to abandon it, though with regret. This sacrifice was so much the more considerable, as it occasioned a loss of time, and considerable increase of expence. We decided that

we

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we would receive the gas in a solution of potash; but as the doses in which this alkali may be used have limits of great extent, we endeavoured to keep as near as possible to that preparation which is sufficient to prevent the spontaneous disengagement of the gas, and by that means cause the liquor to lose the odour we were desirous of avoiding. This dose was 5 kilograms of potash to 100 litres of water (11 pounds avoirdupois, to 21½ ale gallons.)

319. "The rags bleached in this manner became of the most brilliant white. Nevertheless, a part of this perfection disappeared, when the rag was converted into paste, and that paste into paper. It was easy to discover the cause; namely, that the interior parts of the thread in the rag were less exposed to the action of the liquor than those at the surface. This motive determined us to abandon the bleaching of the rags, and to operate upon the paste itself.

320. "We were here opposed by new obstacles. When the rag is converted into a paste proper to be worked, its coherence is such that it settles, and no longer permits the leys and baths of the bleaching liquor to penetrate through all its parts, in consequence of which property the paper was found to have veins and different shades of colour. We remedied this inconvenience, by taking the matter in a mean state between the rag and the paste proper to be converted into sheets of paper. We succeeded in this respect by destroying the texture of the rag under the first cylinder so as to separate its fibres, an operation which usually lasted two hours for a pile of 50 kilograms. Thus it was, that by successively avoiding the extremes of too much and too little mechanical connexion, we advanced towards our object.

321. "The apparatus which Citizen Welter imagined, and of which Citizen Berthollet has given a description in the first volume of the Journal of Arts and Manufactures, is applicable to all the methods which can be employed to procure the different kinds of bleaching liquor, whether the water of the receiver contains fixed alkali or not; whether the muriatic acid be used on the oxyd of manganese, or the gas be obtained by sulphuric acid, upon the mixture of oxyd of manganese and muriate of soda. This apparatus is particularly preferable to all others in the case where the water of the receiver contains no alkali, because the absorption of the gas is favoured by its being brought into contact with the water at a great number of surfaces. But as we had determined to use a solution of potash, we were able to make some modifications of this apparatus.

322. "One thousand litres of water are placed in the receiver, holding in solution fifty kilograms of white purified and calcined potash.

"When the disengagement of gas is effected by the muriatic acid, the materials are used in the following doses:

Oxyd of manganese	24 kilograms
Muriatic acid at 20 degrees of density according to the aerometer of Baumé,	68
	92

which makes for each of the eight distilling vessels 11½ kilograms of materials.

323. "The operation is begun by charging the receiver with 1000 litres of alkaline water, after which the aperture 8 is closed with its stopper well luted. Each matrass is then placed in its sand-bed; and pulverized manganese is introduced. The muriatic acid is poured upon the manganese, and the stoppers into which the tubes of communication pass, are duly placed. The juncture is luted with paper soaked in starch. And the lute is left to dry from six to twelve hours, after which the fire is lighted in the furnaces.

324. "The process of distillation lasts from ten to twelve hours. When it is finished the tubes are unluted, the fire extinguished, and the matrasses suffered to cool in their sand beds, till the temperature of these beds has descended to 60 or 70 degrees, (centigrade) at which period, water of the same heat is poured into the matrasses. The water dilutes the residue of the distillation, which mixture is to be poured out, and the vessels suffered to cool in baskets containing straw. If the precaution of introducing hot water in this manner upon the residue were not taken, it would become so solid when the operation is performed with sulphuric acid, in the manner we are about to describe, that it could not be extracted without much trouble and danger of breaking the vessels.

325. "If the disengagement of the gas be made by sulphuric acid, the following doses are used:

Oxyd of manganese	25 kilograms
Muriate of soda	70
Sulphuric acid at 50 degrees of density	25
Total	120

"The acid is to be diluted with an equal bulk of water, or 16 litres, which will reduce its density to 31 degrees.

"The eighth part of this for each matrass amounts to 14¼ kilograms.

326. "The oxyd of manganese and muriate of soda being pulverized are mixed together. The matrass is to be charged and the operation conducted as before described. This method is the most economical, because the sulphuric acid is cheaper than the muriatic, and also because it is practicable to obtain from the residue of the distillation, the soda of the muriate which is converted into sulphate of soda; that salt being decomposable by well known-processes.

"In order to measure the force of these liquors, or their bleaching power, we made use of the solution of indigo prescribed by Citizen Descroizilles.

"One part by measure of the bleaching liquid prepared as before mentioned, will usually destroy the blue colour of nine parts of proof solution of indigo; it was of the same strength as that of Javel, prepared by Citizen Alban.

Choice and Preparation of the Rags.

327. "The strength or tenacity of paper depends upon the staple or fibre of the material from which it is made. Rags of new cloth and cordage compose a paper more tough than old rags, and the first of these materials presents a great variety on account of the quality of the hemp or flax of which they are formed.

Rags

Rags of fine new cloth, whether raw or bleached by the oxygenated muriatic acid, stand in the first rank, after which cordage and old rags may be classed.

328. "Paper intended for bills of exchange, or other commercial and legal instruments, ought to be tough, in order that it may not be easily torn when thin. For this paper the materials of the first class must be entirely, or in large proportion, employed. The price which the consumers are disposed to pay for this article, is sufficient to indemnify the manufacturer for his care and industry, as this kind of paper is sold in France for 5 or 6 franks the kilogram.

329. "The other papers also require to be more or less tough, according to their thinness, and the use to which they are applied, but a clear white colour is sought in paper of every description. The first operation to which the rags are subjected is sorting, in order that each branch of the manufacture may have its appropriate material, after which they are cut with shears into pieces of about one decimeter, or three or four inches square.

330. "I will suppose that the object of the manufacturer, is to obtain paper of a beautiful white. If it is intended to be thin, so that, for example, a ream of the size denominated *raisin* should weigh only four or five kilograms, that is to say, about one-third of the weight of common paper of the same form; the manufacturer makes choice either of new rags already of a fine white, or of unbleached rags.

"In the case of the white rags, it is sufficient to pass them under the first cylinder, then to give them a bath of the bleaching liquor, and afterwards a bath of sulphuric acid, as we shall proceed to direct; after which they are passed under the finishing cylinder for seven or eight hours, and, lastly, conveyed to the working trough to be made into sheets of paper.

331. "Rags, which have never been bleached, may be treated by either of the following processes: that is to say, the first, which preserves the utmost degree of toughness to the paper, but is likewise the most expensive, consists in decomposing the rag, and afterwards applying the method of Citizen Berthollet for bleaching piece goods; namely, subjecting it to three or four lixiviations, and afterwards alternately to lixiviations, baths of the bleaching liquor, and baths of sulphuric acid. The weight of the raw unbleached material is diminished from 50 to 45 per cent. in these operations.

332. "This method was the first which we used for the assignat paper; but we soon perceived that we might omit most of the lixiviations and baths of the bleaching fluid, and still preserve as much toughness as the paper required. Nothing further was necessary for this purpose than to suffer the rag to undergo a degree of fermentation more or less advanced, by leaving it to rot. In this operation the colouring matter undergoes a slow combustion, and passes to a kind of saponaceous state, and is carried off by the water, by washing the rags in the vessel of the first cylinder.

"One single lixiviation, to baths of the bleaching liquor, and one of sulphuric acid, are then sufficient to bleach completely the raw rags or cordage. This is the second method. We were not at that time acquainted with the economical process of Citizen Chaptal in the operations of lixiviation. This will, no doubt, be used; but the effect of rotting, carefully conducted, will always be found very advantageous.

333. "Lastly, If the rags be neither perfectly white, nor raw and unbleached, but in a medium state, they are left to rot for a shorter time, for example, 12 or 14 days, and are taken up when the heat of the fermentation raises the thermometer to 30° or 35°, after which the process is to be conducted as before mentioned.

Composition of a bath of the bleaching liquor, for a pile of decomposed rags, weighing 50 kilograms.

334. "For each heap of rags, a certain number, for example, eight or nine, wooden tubs are disposed in a line, capable of containing in the whole 600 litres of water: 450 litres of pure water are poured in, and 90 litres of bleaching liquor are added in equal portions to each of the vessels, after which the 50 kilograms of decomposed rags are disposed in equal portions in each tub. The stuff is left for about 12 hours in this bath, agitating it from time to time, after which it is to be completely washed in clean water, and put into a bath of sulphuric acid, composed of water 200 litres, and acid at 50 degrees 3 kilograms, which bath will then have the strength of about four degrees of the aerometer of Baumé.

"The immersion in the bath must continue for three quarters of an hour or an hour, after which the materials must be well washed in clear water, and carried to the mill to be manufactured.

335. "If the action of the baths of bleaching liquor be not exhausted by the immersion of the decomposed rags (which may be ascertained by the solution of indigo), it may be applied to other materials of the same kind.

336. "Such was the state in which we left this new art in the year 3. Since that time Citizen Welter, to whom chemistry and the arts are indebted for a number of ingenious processes, has simplified that of preparing the bleaching liquor. He has found, for example, that instead of the three vessels of the receiver, it is sufficient to employ two even for the simple liquor that contains no fixed alkali.

"It was before seen that we were obliged to employ an alkaline solution in the receiver, to prevent that odour which the simple liquor emits when paper stuff is agitated in the baths. The use of alkali answered our purpose very well in this respect; but this expenditure, besides weakening the bleaching liquor, nearly doubled our expence. Though this difference in the price was of little consequence with regard to the object we then had in view, it is not so with regard to the common operation upon paper intended for sale. Every means of economy must then be used. Now Citizen Welter found that it is easy to obviate the inconvenience of the same liquor in the operation. His method consists in no longer agitating the goods or material in an open bath, but to close it exactly by means of a cover; and he agitates it by means of cross pieces attached to a handle turned on the outside.

337. "A rough estimate of the price of the simple bleaching liquor prepared by the sulphuric acid, this being the most economical process.

"The receiver is supposed to contain 1000 litres of water.

25 kilograms

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	Fr.	cent.
25 kilograms of oxide of manganese cost at most	15	0
70 kilograms of muriate of soda	7	0
25 kilograms of sulphuric acid, at 50 c.	37	50
Three days work principal men	9	0
Three days do. assistant or labourer	4	50
Fuel, about	3	0
Wear and tear	6	0
Our apparatus cost 622 franks, and the carriage and fixing increased our expence to 1000 franks, the interest of which, at 10 per cent. is 100 franks; and if the work be repeated so many times in the year, the interest per operation will be	1	0
	Fr. 83	0

"Hence the litre of bleaching liquor will cost nearly 9 cents in round numbers (R).

338. "Estimate of the increase of expence occasioned in the operation upon a pile of 50 kilograms of the paste of paper, supposing one bath of the bleaching liquor and one of sulphuric acid, which is most commonly the case.

Ninety litres of the bleaching liquor at nine cents	8 fr.	10 c.
Three kilograms of sulphuric acid, at 1 fr. 50 c.	4	50
Workmanship	0	50
Total,	13	20

Which gives for each kilogram of paper an expence of 0,262 franks, or about 27 cents. Now the common paper in the market usually sells for about 1 fr. 30 c. or 1 fr. 40 c. the kilogram, and with the simple augmentation of 27 cents for the operations of bleaching, it obtains the preference beyond that which is sold for three, four, or even five franks, which can only be obtained in a limited quantity, on account of the selection of rags. The foregoing methods must therefore produce a great diminution in the price of fine paper. They are more particularly advantageous when applied to the manufacture of thin paper, because the expences of bleaching are always proportioned to the weight of the material, and consequently are least upon thin paper."

Of Whitening and Cleaning Prints, Maps, Books, and other Articles of Paper.

339. The oxygenated muriatic acid was first applied to this purpose by Citizen Chaptal, and the method has been employed with the greatest success by Citizens Vialard and Heudier.

The acid in the state of gas might be used for this purpose, but it is safer and equally efficacious to employ it in the liquid form.

340. 'Simple immersion in oxygenated muriatic acid, letting the article remain in it a longer or shorter space of time, according to the strength of the liquid, will be sufficient to whiten an engraving. If it be required to whiten the paper of a bound book, as it is necessary that all the leaves should be moistened by the acid, care must be taken to open the book well, and to make the boards rest on the edge of the vessel, in such a manner that the paper alone be dipped in the liquid: the leaves must be separated from each other, in order that they be equally moistened on both sides.

'The liquor assumes a yellow tint, and the paper becomes white in the same proportion. At the end of two or three hours the book may be taken from the acid liquor and plunged into pure water, with the same care and precaution as recommended in regard to the acid liquor, that the water may exactly touch the two surfaces of each leaf. The water must be renewed every hour, to extract the acid remaining in the paper, and to dissipate the disagreeable smell.

341. 'By following this process, there is some danger that the pages will not be all equally whitened, either because the leaves have not been sufficiently separated, or because the liquid has had more action on the front margins than on those near the binding. On this account the practice followed by book-binders, when they wish to whiten printed paper, is to be preferred. They destroy the binding entirely, that they may give to each leaf an equal and perfect immersion; and this is the second process recommended by M. Chaptal.

"They begin (says he) by unsewing the book and separating it into leaves, which they place in cases formed in a leaden tub, with very thin slips of wood or glass, so that the leaves when laid flat are separated from each other by intervals scarcely sensible. The acid is then poured in, making it fall on the sides of the tub, in order that the leaves may not be deranged by its motion. When the workman judges, by the whiteness of the paper, that it has been sufficiently acted upon by the acid, it is drawn off by a cock at the bottom of the tub, and its place is supplied by clear fresh water, which weakens and carries off the remains of the acid, as well as its strong smell. The leaves are then to be dried, and, after being pressed, may be again bound up.

"The leaves may be placed also vertically in the tub; and this position seems to possess some advantage, as they will then be less liable to be torn. With this view I constructed a wooden frame, which I adjusted to the proper height, according to the size of the leaves which I wished to whiten. This frame supported very thin slips of wood, leaving only the space of half a line between them. I placed two leaves in each of these intervals, and kept them fixed in their place by two small wooden wedges, which I pushed in between the slips. When the paper was whitened I lifted up the frame with the leaves, and plunged them into cold water to remove the remains of the acid, as well as the smell. This process I prefer to the other.

342.

(R) As the price of all these several items in France must materially differ from the same in England, it was thought unnecessary to reduce the numbers.

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342. "By this operation books are not only cleaned, but the paper acquires a degree of whiteness superior to what it possessed when first made. The use of this acid is attended also with the valuable advantage of destroying ink spots. This liquor has no action upon spots of oil, or animal grease; but it has been long known, that a weak solution of potash will effectually remove stains of that kind.

343. "When I had to repair prints so torn that they exhibited only scraps pasted upon other paper, I was afraid of losing these fragments in the liquid, because the paste became dissolved. In such cases I enclosed the prints in a cylindrical glass vessel, which I inverted on the water in which I had put the mixture proper for extricating the oxygenated muriatic acid gas. This vapour, by filling the whole inside of the jar, acted upon the print; extracted the grease as well as ink spots; and the fragments remained pasted to the paper."

344. Vialard and Heudier have by this process restored several of the most valuable books of the French national library, and we believe they were the first who carried Chaptal's process into actual execution.

It is necessary, that we may fully succeed in this process, to be very precise in the quantity of the acid employed, and to use considerable address in the management of it, otherwise we shall injure the paper, and render the books incapable of being bound again. But with caution and a little experience, the method is perfectly safe and easy.

345. As it is convenient to be able to prepare the acid employed for this purpose in the most simple and economical way, we may recommend the following:

"To oxygenate the muriatic acid, nothing is necessary but to dilute it, and mix it in a very strong glass-vessel with manganese, in such a manner, that the mixture may not occupy the whole content of the glass. Air bubbles are formed on the surface of the liquor; the empty space becomes filled with a greenish vapour; and, at the end of some hours, the acid may be farther diluted with water and then used. It has an acid taste, because the whole is not saturated with oxygen; but it possesses all the virtues of the oxygenated muriatic acid. This process may be followed when there is not time to set up an apparatus for distilling, in order to procure the oxygenated acid."

346. It has been said, that the acid is not capable of removing spots of grease from books and prints. A method of doing this was lately published by M. Deschamps junior, and is as follows:

"After having gently warmed the paper stained with grease, wax, oil, or any fat body whatever, take out as much as possible of it, by means of blotting-paper. Then dip a small brush in the essential oil of well rectified spirit of turpentine, heated almost to ebullition (for when cold it acts only very weakly), and draw it gently over both sides of the paper, which must be carefully kept warm. This operation must be repeated as many times as the quantity of the fat body imbibed by the paper, or the thickness of the paper, may render necessary. When the greasy substance is entirely removed, recourse may be had to the following method to restore the paper to its former whiteness, which is not completely restored by the first process. Dip another brush in highly rectified spirit of wine, and draw it, in like manner, over the place which was stained, and particularly round the edges, to remove the border, that would still present a stain. By employing these means, with proper caution, the spot will totally disappear; the paper will resume its original whiteness; and if the process has been employed on a part written on with common ink, or printed with printers ink, it will experience no alteration.

Of Bleaching Yellow Wax.

347. Before the discovery of oxymuriatic acid and its application to bleaching, this was effected by exposing the yellow wax, formed into thin cakes, to the free action of the air, sun, and dews. The acid, however, as being far more expeditious, is to be preferred.

In the bleaching of wax, it is proper to employ the simple acid, and its action would be the most effectual if used in the gaseous form. For this purpose, a pneumatic tub, with a cover secured in the manner recommended by Rupp, is the most proper. This should be filled with water, and the wax shred very fine must be introduced, and the gas made to pass through the water, while the agitator is kept in constant motion. In the course of an hour or two the wax will be bleached, may be separated from the water, melted and formed into cakes.

On applying the Residuums to profit.

348. Before we conclude our account of the various bleaching processes in which the oxygenated muriatic acid is concerned, it will be proper to inquire how far the materials employed in procuring this acid may be turned to account after the distillation.

The substances which remain in the distilling articles are a portion of undecomposed oxide of manganese, some sulphat of manganese, and a large quantity of sulphat of soda (Glauber's salt).

The whole mixture may be employed with advantage as a glazing to coarse earthen-ware. This glazing has a dark colour, something like that of bronze, which it receives from the manganese: it is attended with this advantage, that it is perfectly safe, and is therefore much superior to any glazing, where lead enters as a part of the composition.

349. But the object of most importance is to decompose the sulphat of soda, in order to obtain the alkali. There are several methods of effecting this, but perhaps the two following are the best.

350. The first is that contrived by M. M. Malherbe and Athenas. The first object in this process, is to reduce the sulphate to the state of an alkaline sulphuret (liver of sulphur).

"Malherbe and Athenas have succeeded in this by employing iron as the intermediate substance: they mixed one part of charcoal dust with nine parts of the sulphat of soda, and exposed the mixture to the heat of a reverberating furnace: when the sulphuret entered into combustion, they added from three to five parts of old iron rendered as small as possible; and the whole being fused together, they obtained a black paste, composed of iron, soda, sulphat of iron, &c. This mixture was lixiviated, and filtered through a basket filled with

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with lime: it was then evaporated to dryness, and the residuum was calcined in a reverberating furnace. When soda of a superior quality is required, the washing and calcination must be repeated.

"Dize and Le Blanc decomposed the sulphat of soda, by means of the carbonate of lime, in order to neutralize the alkali, by saturating it, at a very high temperature, with carbonic acid. Their process consists in taking two parts of sulphat of soda, dried to deprive it of its water of crystallization, two parts of well ground chalk (carbonate of lime), and one part of charcoal powder, mixing them well in a muffled mortar, and then bringing the mixture to a white heat in a reverberating furnace: when the matter is fused, it is stirred till the sulphur is consumed, and the ebullition and the jet of the flame produced by the hydrogen gas have ceased to appear. It is then taken from the furnace, and it may be lixiviated to obtain the soda very pure. In whatever manner the sulphat is decomposed, this object merits the greatest attention at bleachfields on account of the considerable degree of economy which results from the different manipulations. The ley of the oxygenated muriatic acid will be obtained at little or no expence by bleachers, when they seriously set about extracting the soda from the sulphat formed during the distillation.

Bleaching by Sulphuric Acid.

351. From the effects produced by sulphuric acid in the processes of bleaching, in which it has been seen to act a material part, a proposal was lately made to employ it solely for this purpose, but we believe the project has never been carried into execution. It is certain, that a very weak bath containing one part of acid to five hundred of water * may be employed with the greatest safety; and when cloth remains immersed in it for a considerable time, it acquires a high degree of whiteness.

* *Philosoph. Magazine*, p. 273.

Of Bleaching by Steam.

352. The various processes which we have described, form nearly a complete abridgment of the history of bleaching; we have endeavoured to follow as closely as possible the progress of human genius, and to show how the rapid advances of modern chemistry have contributed to the improvement of this interesting art.

353. We are now to describe a new method, for which we are indebted to C. Chaptal. This ingenious and learned man, published some time since a memoir on the method of bleaching with steam, a process which we received from the Levant soon after the introduction of the art of dyeing Adrianople red, and which has been ever since employed in the interior of France, under the name of *Blanchiment à la fumée*. At the time when the disinterested Chaptal published an account of this method, it was a secret, the knowledge of which was confined to a few manufacturers. They only employed it in bleaching cotton in the states of wool and thread, in imitation of the eastern nations; but Chaptal, with his usual ingenuity, perceived the possibility of extending the process to the bleaching of thread of flax and hemp, and he invited the assistance of artists for the purpose of effecting this desirable end.

354. This appeal of Chaptal, induced many manufacturers as well in France as in other countries, to make trial of this new method; and it was tried nearly at the same time at Paris and in Ireland. The apparatus constructed by C. Bawens, proprietor of the manufactory of cotton thread and stuffs at Bons Hommes near Passy, gave surprising results. He could bleach from two to three thousand ells of cotton in a day, with such facility, and at so moderate an expence, as proved the new method to be incomparably better than any before employed. The first trial was made on 1500 ells of cloth intended for printing; after the operation, it exhibited no variegation of surface, no shades, but one uniform complete whiteness. His apparatus resembles perfectly what has been described by C. Chaptal, and answers extremely well for bleaching cotton, both in the wool and when spun into thread. There have been several improvements lately made on it, which render it much more advantageous and of more extensive utility; but it will be proper, before examining these, to describe the apparatus recommended by Chaptal, which we shall do in his own words.

355. "At the distance of about sixteen inches above the grate of a common furnace, supplied with pit-coal, is fixed a copper boiler of a round form, 18 inches deep and four feet broad. The edges of this copper turned back, are made to rest on the side-walls of the brick-work of the furnace; they are about seven inches broad. The rest of the furnace is built of hewn stone, and forms an oval boiler six feet in height, and five feet in breadth at the centre: the upper part of this boiler has a round hole eighteen inches in diameter, which may be shut by a moveable piece of strong stone, or a copper lid adapted to it. Upon the edge of the copper boiler which forms the bottom of this kind of Papin's digester, is placed a grating made of wooden bars, so close together, that the cotton placed on them cannot fall through, and sufficiently strong to bear the weight of about 1600 pounds."

356. In the apparatus of C. Bawens, the mode of heating employed in Count Rumford's furnaces was used to reduce the quantity of fuel consumed, and thus render the process more economical. The heat of the chimney also served to heat the bath of weak sulphuric acid.

In other countries an apparatus has been employed, which possesses the advantage of winding up the stuffs within the copper, which resembles that of a steam engine with its tubes, safety valves, and collars of leather; but it has this inconvenience, that the stuff must be introduced at the top (s).

357. C. O'Reilly, to whom Chaptal had communicated

(s) The following passage translated by Nicholson from the *Journal de Physique*, is worthy of notice.

"A new method of bleaching has just been tried at Balynah, and has completely succeeded. The principle of the process appears to have been published by a French chemist, Chaptal, who is much respected by our manufacturers. I speak of the art of discolouring piece-goods in a digester, by caustic alkaline ley. Though our first

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Vegetable Substances.

ed his ideas, soon conceived methods of improving the apparatus, and of applying it to various purposes suited to the different articles.

The first apparatus which he proposed to be executed at Jouy, represented an arched chamber of hewn stone, six feet eight inches long by three feet ten inches broad; and three feet and a half high above the level of the wooden grate. (See Plate XCII. fig. 8.). At one of the extremities is a door three feet long and two high, which is closed by a plate of cast iron, in which a hole is made for the introduction of a conical valve which is kept in its situation by a screw and a spring made as powerful as possible. The object of this valve was to guard against an explosion which might take place from the sudden expansion of the steam, which there is some cause to dread. The door was moveable, and fastened by ten bars and as many screws, which press against the rabbit, which is covered with tow or wet leather) so as to prevent any of the steam from escaping this way. The door should be made with two iron handles, that it may be removed with the more ease.

The copper which forms the bottom of this apparatus, and in which the caustic alkaline solution is boiled, is 18 inches deep, and its other dimensions are less by four inches than those of the chamber. This gives room for the edges of the copper, and for a wooden grate on which the men may walk and conduct the operations. In the middle of the chamber are fixed two reels, on which from eighteen to twenty pieces of cloth are rolled. The axes of these reels pass through collars of leather, which prevent the escape of the steam; they have handles on the outside to roll and unroll the pieces, and there is a regulator communicating with the inside of the copper, to point out the height of the liquor, and shew how far it is exhausted. It is heated after Count Rumford's plan.

358. Another apparatus was constructed at Troyes for the purpose of bleaching hosiery. As these goods cannot be rolled up; and as the action of the vapour might be lessened were they heaped together, O'Reilly contrived frames of wood covered with cloth, and placed at the distance of four inches, one above another. Upon these frames the goods were spread in such a manner that the vapour rising from the copper might penetrate to every part, destroy the colouring matter, and thus complete the bleaching.

359. From some farther observations he was led to propose a roller placed in such a way, that the cloth rolled on it might on occasion be drawn through the liquor in the copper, to moisten it now and then, and thus increase the action of the liquor *.

360. After this account of O'Reilly's apparatus, of which a more particular description will be given presently, we come to the actual method of bleaching by steam. The following are the directions given by Chaptal.

361. "The cotton, disposed in handfuls, must first be impregnated with a slight solution of soda rendered caustic by lime. This operation is performed in a wooden or stone trough, in which the cotton is trod down by means of the feet covered with wooden shoes. When the alkaline liquor has uniformly penetrated the cotton, it is put into the boiler, and piled up on the wooden grate before mentioned; the redundant liquor runs through the bars into the copper boiler, and forms a

* O'Reilly's Essai.

first attempts did not perfectly succeed, we were not discouraged. The linen was exposed to the action of vapour in the apparatus, but it was not equally affected, as it appeared to be blotched in several places; we were, therefore obliged to construct an apparatus, in order to unroll and separate the goods, and to expose the greatest surface possible to the action of the vapour. Suppose the boiler of a steam engine, in the form of an elongated ellipsis, provided with a safety valve, two tubes with cocks, to shew the consumption of the liquor, and a mercurial gage, to ascertain the strength of the steam. This boiler is bedded in masonry, or brick work, that it may resist the excessive pressure which necessarily takes place. In the interior part of the apparatus are six reels, three at each end, alternating with each other, in order that the action of the steam may be more equable upon the goods. These reels are slowly and uniformly carried round by simple tooth and pinion work of wood, and the first motion is given to an axis which passes out of the boiler through a stuffing box, which prevents the escape of vapour. At the top is an opening of about sixteen inches diameter, with a rim or flanch, on which the cover is fitted, and firmly secured by screws. Between the two metallic faces are placed strips of soaked leather, to prevent the vapour from escaping. When the cover is taken off, the workmen can enter the boiler, to dispose the goods upon the rollers, each of which contains about fifteen or twenty pieces, making in the whole about forty-five or sixty. The raw material, namely, cunnamara kelp, is an article of inconsiderable expence, or else the soda extracted from sea salt, in which there remains indeed a small portion indecomposed, but which we procure at a very reasonable price. It is rendered caustic by the addition of some good lime, which is made from our limestone of Parre. With these a ley is formed, which is equal to fourteen degrees of our hydrometer. In this lixivium the piece goods are boiled, and then conveyed to the digester, on the bottom of which the ley stands to about five inches in depth. The workman stands upon a perforated stage, which prevents him from stepping into the ley while he is arranging the pieces: after which, having placed them on the rollers, the apparatus is closed, the fire lighted, and the operation begins. As soon as ebullition takes place, the handle on the outside is incessantly turned, and as soon as the roller at one end is filled, the handle is shifted to the other roller, and the turning performed in the contrary direction. In this manner the operation is continued till the whole of the contents is bleached. From this description you may easily understand how this operation is performed; I shall, however, take the first opportunity of sending you a plan and description of the apparatus, if you wish for further information. You are at liberty to make whatever use you please of this account: the expence of bleaching is not more than one farthing per yard, including coals, workmen's wages, &c. as well as interest for the capital employed in the apparatus."

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a stratum of liquid, which permits the mass to be heated without any danger of burning either the cotton or the metal. To form the alkaline ley, Alicant soda equal to a tenth of the weight of the cotton subjected to the operation is employed; and in a boiler such as that the dimensions of which I have given, about 800 pounds of cotton may be put at one time. The ley is generally of two degrees by the aerometer. As soon as the cotton is introduced into it, and arranged in the boiler, the upper aperture is shut with its usual covering, scarcely any opening being left, that the steam developed by the fire may assume a much more considerable degree of heat, and react with force on the cotton. When every thing is arranged, the fire in the furnace is kindled, and the ley is maintained in a state of slight ebullition during 36 hours. The apparatus is then suffered to cool, and the cotton being taken out is carefully washed; after which it is exposed on the grass for two or three days, extending it on poles in the day time, and spreading it out on the grass during the night. The cotton will then have acquired a high degree of whiteness; and if any portions of it be still found coloured, they must be put into the boiler for a second operation, or be left on the grass some days longer. These shades in bleaching cotton arise, in particular, from all the parts of the cotton in the first operation not having been completely and uniformly impregnated with the ley. They may be owing also to the cotton, when arranged in the boiler, having been too much accumulated on certain points. When it is judged that the ley has been exhausted by ebullition, the boiler is opened, and the dried cotton is moistened with a new quantity of the solution of soda: without this precaution it would be in danger of being burnt. It may be easily conceived, by an estimate of the matters and time employed in this operation, with how much saving of expence it is attended: cotton is bleached by this method in all the manufactories of the south of France, where it is used, at the low rate of two sols per pound."

362. Cloth may be bleached in the same way, but requires first to be freed from the weavers dressing, &c. as formerly directed.

363. While the goods are steeping so as to be perfectly impregnated with the alkaline ley, the copper is to be filled to the height of a foot with ley of the same strength. This may be done by means of a curved leaden funnel, but as the door is sufficiently large, the ley may be thrown in with buckets.

A workman then enters the chamber, and fixes one end of a piece of cloth by means of packthread to one of the arms of the farthest reel A (fig. 9. Plate XCII.) while another workman without turns the handle till the whole piece is wound on; the end of another piece is then fastened to the first, and so on till 18 or 20 pieces are wound round the first reel. The remaining extremity of the last piece is then passed over the roller B, near the arch of the chamber; from thence it is carried below the two rollers C, D, in the copper E E; is again carried to the arch, and made to pass over the roller F, and is lastly fastened to an arm of the other reel G. The workman then ascertains the height of the liquor in the copper by the regulator, and then shuts the cock, and closes up the door by rags and the proper screws, so as to prevent all escape of steam. The fire is then kindled, and the liquor made to boil. The workman then begins to wind off the pieces, commencing with the reel to which the last end was tacked, till this has received the whole charge; he then lowers the cranks of the lower rollers, so as to plunge the goods into the boiling ley, and immediately begins to reel off with dispatch; again raises the rollers, and reels the pieces back without passing through the ley.

At the end of two hours, more or less according to the fineness of the pieces, the alkali carried up by the heat will completely have penetrated the fibres of the cloth, which are swelled by the extraordinary heat of the steam.

The fire is now extinguished, and as soon as all is sufficiently cool, the door is opened, and they prepare for immersing the stuffs in the oxygenated muriatic acid, after they are first well rinsed in fair water.

364. For immersion the tub described in 262. is employed, and the pieces are fastened and reeled in the manner there described, till the liquor on examination is found pretty much exhausted. The pieces are then taken out separately, well rinsed in a stream of water, and exposed on the grass for three or four days. They are then passed through a bath of very weak sulphuric acid, and will then have acquired a high degree of whiteness.

If linen or hempen cloth should retain a slight yellow cast, which will sometimes happen, the steaming must be repeated; and they must be exposed again for a day or two on the grass.

365. Hosiery and threads are bleached in the same way, but they are to be placed on frames at such a distance from each other that they may be easily penetrated by the steam; but as these articles cannot, like the cloths, be made to pass through the ley in the copper, the process is to be stopped at the end of two hours, and then the upper frame is completely wet with ley, which oozes through, and thus moistens all the lower frames. The boiling is again commenced, and continued for four hours. For the immersion, the apparatus of Rupp with the vertical reels is the best possible, and the goods are to be hung on the upper end of the reel. After immersion, they are rinsed, exposed on the grass, and passed through the acid bath as other articles.

366. Chaptal has lately applied this method to a very important object, the scouring and whitening of foul linen.

"I have no doubt," says he, "but that linen garments may be bleached to advantage by the same process; but as it was necessary to bring these notions to the test of experiment, I invited Citizen Bawens to allow me to make the experiment on a large scale with his apparatus. Accordingly, on the 27th Pluviose, in the year 9, I had 200 pair of sheets from the hospital of the Hotel Dieu at Paris, chosen among those that were most soiled, and taken to the manufactory of Citizen Bawens.

"Three experiments were made upon these sheets.

"*Experiment* 1. One hundred and thirty sheets were impregnated with a caustic alkaline ley, containing one hundredth part of soda. They were kept for six hours in the engine of steam; after which they were impregnated again, in order to be placed again six hours in the same machine.

"The same process was repeated a third time; after which they were carefully rinsed, and no spots of wine,

wine, grease, blood, or animal ejection, were to be seen. One quarter of a pound of soap was used in rinsing these cloths.

"All the assistants were convinced that the ordinary processes would not have given either so perfect a white, nor so agreeable a lixivial smell.

"The texture was in no respect altered.

"*Experiment* 2. The alkaline ley contained only six parts of soda, but five pounds of soap were also added. The cloths were treated in the same manner, and the results appeared more advantageous. They were easily washed out.

Experiment 3. To the bath of the second experiment a sufficient quantity of new ley was added. One hundred and forty sheets were treated like the preceding, and the result was the same.

"It must be observed that the water of the Seine, in which these sheets were rinsed, was at that time very yellow.

"This experiment appeared to me to offer several results worth the attention of the Institute.

"In the first place the process is economical. Two hundred pair of sheets, which were bleaching by three successive operations, demanded an expenditure, according to the account furnished by Citizen Bawens, which is in the proportion of 7 to 10, compared with that commonly made in the hospitals. This expence may be reduced to less than one-third, if a suitable place and apparatus were appropriated to this use.

"2. Two days at most are required to complete the operation. This economy of time is incalculably beneficial.

"3. The linen is neither changed nor torn, as it passes through the hands only once, and it is of no use to beat it.

"4. The extreme heat to which the linen is exposed in the apparatus, causes its texture to be penetrated by the alkaline fluid to such a degree, that the substances with which it is impregnated cannot be masked from its action; so that the putrid exhalations, and other substances attached to its texture, are necessarily destroyed or changed in their nature.

"This effect must be more particularly seen with regard to its value, by physicians, who are aware with what facility the seeds of various disorders are perpetuated in hospitals, and how insufficient the greater number of processes used in washing linen have proved to destroy them."

367. It only remains that we should give a brief explanation of the manner in which the steam, thus confined, acts in bleaching the goods.

It has appeared from the former parts of this article, that the bleaching of vegetable substances depends on the united influence of moisture, light, and oxygen; and the mode in which these act, as also the action which alkalies exert on the colouring matter of cloth, has been explained. This action of the alkali is materially assisted by the increased temperature of this vapour bath, by which the fibres of the cloth, &c. are swelled and opened; and thus the caustic alkali carried up with the stream, greedily seizes on and destroys the colouring matter; or, should some part of it escape, a second steaming, after immersion and exposure to the air, never fails to discharge it. The increased temperature, independently of swelling and opening the texture of the cloth, seems also to render the alkali more active than it can be in the ordinary leys, in which the temperature never exceeds 162° Fahrenheit; for one degree of the aerometer is always a sufficient strength, and very seldom more than half a degree is required.

By passing the goods through a single bath of oxygenated muriatic acid, or oxymuriat of lime, a combination takes place between the oxygen of the liquor and the carbon produced by the destruction of the extracto-resinous matter by the alkali, and carbonic acid is formed, and this is dissipated by the subsequent exposure to the atmosphere.

368. We cannot however agree with O'Reilly *, that the steam itself possesses no bleaching power, as we are convinced from the common process of cooking green vegetables in steam, by which, as is well known, they lose their green colour, that this is not the case.

* *Essai sur le Blanch.* p. 147.

369. It has been supposed that the vapour arising from a boiling solution of caustic alkali would not itself be caustic, or produce the same effects as the solution; a supposition which was founded on the concentration of salts by evaporation; but we are by no means to infer, from what takes place in the open air, where the moisture is constantly absorbed as it rises, that the same will happen in a close apparatus, where the temperature is considerably increased; and, in fact, that alkali is capable of being raised by steam is fully proved by suspending paper tinged blue over a boiling solution of potash, when the blue will soon be converted into a green.

We shall conclude this article with M. Chaptal's observations on the art of scouring different kinds of stuffs.

"This art supposes, 1st, a knowledge of the different substances capable of staining any kind of cloth; 2d, of the substances to which recourse must be had in order to make those deposited on the stuff to disappear; 3d, a knowledge of the effects produced on colours by those re-agents which it may be necessary to employ to destroy stains; 4th, a knowledge of the manner in which the cloth is affected by those re-agents; 5th, of the art of restoring a colour changed or faded.—Of those bodies which occasion spots on different kinds of cloth, some are easily distinguished by their appearance, such as greasy substances; but others have more complex effects, such as acids, alkalies, perspired matter, fruits, urine, &c. Acids redden black, fawn, violet and puce-colour, and every shade communicated with orchilla-weed, iron, astringents, and every blue except indigo and Prussian blue. They render the yellows paler, except that of arnotto, which they change into orange.

"Alkalies change to violet the reds produced by Brazil wood, logwood, and cochineal. They render the greens on woollen cloth yellowish, make yellow brownish, and change the yellow produced by arnotto to aurora. Perspired matter produces the same effects as alkalies.

370. "When the spots are produced by simple bodies on stuffs, it is easy to remove them by the means already known. Greasy substances are removed by alkalies, soaps, the yolk of eggs, fat earths; oxyds of iron, by the nitric and oxalic acids; acids by alkalies, and reciprocally. Stains of fruit on white stuffs may be removed by the sulphurous acid, and still better by the oxygenated

Vegetable Substances.

oxygenated muriatic acid. But when the spots are of a complex kind, it will be necessary to employ several means in succession. Thus, to destroy the stain of coom from carriage-wheels, after the grease has been dissolved the oxide of iron may be removed by the oxalic acid.

371. "As colours are often changed by re-agents, it will be necessary, in order to restore them, that the scourer should possess a thorough knowledge of the art of dyeing, and how to modify the means according to circumstances. This becomes the more difficult when it is necessary to reproduce a colour similar to that of the rest of the stuff, to apply that colour only in one place, and often to restore the mordant by which it was fixed, and which has been destroyed, or even the first tint which gave the colour its intensity. It may be readily conceived that the means to be employed must depend on the nature of the colour, and the ingredients by which it was produced; for it is known that the same colour may be obtained from very different bodies. Thus, after an alkali has been employed to destroy an acid spot on browns, violets, blues, poppies, &c. the yellow spot which remains may be made to disappear by a solution of tin; a solution of sulphat of iron restores the colour to brown stuffs which have been galled; acids restore to their former splendour yellows which have been rendered dusky or brown by alkalies; blacks produced by logwood become red by acids; alkalies change these red spots to yellow, and a little of the astringent principle makes them again become black. A solution of one part of indigo in four parts of sulphuric acid, diluted with a sufficient quantity of water, may be employed with success to revive the blue colour of cotton or wool which has been changed. Scarlet may be revived by means of cochineal and a solution of the muriat of tin, &c.

"The choice of re-agents is not a matter of indifference. Vegetable acids are preferable; the sulphurous acid, however, may be employed for stains occasioned by fruit: it does not change the blue of silk nor colours produced by astringents: it does not degrade the yellow of cotton. Ammonia succeeds better than fixed alkalies in removing spots produced by acids. It is employed in vapour; its action is speedy, and seldom alters the colour.

372. "The means of removing greasy spots are well known. This effect is produced by alkalies, fullers earth, volatile oils dissolved in alcohol, a heat proper for volatilizing grease, &c. Spots occasioned by ink, rust, or iron-mould of any kind, and all those produced by the yellow oxide of iron, are removed by the oxalic acid: the colour may be restored by alkalies, or a solution of the muriat of tin. These spots may be removed also by the oxygenated muriatic acid, when they are on white stuffs or paper.

"The action of alkalies, and that of perspired matter, are the same: their spots may be effaced by acids, or even by a weak solution of the muriat of tin. When these spots arise from several unknown causes, in order to destroy them recourse must be had to *polychrest* compositions. The following may be considered as one of the most efficacious. Dissolve white soap in alcohol, and mix this solution with the yolks of from four to six eggs: add gradually essence of turpentine; and incorporate with the whole some fullers earth, in such a manner as to form balls of a suitable consistence. Moisten the spot; and, having rubbed it with these balls, the spot will be removed by washing the stuff. All spots, except iron-mould and ink, may be removed in this manner.

"Washing destroys the lustre, and leaves a tarnished place disagreeable to the eye; but the lustre may be restored by drawing over the washed place, and in the direction of the pile, a brush moistened in water impregnated with a little gum. You may then apply a sheet of paper, or a piece of cloth, and a considerable weight, under which the cloth must be left to dry."

Description of Apparatus.

Plate XCI.

Fig. 1, 2. O'Reilly's Apparatus for preparing SULPHUROUS ACID.

Fig. 1. Elevation of the APPARATUS.

A, The furnace which is made capable of containing three distilling vessels.

a, A curved funnel for introducing the sulphuric acid.

b, A tube passing from the matrass to an intermediate leaden vessel B intended to condense the sulphuric acid which comes over undecomposed, and having five necks, three of which receive tubes similar to b, and from the fourth passes the tube d.

c, A tube of safety.

d, A tube passing from the intermediate vessel to the first of the tall Wolfe's vessels C intended to condense the sulphurous acid.

D, The second of the Wolfe's vessels, with tubes to connect it with the first and third.

Each of these vessels has a leaden cock to empty the acid liquor into the immersing tubs.

Fig. 2. Plan of the above VESSELS.

Fig. 3. A vertical Section of RUPP'S IMMERSING TUB, as improved by O'Reilly.

a, b, The tub.

c, d, The cover perfectly air-tight.

e, The partition dividing the tub into two parts.

f, A funnel filled with a plug.

g, g, The wooden reels on which the stuffs are rolled.

h, h, h, h, h, h, h, Seven rollers, over and under which the stuffs pass, so as to expose a large surface to the bleaching liquor.

i, A leaden cock to draw off the liquor.

Fig. 4. Rupp's Original Apparatus, as described in 253.

Fig. 5, 6, 7. The Original Apparatus for distilling the OXYGENATED MURIATIC ACID GAS, described in 209.

Plate XCII.

Fig. 8. The Apparatus employed for this purpose in IRELAND.

a, The ash-hole.

b, The place for the fire.

c, A

c, A door by which fuel is introduced.

d, Door of the ash, with a register to regulate the draught of air.

e, A boiler of cast iron filled with hot water, in which is placed the alembic.

f, A, three-footed iron stand to support

gg, A leaden alembic.

h, A glass or leaden curved funnel for introducing the sulphuric acid.

i, A leaden cover firmly fixed by luting to the neck of the alembic, and pierced with three holes for the transmission of the funnel, the handle of an agitator, and a condensing tube.

k, The agitator formed of iron covered with lead.

l, A leaden tube three inches in diameter for conducting the gas into

m, An intermediate vessel of lead for condensing the acid which may pass over from the alembic uncombined.

The tube l descends through the first opening m 1, nearly to the bottom of the vessel, which is two-thirds filled with water; the oxygenated muriatic acid traverses the water, and passes out at the top through the leaden tube n into o, o, the pneumatic tub, made of wood fitted with a cover r, which is perfectly air-tight, and through which passes an agitator p, with three leaves for mixing the gas with the water.

q, q, q, Three shelves in the tub, which by retarding the ascent of the bubbles of gas, facilitate its union with the water.

s, A stop-cock for letting off the liquor.

Fig. 9. A Vertical Section of O'Reilly's Apparatus for Bleaching by Steam.

E, E, E, The boiler.
A, G, The two reels.
B, F, The upper rollers.
C, D, The lower moveable rollers.
H, The regulator.
I, A stopcock.
K, The door of the chamber.

Fig. 10. The Apparatus, with Frames for Bleaching Thread and Hosiery.

Fig. 11. Plan of Loysel's Apparatus for Bleaching Paper.

1, 1, 1, &c. Eight furnaces, having a chimney of sheet iron common to each pair of furnaces.

2, 2, 2, &c. Eight vessels of cast iron, containing sand.

3, 3, 3, &c. Eight matrasses, balloons, or bottles of stone-ware, compact, and well baked, intended to contain the materials which afford the gas. Each matrass must be filled only to one-third of its capacity at most. Bodies of glass of little thickness may also be used for this purpose.

4, 4, 4, &c. Tubes of glass to conduct the gas into the receiver. Or these tubes may be made of lead.

5. The receiver. It is composed, 1. of an internal vessel, covered with plates of lead well soldered together, and provided near its bottom with a cock 6, to draw off the liquor when prepared. 2. Another vessel, 7, likewise covered with plates of lead within and without. This second tub is inverted in the first, to contain the gas in proportion as it is disengaged, and to keep in contact with the water of the receiver that portion of gas which had not time to be dissolved in passing through that fluid.

There is a hole, 8, in the upper part of this second vessel. It serves to suffer the common air to escape when water is first poured into this receiver, and it is afterwards closed with a stopper of lead or cork, covered with paper soaked in starch, and fastened to the cork by a piece of cloth or bladder, before the operation begin.

Fig. 12. Vertical section of the apparatus.

Fig. 13. Elevation of the apparatus.

The disposition of the furnaces about the receiver, and the circular form of the receiving vessels, was rendered necessary here by the local circumstances. In other circumstances square vessels might be employed, and all the furnaces might be ranged in a right line under a common chimney.

For an account of the most recent improvements in this art, see Bleaching, Supplement.

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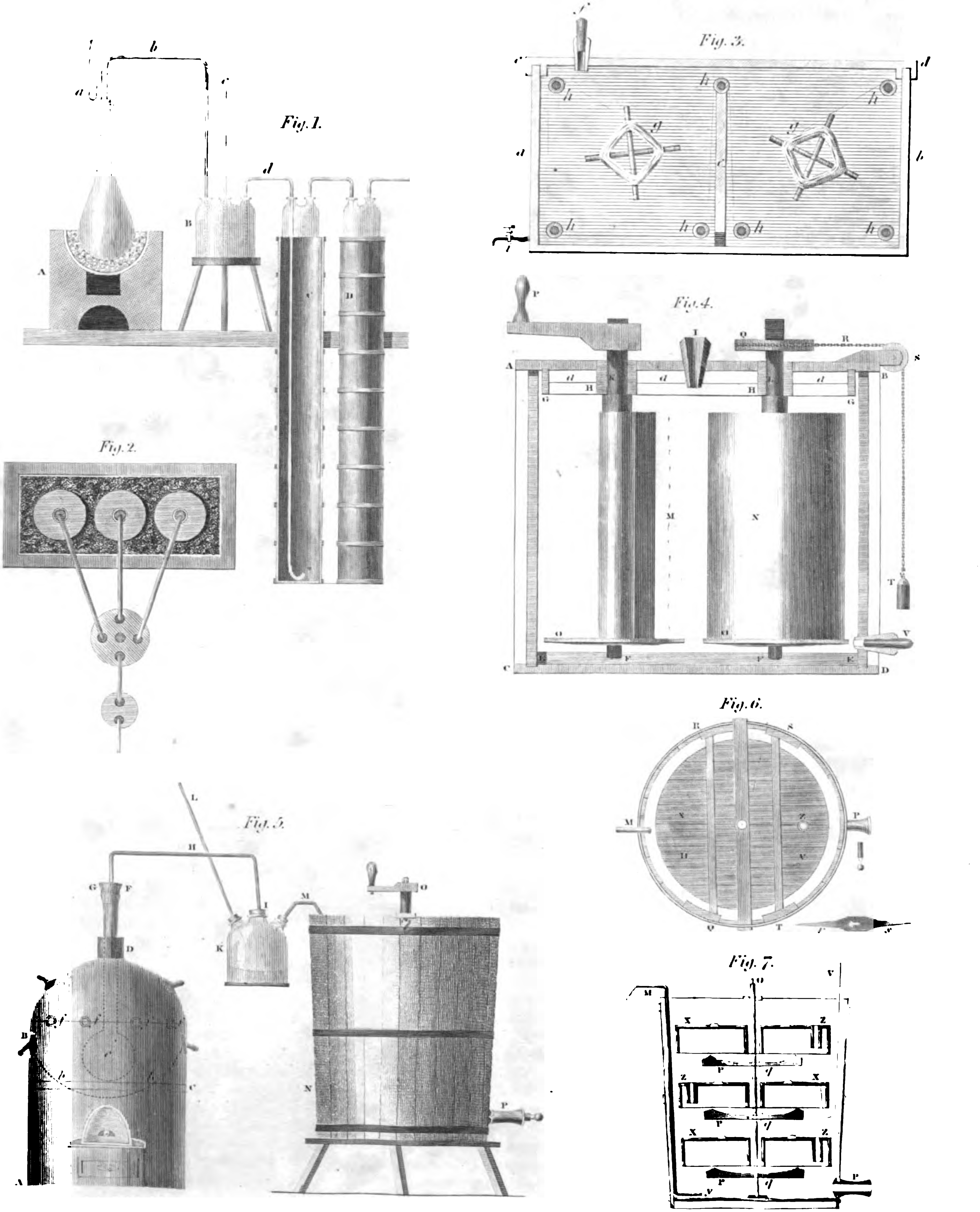

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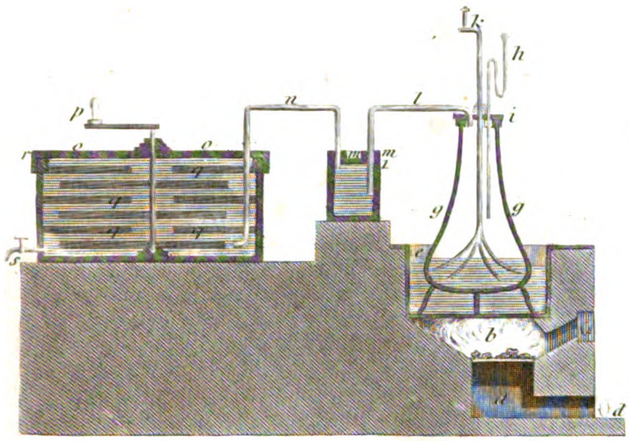
Fig. 8.



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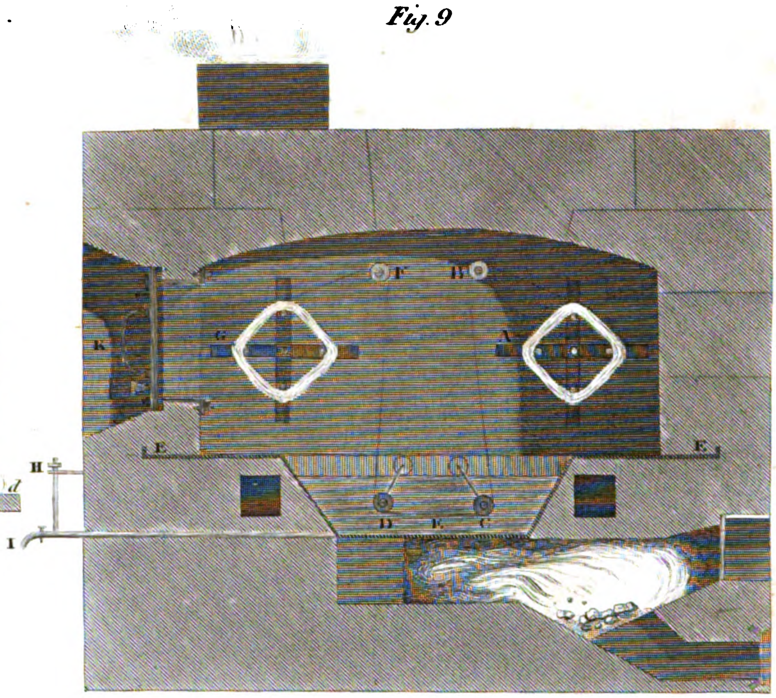

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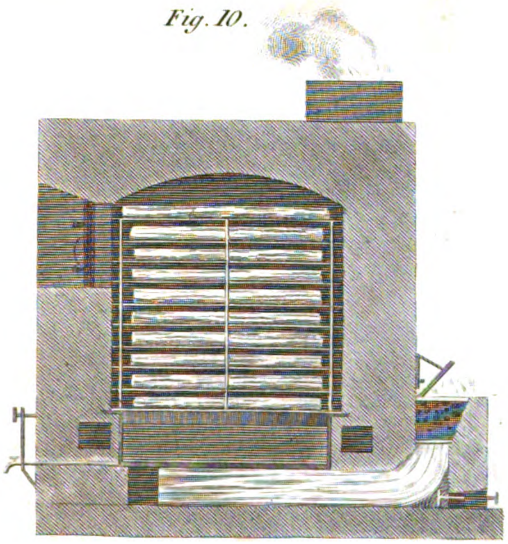

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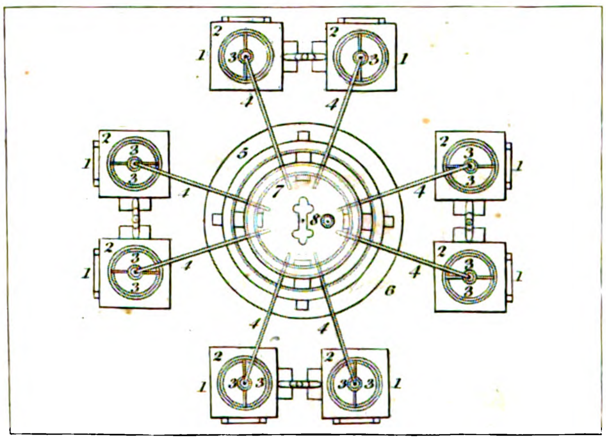

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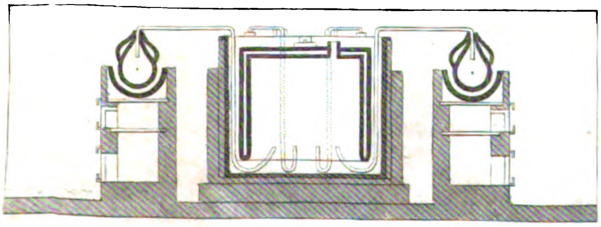

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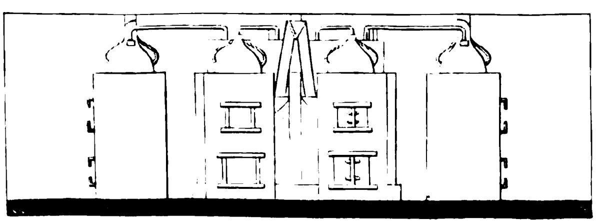

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BLEAK, in *Ornithology*. See CYPRINUS.

BLECHINGLY, a town of Surry in England, which sends two members to parliament, and the bailiff who returns the members is chosen annually at the lord of the manor's court. The town stands on a hill, and contained 1116 inhabitants in 1811. W. Long. 0. 15. N. Lat. 51. 20.

BLEEDING, in *Therapeutics*; see MEDICINE *Index*. As a chirurgical operation, see SURGERY *Index*.

BLEEDING at the Nose, called *Epistaxis*. See MEDICINE *Index*.

BLEEDING is also used for a hæmorrhage or flux of blood from a wound, rupture of a vessel, or other accident. See HÆMORRHAGY.

BLEEDING of a Corpse, is a phenomenon said to have frequently happened in the bodies of persons murdered, which, on the touch, or even the approach, of the murderer, began to bleed at the nose, ears, and other parts; so as formerly to be admitted in England, and still allowed in some other parts, as a sort of detection of the criminal and proof of the fact. Numerous instances of these posthumous hæmorrhagies are given by writers. But this kind of evidence ought to be of small weight: for it is to be observed, that this bleeding does not ordinarily happen, even in the presence of the murderer; yet sometimes in that even of the nearest friends, or persons most innocent; and sometimes without the presence of any, either friend or foe. In effect, where is the impossibility that a body, especially if full of blood, upon the approach of external heat, having been considerably stirred or moved, and a putrefaction coming on, some of the blood-vessels should burst, as it is certain they all will in time?

BLEEDING is also used for the drawing out of the sap of plants, otherwise called *tapping*. See TAPPING.

BLEKING, a province in the south part of Sweden, having the Baltic sea on the south, Smaland on the north, and the province of Schonen on the west. Its principal towns are Christianstadt, Elleholm, Ahuys, Roterby, and Christianople, which last is the capital.

BLEMYES, or BLEMMYES, a fabulous people of Ethiopia, said to have had no heads; their eyes, mouths, &c. being situated in their breasts. See ACEPHALOUS.

BLENCH, or BLANCH. See BLANCH.

BLEND, or BLINDE. See BLENDE, MINERALOGY *Index*.

BLEND-Water, called also *morehough*, a distemper incident to black cattle, comes either from the blood, from the yellows, or from the change of ground.—In order to cure it, take bole armoniac, and as much charcoal-dust as will fill an egg shell, a good quantity of the inner bark of an oak, dried and pounded together to a powder, and give it to the beast in a quart of new milk and a pint of earning.

BLENHEIM, a village of Germany, in the kingdom of Bavaria; situated in E. Long. 2. 30. N. Lat. 48. 40. This village is remarkable for the defeat of the French and Bavarians in 1704, by the English and their confederates under Prince Eugene and the duke of Marlborough. The French army amounted to 60,000 veterans, who had shared in the conquests of their grand monarque; and were now commanded by two generals the most distinguished at that time in France, Marshal Tallard and the duke of Bavaria. The former had established his reputation by many victories. He was active and penetrating; his ardour often rose to impetuosity; but he was so shortsighted as to be incapable of seeing objects at a very small distance. The duke of Bavaria was equally experienced in the field, and had stronger motives for activity: His country was ravaged before his eyes, and nothing remained of his possessions but the army which he commanded. The allied army, commanded by Eugene and Marlborough, amounted to about 52,000 men, troops who had long been familiar with victory, and who had seen the French, the Turks, and the Russians, fly before them. Both armies, after many marches and countermarches, approached each other. The French were posted on a hill near the town of Hochstet; their right covered by the Danube and the village of Blenheim; their left by the village of Lutzengen; and their front by a rivulet, the banks of which were steep and the bottom marshy. The right wing of the French was commanded by Marshal Tallard; their left by the duke of Bavaria, and under him General Marsin, an experienced Frenchman. Their position being advantageous, they were willing to await the enemy rather than offer battle. On the other hand, Marlborough and Eugene were stimulated to engage them at all events, in consequence of an intercepted letter from Villeroy, intimating that he was preparing to cut off all communication between the Rhine and the allied army. The dispositions, therefore, being made for the attack, and the orders communicated to the general officers, the allied forces advanced into the plain, and were ranged in order of battle. The cannonading began about nine in the morning, and continued to about half after twelve. The troops then advanced to the attack; the right under the direction of Prince Eugene, the left headed by Marlborough, and opposed to Marshal Tallard. Marlborough, at the head of the English troops, having passed the rivulet, attacked the cavalry of Tallard with great bravery. This general being then reviewing the disposition of his troops to the left, his cavalry fought for some time without the presence of their commander. Prince Eugene had not yet attacked the forces of the elector; and it was near an hour before he could bring up his troops to the engagement. Tallard was no sooner informed that his right was attacked by the duke, than he flew to its head, where he found a furious encounter already begun; his cavalry being thrice driven back, and rallying as often. He had posted a large body of forces in the village of Blenheim; and he made an attempt to bring them to the charge. They were attacked by a detachment of Marlborough's troops so vigorously, that instead of assisting the main body, they could hardly maintain their ground. All the French cavalry being thus attacked in flank, was totally defeated. The English army now penetrated between the two bodies of the French, commanded by the marshal and elector, while the forces in the village of Blenheim were separated by another detachment. In this distressed situation Tallard flew to rally some squadrons; but from his shortsightedness mistaking a detachment of the enemy for his own, he was made prisoner by the Hessian troops who were in the allied army. Meanwhile, Prince Eugene on his part, after having been thrice repulsed, at last put the enemy into confusion. The rout then became general, and the flight precipitate. The consternation of the French soldiers was such, that they threw themselves into the Danube, without knowing whither they fled. The allies being now masters of the field of battle, surrounded the village of Blenheim, where a body of 13,000 men had been posted in the beginning of the action, and still maintained their ground. These troops seeing themselves cut off from all communication with the rest of the army, and despairing of being able to force their way through the allies, threw down their arms, and surrendered themselves prisoners of war. Thus ended the battle of Blenheim, one of the most complete victories that ever was obtained. Twelve thousand French and Bavarians were slain in the field or drowned in the Danube; 13,000 were made prisoners of war; and there were taken 100 pieces of cannon, 22 mortars, upwards of 100 pair of colours, 200 standards, 17 pair of kettle-drums, upwards of 3000 tents, 34 coaches, 300 loaded mules, two bridges of boats, and all the French baggage, with their military chest. Next day, when the duke of Marlborough visited his prisoner the marshal, the latter assured him that he had overcome the best troops in the world. "I hope, Sir (replied the duke), you will except those troops by whom they were conquered." The allies, in consequence of this victory, became masters of a country 100 leagues in extent.

Blenheim House, a noble and princely house erected in honour of the duke of Marlborough at Woodstock near Oxford, which with the manor of Woodstock is settled on the duke and his heirs, in consideration of the eminent services by him performed for the public; and for building of which house the sum of 500,000l. was granted by parliament, &c.—The tenure by which his grace holds the manor of Woodstock is the presenting at the castle of Windsor annually on the day in which the battle of Blenheim was fought, a flag embroidered with flowers-de-lis; which flag is shewn to all strangers who visit the castle.

BLENNIUS, the Blenny. See Ichthyology *Index*.

BLESS, Henry, painter of history and landscape, was born at Bovine, near Dinant, in 1480. He acquired his skill in the art merely by the strength of his natural genius, assisted by a diligent study and observation of the works of Patenier, without having any other instructor; and at last rendered himself very eminent, particularly by his landscapes. His best performances were bought up by the emperor Rodolph, and they are still preserved at Vienna. His style of composition in historical subjects resembles the style of the Flemish artists of that age, and exhibits a great number of figures finished with extreme neatness. But he crowded several subjects into one design; as in his picture of the disciples at Emmaus, he represented not only that incident, but, in different groups disposed in the back ground, he represented likewise the different parts of the passion of our Saviour. And yet, notwithstanding the impropriety of that manner of composing, his pictures were so delicately pencilled and finished, and his landscapes in particular so agreeably invented, so full of variety, and well executed, that even in Italy his works were in great request, and were distinguished there by the appellation of the *owl-pictures*: for he fixed an owl, as his peculiar mark, in every picture he painted; by which the works of this master are always indisputably known. He died in 1550.

BLESTIUM, a town in Britain. Now *Old-town*, not far from Hereford.

BLETONISM, a faculty of perceiving and indicating subterraneous springs and currents by sensation. The term is modern, and derived from a M. Bleton, who for some years past has excited universal attention by his possessing the above faculty, which seems to depend upon some peculiar organization. Concerning the reality of this extraordinary faculty, there occurred great doubts among the learned. But M. Thouvenel, a Frenchman of some consequence and a philosopher, seems to have put the matter beyond dispute, in two memoirs which he has published upon the subject. He was charged by the king with a commission to analyse the mineral and medicinal waters in France; and, by repeated trials, he had been so fully convinced of the capacity of Bleton to assist him with efficacy in this important undertaking, that he solicited the ministry to join him in the commission upon advantageous terms. All this shows that the operations of Bleton have a more solid support than the tricks of imposture or the delusions of fancy. In fact, a great number of his discoveries are ascertained by respectable affidavits. The following is a strong instance in favour of Bletonism. "For a long time the traces of several springs and their reservoirs in the lands of the abbé de Vervians had been entirely lost. It appeared, nevertheless, by ancient deeds and titles, that these springs and reservoirs had existed. A neighbouring abbey was supposed to have turned their waters for its benefit into other channels, and a law-suit was commenced upon this supposition. M. Bleton was applied to: he discovered at once the new course of the waters in question: his discovery was ascertained, and the law-suit was terminated."

Bleton has been mistaken more than once; and our author enumerates, with the fairest candour, the cases in which he has failed: but these cases are very rare in comparison with those in which he has succeeded. Besides, even the mistakes of Bleton do not invalidate the reality of his talents; since a talent may be real without being perfect, or exerting itself with the same success in every trial.

Many were indisposed against Bletonism, because they looked upon the facts on which it is founded as inexplicable. But M. Thouvenel assigns principles upon which the impressions made by subterraneous waters and mines may be naturally enough accounted for. Having ascertained a general law by which subterraneous electricity exerts an influence upon the bodies of certain individuals eminently susceptible of that influence, and shown that this law is the same whether the electrical action arises from currents of warm or cold water, from currents of humid air, from coal or metallic mines, from sulphur, and so on, he observes, that there is a diversity in the physical and organical impressions which are procured by this electrical action, according as it proceeds from different fossil bodies which are more or less conductors of electrical emanations. There are also artificial processes, which concur in leading us to distinguish the different focuses or conductors of mineral electricity; and in these processes the

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the use of electrometrical rods deserves the attention of philosophers, who might perhaps in process of time substitute in their place a more perfect instrument. Their physical and spontaneous mobility, and its electrical cause, are demonstrated by indisputable experiments.

On the other hand, our author proves, by very plausible arguments, the influence of subterraneous electrical currents, compares them with the electrical currents of the atmosphere, points out the different impressions they produce according to the number and quality of the bodies which act, and the diversity of those which are acted upon. The ordinary sources of cold water make impressions proportional to their volume, the velocity of their currents, and other circumstances. Their stagnation destroys every species of electrical influence; at least, in this state they have none that is perceptible. Their depth is indicated by geometrical processes, founded upon the motion and divergence of the electrical rays; but there are second causes which sometimes diversify these indications, and occasion seeming errors. These errors, however, according to our author, are only exceptions to the general rule; exceptions which depend on the difference of mediums and situations, and not on the inconstancy or incertitude of the organical, sensitive, or convulsive faculties of the Bletonist.

All the hot springs in France, traced by our author from the places where they flow to the places where their formation commences (sometimes at a distance of 15 leagues), led him constantly to masses of coal; where they are collected and heated in basons of different depths and dimensions, nourished by the filtration of lakes and the course of torrents, and mineralized by saline, sulphureous, metallic, and bituminous substances, in the natural furnaces where they are heated, or in the strata through which they flow.

The last and the most singular and important phenomenon which our author met with in the course of his experiments must not be here omitted. Over the veins of iron mines alone the electrometrical rods assume a motion of rotation diametrically opposite to that which they exhibit over all other mines. This phenomenon takes place with the same distinction when iron and other metals are extracted from their mines and deposited under ground. But the most remarkable circumstance in this distinctive action of these metals is, that it has a uniform and constant direction from east to west in all metals, iron excepted, just as iron rendered magnetic has an action directed from south to north. The action of red metals is more palpable than that of the white; but the latter, though weaker, has nevertheless, a real existence in the sulphur. In the supplement to this memoir, there is an accurate account of the processes that have furnished these invariable results. They will naturally suggest, says our author, the idea of constructing an electrical compass, which may be of as eminent use in experimental philosophy as the magnetic compass is in navigation. The natural and spontaneous direction of metallic emanations towards the west being ascertained, it only remains to render them palpable by the construction of an instrument which may be substituted in the place of the electrometrical twig that goes vulgarly by the name of the *divining rod*.

His analysis of the hot springs of Bourbon-Lancy, to the source of which in the great mountains of Burgundy he was led by the electrical sensations of Bleton, shows the great intelligence and sagacity of our author in operations of this nature. He found the origin of these famous hot springs in the centre of an oblong rising ground, full of coal, and commanded on three sides by a group of mountains, of which the greatest part was filled with the same mineral. From a particular case, here circumstantially described, in which the electrical rays of the subterraneous water and those of the adjacent coal crossed each other, our author deduces a very natural account of the errors which may sometimes, though rarely, mislead for a time the greatest adepts in Bletonism, when they find themselves in combined spheres of electrical activity. Another observation, which seems confirmed by several facts, accounts farther for this fallibility; the observation is, that electrical rays, whether direct or collateral, issuing from subterraneous focuses, seem to undergo in certain cases a sort of refraction as they pass from one medium to another, or traverse bodies which differ with respect to the property of transmitting this electricity. In a word, it follows from these observations, that when such privileged investigators of currents or minerals as Bleton are placed upon the electrical spheres of these bodies, they will indicate their situation and their respective depths according to the impressions they feel within themselves, or the motions they observe in the electrometrical instruments which they employ: and if they meet with second accidental causes or complications of electrical spheres, which modify or alter these methods of trial, this will necessarily occasion mistakes in the results of their operations which they may probably rectify; but which, at all events, it would be unjust to lay to their charge, or allege as an objection against the reality of their talent.

BLIGHT, in *Husbandry*, a disease incident to plants, which affects them variously, the whole plant sometimes perishing by it, and sometimes only the leaves and blossoms, which will be scorched and shrivelled up, the rest remaining green and flourishing.

Some have supposed that blights are usually produced by an easterly wind, which brings vast quantities of insects eggs along with it, from some distant place, that, being lodged upon the surface of the leaves and flowers of fruit-trees, cause them to shrivel up and perish.

To cure this distemper, they advise the burning of wet litter on the windward side of the plants, that the smoke thereof may be carried to them by the wind, which they suppose will stifle and destroy the insects, and thereby cure the distemper.

Others direct the use of tobacco-dust, or to wash the trees with water wherein tobacco-stalks have been infused for 12 hours; which they say will destroy those insects, and recover the plants.

Pepper-dust scattered over the blossoms of fruit-trees, &c. has been recommended as very useful in this case; and there are some that advise the pulling off the leaves that are distempered.

The true cause of blights seems to be continued dry easterly winds for several days together, without the intervention of showers, or any morning dew, by which the perspiration in the tender blossom is stopped; and if

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if it so happens that there is a long continuance of the same weather, it equally affects the tender leaves, whereby their colour is changed, and they wither and decay.

The best remedy for this distemper, is gently to wash and sprinkle over the tree, &c. from time to time, with common water; and if the young shoots seem to be much infected, let them be washed with a woollen cloth, so as to clear them, if possible, from this glutinous matter, that their respiration and perspiration may not be obstructed. This operation ought to be performed early in the day, that the moisture may be exhaled before the cold of the night comes on: nor should it be done when the sun shines very hot.

Another cause of blights in the spring, is sharp hoar-frosts, which are often succeeded by hot sunshine in the day-time. This is the most sudden and certain destroyer of the fruits that is known.

BLIGHTED CORN. See SMUT.

1 Blindness, what.

BLIND, an epithet applied to a person or sensitive creature deprived of the use of his eyes; or, in other words, to one from whom light, colours, and all the glorious variety of the visible creation, are intercepted by some natural or accidental disease. Such is the literal acceptation of the term: but it is likewise used in a metaphorical sense, to signify mental or intellectual darkness; and frequently implies, at the same time, some moral or spiritual depravity in the soul thus blinded, which is either the efficient or continuing cause of this internal malady. Yet, even in metaphor, the epithet of *blind* is sometimes applied to a kind of ignorance, which neither involves the idea of real guilt nor of voluntary error. It is, however, our present intention to consider the word, not in its figurative, but in its natural and primary sense. Nor do we mean in this place to regard it as a subject of medical speculation, or to explore its causes and enumerate its cures. These are in the department of another science *. It is rather our design to consider, By what means this inexpressible misfortune may be compensated or alleviated to those who sustain it; what advantages and consolations they may derive from it; of what acquisitions they may be susceptible; what are the proper means of their improvement; or by what culture they may become useful to themselves, and important members of society.

2 Either natural or metaphorical.

* See the Index subjoined to *Medicine*.

3 How the blind may be rendered useful in an individual or a social capacity.

There is not perhaps any sense or faculty of the corporeal frame, which affords so many resources of utility and entertainment as the power of vision; nor is there any loss or privation which can be productive of disadvantages or calamities so multiform, so various, and so bitter, as the want of sight. By no avenue of corporeal perception is knowledge in her full extent, and in all her forms, so accessible to the rational and inquiring soul, as by the glorious and delightful medium of light. For this not only reveals external things in all their beauties, in all their changes, and in all their varieties; but gives body, form, and colour, to intellectual ideas and abstract essences; so that the whole material and intelligent creation lie in open prospect, and the majestic frame of nature, in its whole extent, is, if we may speak so, perceived at a single glance. To the blind, on the contrary, the visible universe is totally annihilated; he is perfectly conscious of no space but that in which he stands, or to which his extremities can reach. Sound, indeed, gives him some ideas of distant objects; but those ideas are extremely obscure and indistinct. They are obscure, because they consist alone of the objects whose oscillations vibrate on his ear, and do not necessarily suppose any other bodies with which the intermediate space may be occupied, except that which gives the sound alone: they are indistinct, because sounds themselves are frequently ambiguous, and do not uniformly and exclusively indicate their real causes. And though by them the idea of distance in general, or even of some particular distances, may be obtained; yet they never fill the mind with those vast and exalting ideas of extension which are inspired by ocular perception. For though a clap of thunder, or an explosion of ordnance, may be distinctly heard after they have traversed an immense region of space; yet, when the distance is uncommonly great, it ceases to be indicated by sound; and therefore the ideas, acquired by auricular experiment, of extension and interval, are extremely confused and inadequate. The living and comprehensive eye darts its instantaneous view over expansive valleys, lofty mountains, protracted rivers, illimitable oceans. It measures, in an indivisible point of time, the mighty space from earth to heaven, or from one star to another. By the assistance of telescopes, its horizon is almost indefinitely extended, its objects prodigiously multiplied, and the sphere of its observation nobly enlarged. By these means, the imagination, inured to vast impressions of distance, can not only recal them in their greatest extent with as much rapidity as they were at first imbibed; but can multiply them, and add one to another, till all particular boundaries and distances be lost in immensity. Thus nature, by profusely irradiating the face of things, and clothing objects in a robe of diversified splendour, not only invites the understanding to expatiate on a theatre so extensive, so diversified, and so attractive; but entertains and inflames the imagination with every possible exhibition of the sublime or beautiful. The man of light and colours beholds the objects of his attention and curiosity from far. Taught by experience, he measures their relative distances; distinguishes their qualities; determines their situations, positions, and attitudes; presages what these tokens may import; selects his favourites; traverses in security the space which divides them from him; stops at the point where they are placed; and either obtains them with ease, or immediately perceives the means by which the obstacles that intercept his passage to them may be surmounted. The blind not only may be, but really are, during a considerable period, apprehensive of danger in every motion towards any place from whence their contracted power of perception can give them no intelligence. All the various modes of delicate proportion, all the beautiful varieties of light and colours, whether exhibited in the works of nature or art, are to them irretrievably lost. Dependent for every thing, but mere subsistence, on the good offices of others; obnoxious to injury from every point, which they are neither capacitated to perceive nor qualified to resist; they are, during the present state of being, rather to be considered as prisoners at large, than citizens of nature. The sedentary life, to which by privation of sight they are destined, relaxes their frame, and subjects them to all the disagreeable sensations which arise from dejection of spirits. Hence the most feeble

4 Disadvantages of blindness.

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feeble exertions create lassitude and uneasiness. Hence the native tone of the nervous system, which alone is compatible with health and pleasure, destroyed by inactivity, exasperates and embitters every disagreeable impression. Natural evils, however, are always supportable; they not only arise from blind and undesigning causes, but are either mild in their attacks, or short in their duration: it is the miseries which are inflicted by conscious and reflecting agents alone, that can deserve the name of evils. These excruciate the soul with ineffable poignancy, as expressive of indifference or malignity in those by whom such bitter potions are cruelly administered. The negligence of wantonness, therefore, with which the blind are too frequently treated, is an enormity which God alone has justice to feel or power to punish.

5 The situation of the blind described by poets.

Those among them who have had sensibility to feel, and capacity to express, the effects of their misfortunes, have described them in a manner capable of penetrating the most callous heart. The venerable father of epic poetry, who in the person of Demodocus the Phæacian bard is said to have described his own situation, proceeds thus:

6 Homer.

> *Τον περι Μουσ' εφιλησε, διδου δ' αγαθον τε, κακον τε*
> *Οφθαλμων μεν αμερσε, διδου δ' ηδειαν αοιδην.* ODYS. θ.

> Dear to the muse, who gave his days to flow
> With mighty blessings mix'd with mighty wo,
> In clouds and darkness quench'd his visual ray,
> Yet gave him power to raise the lofty lay. POPE.

Milton, in his address to light, after a sublime description of his arduous and gloomy journey from the regions of primeval darkness to this our visible diurnal sphere, thus continues to apostrophize the celestial beam:

7 Milton.

> Taught by the heav'nly muse to venture down
> The dark descent, and up to reascend,
> Though hard and rare; thee I revisit safe,
> And feel thy sov'reign vital lamp: but thou
> Revisit'st not these eyes, that roll in vain
> To find thy piercing ray, and find no dawn:
> So thick a drop serene hath quench'd their orbs,
> Or dim suffusion veil'd. Yet not the more
> Cease I to wander, where the muses haunt
> Clear spring, or shady grove, or sunny hill,
> Smit with the love of sacred song: but chief
> Thee, Sion, and the flow'ry brooks beneath,
> That wash thy hallow'd feet, and warbling flow,
> Nightly I visit; nor sometimes forget
> Those other two equall'd with me in fate,
> So were I equall'd with them in renown,
> Blind Thamyris, and blind Mæonides,
> And Tiresias and Phineus prophets old:
> Then feed on thoughts, that voluntary move
> Harmonious numbers; as the wakeful bird
> Sings darkling, and in shadiest covert hid
> Tunes her nocturnal note. Thus with the year
> Seasons return; but not to me returns
> Day, or the sweet approach of ev'n or morn,
> Or sight of vernal bloom, or summer's rose,
> Or flocks, or herds, or human face divine;
> But cloud instead, and ever-during dark,
> Surrounds me, from the cheerful ways of men
> Cut off, and for the book of knowledge fair
> Presented with an universal blank,
> Of nature's works to me expung'd and ras'd,
> And wisdom at one entrance quite shut out.
> PAR. LOST, Book III.

The same inimitable author, in his tragedy of Sampson Agonistes, and in the person of his hero, deplores the misfortune of blindness with a pathos and energy sufficient to extort the deepest sighs from the most unfeeling hearts:

> ———————— But chief of all,
> O loss of sight, of thee I must complain!
> Blind among enemies, O worse than chains,
> Dungeon, or beggary, decrepid age.
> Light, the prime work of God, to me is extinct,
> And all her various objects of delight
> Annull'd, which might in part my grief have eas'd.
> Inferior to the vilest now become
> Of man or worm. The vilest here excel me:
> They creep, yet see; I dark in light, expos'd
> To daily fraud, contempt, abuse, and wrong,
> Within doors, or without, still as a fool,
> In power of others, never in my own;
> Scarce half I seem to live, dead more than half.
> O dark, dark, dark, amid the blaze of noon.
> Irrecoverably dark, total eclipse
> Without all hope of day!
> O first-created Beam, and thou great Word,
> *Let there be light*, and light was over all!
> Why am I thus bereav'd thy prime decree?
> The sun to me is dark,
> And silent, as the moon
> When she deserts the night,
> Hid in her vacant interlunar cave.
> Since light so necessary is to life,
> And almost life itself, if it be true
> That light is in the soul,
> She all in every part; why was the sight
> To such a tender ball as th' eye confin'd!
> So obvious, and so easy to be quench'd?
> And not, as feeling, throughout all parts diffus'd,
> That she might look at will through ev'ry pore?
> Then had I not been thus exil'd from light,
> As in the land of darkness, yet in light,
> To live a life half dead, a living death:
> And bury'd; but yet more miserable!
> Myself the sepulchre, a moving grave;
> Bury'd, yet not exempt
> By privilege of death and burial
> From worst of other evils, pains and wrongs,
> But made hereby obnoxious more
> To all the miseries of life.

8 Ossian.

Ossian, the Caledonian bard, who lived before the authenticated history of his nation dates its origin, who in his old age participated the same calamity, has in more than one passage of his works described his situation in a manner so delicate, yet so pathetic, that it pierces the inmost recesses, and excites the finest feelings of the heart. Of these passages, take the following:

"O thou that rollest above, round as the shield of my fathers! whence are thy beams, O sun! whence thy everlasting light? Thou comest forth in thy awful beauty, and the stars hide themselves in the sky; the moon,

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moon, cold and pale, sinks in the western wave. But thou thyself movest alone: who can be a companion of thy course? The oaks of the mountains fall; the mountains themselves decay with years; the ocean shrinks and grows again; the moon herself is lost in heaven: but thou art for ever the same; rejoicing in the brightness of thy course. When the world is dark with tempests; when thunder rolls and lightning glances through the heavens; thou lookest in thy beauty from the clouds, and laughest at the storm. But to Ossian thou lookest in vain: for he beholds thy beams no more; whether thy yellow hair flows on the eastern clouds, or thou tremblest at the gates of the west. But thou art, perhaps, like me, for a season; and thy years will have an end; thou shalt sleep in thy clouds, careless of the voice of the morning.—Exult then, O sun, in the strength of thy youth! age is dark and unlovely; it is like the glimmering light of the moon, when it shines through broken clouds, and the mist is on the hills, the howling blast of the north is on the plain, the traveller shrinks in the midst of his journey."

9 The dejection attending blindness accounted for.

Thus dependent on every creature, and passive to every accident, can the world, the uncharitable world, be surprised to observe moments when the *blind* are at variance with themselves and every thing else around them? With the same instincts of self-preservation, the same irascible passions which are common to the species, and exasperated by a sense of debility either for retaliation or defence; can the blind be real objects of resentment or contempt, even when they seem peevish or vindictive? This, however, is not always their character. Their behaviour is often highly expressive, not only of resignation, but even of cheerfulness; and though they are often coldly, and even inhumanly, treated by men, yet they are rarely, if ever, forsaken of heaven. The common Parent of nature, whose benignity is permanent as his existence and boundless as his empire, has neither left his afflicted creatures without consolation or resource.

10 Some advantages peculiar to the blind.

Even from their loss, however oppressive and irretrievable, they derive advantages; not indeed adequate to recompense, but sufficient to alleviate, their misery. The attention of the soul, confined to these avenues of perception which she can command, is neither dissipated nor confounded by the immense multiplicity nor the rapid succession of surrounding objects. Hence her contemplations are more uniformly fixed upon herself, and the revolutions of her own internal frame. Hence her perceptions of such external things as are contiguous and obvious to her observation become more lively and exquisite. Hence even her instruments of corporeal sensation are more assiduously cultivated and improved, so that from them she derives such notices and presages of approaching pleasure or impending danger as entirely escape the attention of those who depend for security on the reports of their eyes. A blind man, when walking swiftly, or running, is kindly and effectually checked by nature from rudely encountering such hard and extended objects as might hurt or bruise him. When he approaches bodies of this kind, he feels the atmosphere more sensibly resist his progress; and in proportion as his motion is accelerated, or his distance from the object diminished, the resistance is increased. He distinguishes the approach of his friend from far by the sound of his steps, by his manner of breathing, and almost by every audible token which he can exhibit. Prepared for the dangers which he may encounter from the surface of the ground upon which he walks, his step is habitually firm and cautious. Hence he not only avoids those falls which might be occasioned by its less formidable inequalities, but from its general bias he collects some ideas how far his safety is immediately concerned; and though these conjectures may be sometimes fallacious, yet they are generally so true, as to preserve him from such accidents as are not incurred by his own temerity. The rapid torrent and the deep cascade not only warn him to keep a proper distance, but inform him in what direction he moves, and are a kind of audible cynosures to regulate his course. In places to which he has been accustomed, he as it were recognizes his latitude and longitude from every breath of varied fragrance that tinges the gale, from every ascent or declivity in the road, from every natural or artificial sound that strikes his ear; if these indications be stationary, and confined to particular places. Regulated by these signs, the *blind* have not only been known to perform long journeys themselves, but to conduct others through dangerous paths at the dark and silent hour of midnight, with the utmost security and exactness (A).

It

(A) We have read, in authors of good credit, of a very surprising blind guide who used to conduct the merchants through the sands and deserts of Arabia. Vide *Leo Afric.* Descr. Afr. lib. vi. p. 246. and *Casaub.* Treat. of Enthus. c. ii. p. 45.

An instance no less marvellous exists at this present time, 1788, and in our own country. "John Metcalf, a native of the neighbourhood of Manchester, where he is well known, became blind at a very early age, so as to be entirely unconscious of light and its various effects. This man passed the younger part of his life as a waggoner, and occasionally as a guide in intricate roads during the night or when the tracks were covered with snow. Strange as this may appear to those who can see, the employment he has since undertaken is still more extraordinary: it is one of the last to which we could suppose a blind man would ever turn his attention. His present occupation is that of a projector and surveyor of highways in difficult and mountainous parts. With the assistance only of a long staff, I have several times met this man traversing the roads, ascending precipices, exploring valleys, and investigating their several extents, forms, and situations, so as to answer his designs in the best manner. The plans which he designs, and the estimates he makes, are done in a method peculiar to himself; and which he cannot well convey the meaning of to others. His abilities in this respect are nevertheless so great, that he finds constant employment. Most of the roads over the Peak in Derbyshire have been altered by his directions; particularly those in the vicinity of Buxton: and he is at this time constructing a new one betwixt Wilmslow and Congleton, with a view to open a communication to the great London road, without being

11 Whether the blind are able to distinguish colours.

It were endless to recapitulate the various mechanical operations of which they are capable, by their nicety and accuracy of touch. In some the tactile powers are said to have been so highly improved, as to perceive that texture and disposition of coloured surfaces by which some rays of light are reflected and others absorbed, and in this manner to distinguish colours. But the testimonies for this fact still appear to us too vague and general to deserve public credit. We have known a person who lost the use of his sight at an early period of infancy, who in the vivacity or delicacy of his sensations was not perhaps inferior to any one, and who had often heard of others in his own situation capable of distinguishing colours by touch with the utmost exactness and promptitude. Stimulated, therefore, partly by curiosity to acquire a new train of ideas, if that acquisition were possible; but still more by incredulity with respect to the facts related; he tried repeated experiments, by touching the surfaces of different bodies, and examining whether any such diversities could be found in them as might enable him to distinguish colours: but no such diversity could he ever ascertain. Sometimes, indeed, he imagined that objects which had no colour, or, in other words, such as were black, were somewhat different and peculiar in their surfaces; but this experiment did not always nor universally hold. His scepticism therefore still continues to prevail (B). That their acoustic perceptions are distinct and accurate, we may fairly conclude from the rapidity with which they ascertain the acuteness or gravity of different tones, as relative one to another: and from their exact discernment of the various kinds and modifications of sound, and of sonorous objects, if the sounds themselves be in any degree significant of their causes. From this vivacity and accuracy of external sensation, and from the assiduous and vigorous application of a comprehensive and attentive mind alone, we are able to account for the rapid and astonishing progress which some of them have made, not only in those departments of literature which were most obvious to their senses and accessible to their understandings, but even in the abstractest, and (if we may be allowed the expression) in the most occult sciences.

12 Instances how far they are susceptible of abstract learning.

What, for instance, can be more remote from the conceptions of a blind man than the abstract relations and properties of space and quantity? yet the incomprehensible attainments of Dr Saunderson in all the branches of mathematics are now fully known and firmly believed by the whole literary world, both from the testimony of his pupils and the publication of his works. But should the fact be still uncertain, it might be sufficiently verified by a living prodigy of this kind with which our country is at present honoured. The gentleman of whom we now speak, though blind from his infancy, by the ardour and assiduity of his application, and by the force of a genius to which nothing is impenetrable, has not only made incredible advances in mechanical operations, in music, and in the languages; but is likewise profoundly skilled in geometry, in optics, in algebra, in astronomy, in chemistry, and in all the other branches of natural philosophy as taught by Newton and received by an admiring world. We are sorry that neither the modesty of this amiable philosopher, nor the limits of this article, will permit us to delineate his character in its full proportions: All we can do is to exhibit his example, that by it the vulgar prejudice, which presumes to think blindness and learning incompatible, may be dissipated; and that an instance of success so noble and recent may inflame the emulation and encourage the efforts of such as have genius and opportunity to pursue the same laudable path (C). If these glorious attempts should neither be perceived

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ing obliged to pass over the mountains." Account by Dr Bew, published in the Transactions of the Manchester Society, vol. i.

(B) See, however, the extraordinary case subjoined to this article.

(C) As particular anecdotes of this astonishing genius have been, since a former edition of the Encyclopædia, delivered to the Manchester Society, by G. Bew, M. D. and afterwards published, we shall here take the liberty to transcribe them from the original volume in which they are inserted, as this freedom is authorized by a letter from Dr Bew's own hand.

"Dr Henry Moyes, who occasionally read Lectures on Philosophical Chemistry at Manchester, like Dr Saunderson, the celebrated professor of Cambridge, lost his sight by the small pox in his early infancy. He never recollected to have seen: 'but the first traces of memory I have (says he), are in some confused ideas of the solar system.' He had the good fortune to be born in a country where learning of every kind is highly cultivated, and to be brought up in a family devoted to learning.

"Possessed of native genius, and ardent in his application, he made rapid advances in various departments of erudition; and not only acquired the fundamental principles of mechanics, music, and the languages, but likewise entered deeply into the investigation of the profounder sciences, and displayed an acute and general knowledge of geometry, optics, algebra, astronomy, chemistry, and in short of most of the branches of the Newtonian philosophy.

"Mechanical exercises were the favourite employment of his infant years. At a very early age he made himself acquainted with the use of edged tools so perfectly, that notwithstanding his entire blindness, he was able to make little windmills; and he even constructed a loom with his own hands, which still show the cicatrices of wounds he received in the execution of these juvenile exploits.

"By a most agreeable intimacy and frequent intercourse which I enjoyed with this accomplished blind gentleman, whilst he resided in Manchester, I had an opportunity of repeatedly observing the peculiar manner in which he arranged his ideas and acquired his information. Whenever he was introduced into company, I remarked that he continued some time silent. The sound directed him to judge of the dimensions of the room, and the different voices of the number of persons that were present. His distinction in these respects was very accurate:

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perceived nor rewarded by an unfeeling world, if human nature should forget to recognize its own excellence so nobly displayed in instances of this kind; yet besides the enjoyments resulting from a sublime and comprehensive understanding, besides the immortal and inexhaustible sources of delight, which are the peculiar portion of a self-approving mind, these happy pupils and favourites of Nature are as it were indulged with her personal intercourse. They become more intimately acquainted with her laws, till by exploring the beneficence of her economy, the sublimity of her ends, the regularity of her procedure, and the beauties of her frame, they imbibe the spirit, and feel the presence of her glorious Author:

By swift degrees the love of nature works,
And warms the bosom; till at last, sublim'd
To rapture and enthusiastic heat,
We feel the present deity, and taste
The joy of God to see a happy world.

THOMSON.

13
Accounts of the effects of recovered sight upon those who have been born blind uncertain.

Much labour has been bestowed to investigate, both from reason *à priori* and from experiment, what might be the primary effects of light and luminous objects upon such as have been born blind, or early deprived of sight, if at a maturer period they should instantaneously recover their visual powers. But upon this topic there is much reason to fear, that nothing satisfactory has yet been said. The fallacy of hypothesis and conjecture, when formed *à priori* with respect to any organ of corporeal sensation and its proper object, is too obvious to demand illustration. But from the nature of the eye, and the medium of its perception, to attempt an investigation of the various and multiform phenomena of vision, or even of the varieties of which every particular phenomenon is susceptible according as the circumstances of its appearance are diversified, would be a project worthy of philosophy in a delirium. Nay, even the discoveries which are said to accrue from experiment, may still be held as extremely doubtful and suspicious; because in these experiments it does not appear to have been ascertained, that the organs to which visible objects were presented immediately after chirurgical operations, could be in a proper state to perceive them. Yet, after all, it is extremely probable, that figure, distance, and magnitude, are not immediate objects of ocular sensation, but acquired and adjusted by long and reiterated experience (D). There are, however, many desiderata, which the perceptions of a man born blind might considerably illustrate, if his instruments of vision were in a right state, and assisted by a proper medium. Such a person might perhaps give a clearer account, why objects, whose pictures are inverted upon the retina of the eye, should appear to the mind in their real positions; or why, though each particular object is painted upon the retina of both our eyes, it should only be perceived as single. Perhaps, too, this new spectator of visible nature might equally amuse our curiosity and improve our theory, by attempting to describe his earliest sensations of colour, and its original effects upon his organ and his fancy. But, as we have already hinted, it is far from being certain, that trials of this kind have ever been fairly made. Such readers as may wish to see a more minute detail of these questions, may consult M. Diderot's *Lettre sur les aveugles, a l'usage de ceux qui voyent*: Works, vol. ii.

Diderot's Works, vol. ii.

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accurate; and his memory so retentive, that he seldom was mistaken. I have known him instantly recognize a person, on first hearing him speak, though more than two years had elapsed since the time of their last meeting. He determined pretty nearly the stature of those he was speaking with by the direction of their voices: and he made tolerable conjectures respecting their tempers and disposition, by the manner in which they conducted their conversation.

"It must be observed, that this gentleman's eyes were not totally insensible to intense light. The rays refracted through a prism, when sufficiently vivid, produced certain distinguishable effects upon them. The red gave him a disagreeable sensation, which he compared to the touch of a saw. As the colours declined in violence, the harshness lessened, until the green afforded a sensation that was highly pleasing to him, and which he described as conveying an idea similar to what he felt in running his hand over a smooth polished surface. Polished surfaces, meandering streams, and gentle declivities, were the figures by which he expressed his ideas of beauty: Rugged rocks, irregular points, and boisterous elements, furnished him with expressions for terror and disgust. He excelled in the charms of conversation; was happy in his allusions to visual objects; and discoursed on the nature, composition, and beauty of colours, with pertinence and precision.

"Doctor Moyes was a striking instance of the power the human soul possesses of finding resources of satisfaction, even under the most rigorous calamities. Though involved 'in ever-during darkness,' and excluded from the charming views of silent or animated nature; though dependent on an undertaking for the means of his subsistence, the success of which was very precarious; in short, though destitute of other support than his genius, and under the mercenary protection of a person whose integrity he suspected, still Dr Moyes was generally cheerful, and apparently happy. Indeed it must afford much pleasure to the feeling heart to observe this hilarity of temper prevail almost universally with the blind. Though cut off from the ways of men, and the contemplation of the human face divine, they have this consolation; they are exempt from the discernment and contagious influence of those painful emotions of the soul that are visible on the countenance, and which hypocrisy itself can scarcely conceal. This disposition likewise may be considered as an internal evidence of the native worth of the human mind, that thus supports its dignity and cheerfulness under one of the severest misfortunes that can possibly befal us."

(D) The gentleman couched by Mr Cheselden had no idea of distance; but thought that all the objects he saw, touched his eyes, as what he felt did his skin. It was a considerable time before he could remember which was the cat and which the dog, though often informed, without first feeling them.

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Blind.

voyent: "A letter concerning the blind for the use of those who see." To these may be added, *Mr Cheselden's Anatomy*, and *Locke's Essay on the Human Understanding*.

When we ruminate on the numberless advantages derived from the use of sight, and its immense importance, in extending the human capacity, or in improving and cultivating every faculty and every function of the mind, we might be strongly tempted to doubt the fidelity of those reports which we have heard concerning such persons as, without the assistance of light, have arrived at high degrees of eminence even in those sciences which appear absolutely unattainable but by the interposition of external mediums. It has, however, been demonstrated by a late ingenious author, that *blind* men, by proper instruction, are susceptible almost of every idea, and of every truth which can be impressed on the mind by the mediation of light and colours, except the sensations of light and colours themselves †.

† See Dr *Reid's Inquiry into the Human Mind*, chap. vi. § 1, 2.

14 How the blind catch the enthusiasm inspired by visual perceptions, a paradox.

Yet there is one phenomenon of this kind which seems to have escaped the attention of that great philosopher, and for which no author either of this or any former period has been able to offer any tolerable account. Still, however, it seems to merit the attention of a philosopher. For though we should admit, that the blind can understand with great perspicuity all the phenomena of light and colours; though it were allowed, that in these subjects they might extend their speculations beyond their instructions, and investigate the mechanical principles of optics by the mere force of genius and application, from the data which they had already obtained; yet it will be difficult, if not impossible, to assign any reason why these objects should be more interesting to a blind man than any other abstract truths whatever. It is possible for the blind, by a retentive memory, to tell you, That the sky is an azure; that the sun, moon, and stars, are bright; and the rose is red, the lily white or yellow, and the tulip variegated. By continually hearing these substantives and adjectives joined, he may be mechanically taught to join them in the same manner; but as he never had any sensation of colour, however accurately he may speak of coloured objects, his language must be like that of a parrot; without meaning, or without ideas. Homer, Milton, and Ossian, had been long acquainted with the visible world before they were surrounded with clouds and ever-during darkness. They might, therefore, still retain the warm and pleasing impressions of what they had seen. Their descriptions might be animated with all the rapture and enthusiasm which originally fired their bosoms, when the grand or delightful objects which they delineated were immediately beheld. Nay, that enthusiasm might still be heightened by a bitter sense of their loss, and by that regret which a situation so dismal might naturally inspire. But how shall we account for the same energy, the same transport of description, exhibited by those on whose minds visible objects were either never impressed, or have been entirely obliterated? Yet, however unaccountable this fact may appear, it is no less certain than extraordinary. But delicacy and other particular circumstances forbid us to enter into this disquisition with that minuteness and precision which it requires. We only mention the fact as one amongst the few resources for entertainment, and avenues to reputation, which are still reserved for the *blind*. Whoever thinks the subject of sufficient consequence to merit a nicer scrutiny, may consult the *Preface to Blacklock's Poems*, written by G. G. Esq. and printed at Edinburgh 1754, or the account of his life and writings by the Rev. Mr Spence, prefixed to a quarto edition of his poems published at London in 1756.

It is hoped, however, that we shall not be suspected of partiality for inserting a character of the same author by one who was a foreigner, a stranger to his person, and prepossessed in his favour by his works alone.

"Blacklock will appear to posterity a fabulous character: even now he is a prodigy. It will be thought a fiction and a paradox, that a man quite blind since he was three years old (E), besides having made himself so good a master of various languages, of Greek, Latin, Italian, and French, should also be a great poet in his own; and without hardly ever having seen the light, should be so remarkably happy in description ‡."

‡ *Carlo Denina Discorso de la Litteratura*, chap. xi.

15 Of the education of the blind.

It is impossible to enter into a detail of particulars with respect to the education of the blind. These must be left to be determined by the genius, the capacity, the circumstances, of those to whom the general rules which may be given should be applied. Much, therefore, must depend on their fortunes, much on their temper and genius; for, unless these particulars were known, every answer which could be given to questions of this kind must be extremely general, and of consequence extremely superficial. Besides, the task is so much more arduous, because whoever attempts it can expect to derive no assistance from those who have written on education before him: And though the blind have excelled in more than one science; yet, except in the case of Saunderson, professor of mathematics in the university of Cambridge, concerning whom we shall afterwards have occasion to speak, it does not appear, that any of them have been conducted to that degree of eminence at which they arrived, upon a premeditated plan. One should rather imagine, that they have been led through the general course and ordinary forms of discipline; and that, if any circumstances were favourable to their genius, they rather proceeded from accident than design.

This fact, if not supported by irrefragable evidence, should, for the honour of human nature, have been suppressed. When contemplated by a man of benevolence and understanding, it is not easy to guess whether his mortification or astonishment would be most sensibly felt. If a heart that glows with real philanthropy must feel for the whole vital creation, and become, in some measure, the *sensorium* of every suffering insect or reptile; how must our sympathy increase in tenderness and force, when the distressed individuals of our own species become its objects? Nor do the blind bear so small

(E) The author is here mistaken: Dr Blacklock only saw the light for five months.

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small a proportion to the whole community, as even in a political view, to be neglected. But in this, as in every other political crime, the punishment returns upon the society in which it is committed. Those abandoned and unimproved beings, who, under the influence of proper culture and discipline, might have successfully concurred in producing and augmenting the general welfare, become the nuisances and burdens of those very societies who have neglected them.

16 Why the blind deserve, and how they may repay public sympathy.

There is perhaps no rank of beings in the sensible universe, who have suffered from nature or accident, more meritorious of public compassion, or better qualified to repay its generous exertions, than the blind. They are meritorious of compassion; for their sphere of action and observation is infinitely more limited than that of the deaf, the lame, or of those who labour under any other corporeal infirmity consistent with health. They are better qualified to repay any friendly interposition for their happiness; because, free from the distraction which attends that multiplicity of objects and pursuits that are continually obvious to the sight, they are more attentive to their own internal economy, to the particular notices of good and evil impressed on their hearts, and to that peculiar province in which they are circumscribed by the nature and cultivation of their powers.

17 Proper employments for the blind.

It will easily occur to the reader, that, if the pupil should not be placed in easy circumstances, music is his readiest and most probable resource. Civil and ecclesiastical employments have either something in their own nature, or in the invincible prejudices of mankind, which renders them almost entirely inaccessible to those who have lost the use of sight. No liberal and cultivated mind can entertain the least hesitation in concluding, that there is nothing, either in the nature of things, or even in the positive institutions of genuine religion, repugnant to the idea of a blind clergyman. But the novelty of the pheuomenon, while it astonishes vulgar and contracted understandings, inflames their zeal to rage and madness. Besides, the adventitious trappings and ceremonies assumed by some churches as the drapery of religion, would, according to these systems, render the sacerdotal office painful, if not impracticable, to the blind.

We have, some years ago, read of a blind gentleman *, descended from the same family with the celebrated lord Verulam, who, in the city of Brussels, was with high approbation created doctor of laws; since that period we have been honoured with his correspondence. He was deprived of sight at nine years of age by an arrow from a cross bow whilst he was attempting to shoot it. When he had recovered his health, which had suffered by the shock, he pursued the same plan of education in which he had been engaged; and having heard that one Nicasius de Vourde, born blind, who lived towards the end of the 15th century, after having distinguished himself by his studies in the university of Louvain, took his degree as doctor of divinity in the university of Cologne; this motive prevailed with him to make the same attempt. But the public, cursed with prejudices for which the meanest sensitive nature might blush, prejudices equally beneath the brutality and ignorance of the lowest animal instinct, treated his intention with ridicule: even the professors were not far from being of that sentiment; and they admitted him into their schools, rather from an impression, that it might amuse him, than become of any use to him. He had the good fortune, however, contrary to their expectations, to obtain the first places among his condisciples. It was then said, that such rapid advances might be made in the preliminary branches of his education; but would soon be effectually checked by studies of a more profound and abstracted nature. This, it seems, was repeated from school to school, through the whole climax of his pursuits; and when, in the course of academical learning, it became necessary to study poetry, it was the general voice that all was over, and that at length he had reached his *ne plus ultra*. But here he likewise confronted their prepossessions, and taught them the immense difference between blindness of body and blindness of soul. After continuing his studies in learning and philosophy for two years more, he applied himself to law, took his degree in that science, commenced pleading counsellor or advocate in the council of Brabant, and has had the pleasure of terminating almost every suit in which he has been engaged to the satisfaction of his clients.

* *Dr Nicholas Bacon.*

18 Law difficult, tho' not impossible, for the blind.

Had it not been for a fact so striking and so well authenticated, though there could have been no doubt that a blind man might discharge the office of a chamber-counsel with success; yet as a barrister, his difficulties must have appeared more formidable, if not absolutely insuperable. For he should remember all the sources, whether in natural equity or positive institutions, whether in common or statutory law, from whence his argument ought to be drawn. He must be able to specify, and to arrange in their proper order, all the material objections of his antagonists: these he must likewise answer as they were proposed, *extempore*.

When, therefore, it is considered how difficult it is to temper the natural association of memory with the artificial arrangements of judgment, the desultory flights of imagination with the calm and regular deductions of reason, the energy and perturbation of passion with the coolness and tranquillity of deliberation; some idea may be formed of the arduous task which every blind man must atchieve, who undertakes to pursue the law as a profession. Perhaps assistances might be drawn from Cicero's treatise on Topics and on Invention; which, if happily applied and improved, might lessen the disparity of a blind man to others, but could scarcely place him on an equal footing with his brethren. And it ought to be fixed as an inviolable maxim, that no blind man ought ever to engage in any province in which it is not in his power to excel. This may at first sight appear paradoxical; but it is easily explained. 19

The blind naturally subject to despondency, should be stimulated by the prospect of attainable excellence.

For the consciousness of the obvious advantages possessed by others, habitually predisposes a blind man to despondency: and if he ever gives way to despair (which he will be too apt to do when pursuing any acquisitions when others have a better chance of success than himself), adieu, for ever adieu, to all proficiency. His soul sinks into irretrievable depression; his abortive attempts incessantly prey upon his spirit; and he not only loses that vigour and elasticity of mind which are necessary to carry him through life, but that patience and serenity which alone can qualify him to enjoy it.

In this recapitulation of the learned professions, we have

20 Physic perhaps impracticable to the blind.

have intentionally omitted physic; because the obstacles which a blind man must encounter, whether in the theory or practice of that art, will be more easily conceived by our readers than described in detail. From this, therefore, let us pass to more general subjects.

It has been formerly hinted, that the blind were objects of compassion, because their sphere of action and observation was limited: and this is certainly true. For what is human existence, in its present state, if you deprive it of action and contemplation? Nothing *then* remains but the distinction which we derive from form or from sensitive and locomotive powers. But for these, unless directed to happier ends by superior faculties, few rational beings would, in our opinion, be grateful. The most important view, therefore, which we can entertain in the education of a person deprived of sight, is to redress as effectually as possible the natural disadvantages with which he is encumbered; or, in other words, to enlarge as far as possible the sphere of his knowledge and activity. This can only be done by the improvement of his intellectual, imaginative, or mechanical, powers; and which of these ought to be most assiduously cultivated, the genius of every individual alone can determine.

21 Too much often expected from the blind.

Were men to judge of things by their intrinsic natures, less would be expected from the blind than others. But, by some pernicious and unaccountable prejudice, people generally hope to find them either possessed of preternatural talents, or more attentive to those which they have than others: For it was not Rochester's opinion alone,

> That if one sense should be suppress'd,
> It but retires into the rest.

Hence it unluckily happens, that blind men, who in common life are too often regarded as rareshows, when they do not gratify the extravagant expectations of their spectators, too frequently sink in the general opinion, and appear much less considerable and meritorious than they really are. This general diffidence of their power at once deprives them both of opportunity and spirit to exert themselves; and they descend, at last, to that degree of insignificance in which the public estimate has fixed them.

22 The elements of education for the blind should neither be too difficult nor too easy.

From the original dawning, therefore, of reason and spirit, the parents and tutors of the blind ought to inculcate this maxim, That it is their indispensable duty to excel, and that it is absolutely in their power to attain a high degree of eminence. To impress this notion on their minds, the first objects presented to their observation, and the first methods of improvement applied to their understanding, ought, with no great difficulty, to be comprehensible by those internal powers and external senses which they possess. Not that improvement should be rendered quite easy to them, if such a plan were possible: For all difficulties, which are not really or apparently insuperable, heighten the charms and enhance the value of those acquisitions which they seem to retard.

23 The powers of action possessed by the blind should never be superseded.

But care should be taken that these difficulties be not magnified or exaggerated by imagination; for it has before been mentioned, that the blind have a painful sense of their own incapacity, and consequently a strong propensity to despair continually awake in their minds. For this reason, parents and relations ought never to be too ready in offering their assistance to the blind in any office which they can perform, or in any acquisition which they can procure for themselves, whether they are prompted by amusement or necessity. Let a blind boy be permitted to walk through the neighbourhood without a guide, not only though he should run some hazard, but even though he should suffer some pain.

If he has a mechanical turn, let him not be denied the use of edge-tools; for it is better that he should lose a little blood, or even break a bone, than be perpetually confined to the same place, debilitated in his frame, and depressed in his mind. Such a being can have no employment but to feel his own weakness, and become his own tormentor; or to transfer to others all the malignity and peevishness arising from the natural, adventitious, or imaginary evils which he feels. Scars, fractures, and dislocations in his body, are trivial misfortunes compared with imbecility, timidity, or fretfulness of mind. Besides the sensible and dreadful effects which inactivity must have in relaxing the nerves, and consequently in depressing the spirits, nothing can be more productive of jealousy, envy, peevishness, and every passion that corrodes the soul to agony, than a painful impression of dependence on others, and of our insufficiency for our own happiness. This impression, which, even in his most improved state, will be too deeply felt by every blind man, is redoubled by that utter incapacity of action which must result from the officious humanity of those who would anticipate or supply all his wants, who would prevent all his motions, who would do or procure every thing for him without his own interposition. It is the course of nature, that blind people, as well as others, should survive their parents; or, it may happen, that they should likewise survive those who, by the ties of blood and nature, are more immediately interested in their happiness than the rest of mankind. When, therefore, they fall into the hands of the world in general, such exigencies as they themselves cannot redress will be but coldly and languidly supplied by others. Their expectations will be high and frequent, their disappointments many and sensible; their petitions will often be refused, seldom fully gratified; and, even when granted, the concession will be so ungraceful, as to render its want infinitely more tolerable than its fruition. For all these reasons, we repeat it once more (because it can never be too frequently reiterated), that, in the formation of a blind man, it is infinitely better to direct than to supersede his own exertions. From the time that he can move and feel, let him be taught to supply his own exigencies; to dress and feed himself; to run from place to place, either for exercise, or in pursuit of his own toys or necessaries.

In these excursions, however, it will be highly proper for his parent or tutor to superintend his motions at a distance, without seeming to watch over him. A vigilance too apparent, may impress him with a notion that malignity or some other selfish motion may have produced it. When dangers are obvious and great, such as we incur by rivers, precipices, &c. those who are intrusted with the blind will find it neither necessary nor expedient to make their vigilance a secret. They ought then to acquaint their pupil, that they are present with him; and to interpose for his preservation, whenever his temerity renders it necessary. But objects of a nature less noxious which may give him some pain without any permanent injury or mutilation, may with design be thrown in this way: providing, however, that this design be always industriously concealed. For his own experience of their bad effects will be an infinitely more eloquent and sensible monitor, than the abstract and frigid counsels of any adviser whatever.

24 Exercises suitable to the blind. When the volatile season of puerile amusement is expired, and the impetuous hurry of animal-spirits subsides, through the whole demeanour of his pupil the tutor will probably observe a more sensible degree of timidity and precaution, and his activity will then require to be stimulated more than restrained. In this crisis, exercise will be found requisite, rather to preserve health, and facilitate the vital functions, than

25 Riding on horseback. merely for recreation. Of all the different kinds of exercise, riding, not in a machine, but on horseback, is by far the most eligible, and most productive of its end. On these occasions, however, care must be taken that the horses employed may neither be capricious nor unmanageable; for on the mansuetude of the creature which he rides, not only his safety, but his confidence, will entirely depend. In these expeditions, whether long or short, his companion or attendant ought constantly to be with him; and the horse should always either be taught implicitly to follow its guide, or be conducted by a leading rein besides the bridle which

26 Walking in all weathers that are tolerable. he himself holds. Next to this mode of exercise, is walking. If the constitution of the blind boy be tolerably robust, let him be taught to endure every vicissitude of weather which the human species can bear with impunity. For if he has been bred with too much delicacy, particular accidents may supersede all his former scruples, and subject him to the necessity of suffering what will not only be severe in its immediate sensation, but dangerous in its future consequences. Yet, when the cold is so intense, or the elements so tempestuous, as to render air and exercise abroad impracticable, there are methods of domestic exercise, which, though

27 Dumb-bells. not equally salutary, may still be eligible; such as dumb-bells, or the bath chair. The first of these are made of lead, consisting of a cylinder, the middle of which may either be rectilineal or arcuated for the conveniency of holding, and terminates at each end in a semiglobular mass. Their weight must be conformed to the strength and age of the person who uses them. The method of employing them is to take one in each hand, and swing them backwards and forwards over his head describing a figure somewhat like a parabola. This not only strengthens the arms, and opens the chest, but pro-

28 Bath-chair. motes the circulation of the fluids. The bath chair is a deal of 12 feet in length, as free from knots and as elastic as possible, supported by a fulcrum at each end, upon which may be placed two rolling cylinders to give it greater play; when seated upon this, by alternately depressing it with his own weight, and suffering it to return to its natural situation, he gives himself a motion, though not equal in its energy, yet somewhat resembling the trot of a horse. There are other elastic seats of the same kind constructed with steel springs, but one of this simple fabrication may answer the purpose.

The spring-deal here recommended by the author, was preferred, as being suitable to the blind in all spheres or conditions of life; but he has since been taught by experience, in a valetudinary state, that the elastic chair is of infinitely greater utility. It consists of three false bottoms, and one real, which is the basis of the whole. The lowest is by far the most extensive. The highest is stuffed to render it an easy seat, and covered with plush, baize, or duffle. Between each of the false bottoms, at either end, behind and before, are placed steel springs, fixed above and below to the boards; not with nails, but staples, and curved in a spiral or serpentine form, each consisting of seven spires or volumina. The volumina are formed in such a manner, that one of them can pass through another, and thus give the springs full play in rising or descending. The lowest bottom or basis of the whole is protended about four inches; which assists you to mount the seat with more facility, and serves as a support for your feet when you ride. This operation is performed by alternately depressing or raising yourself upon the seat, so that the springs yielding to your weight as you descend, and resisting as you rise, may give you a motion like that of the deal above described, but more violent, more rapid, and consequently more salutary. The whole frame of the seat is surrounded with leather, having different apertures to admit or reject the air occasioned by the motion. These general hints are sufficient to give any ingenious artisan an idea of the nature and structure of the machine, which he may alter or improve as conveniency shall dictate.

To these modes of domestic exercise may be added that of a swing, which is formed by a rope suspended from two screws, which ought to be strongly fixed, at proper distances, in the joists of a capacious chamber, with a board and a cushion for a seat, and cords fastened behind and before, lest the impetuosity of the motion should shake the patient out of his position. But this instrument of health is so often formed by children for their amusement, and depends so much upon the form and extent of the area where it vibrates, that a more minute detail of its nature and office would here be unnecessary.

His meals should be temperate, his diet light and 29 Diet.
of easy digestion. If the tone of his stomach be vigorous, vegetables should be preferred to animal food, particularly those vegetables which are most farinaceous and least acescent. Fermented liquors and ardent spirits should never be given him but to gratify the real demands of exhausted nature; for though they exhilarate the spirits, they at the same time corrode the vessels and relax the nerves; a misfortune doubly pernicious to sedentary life. The safest and most wholesome beverages are milk and water. If he should be tired with these, he may be indulged with the variety of chocolate, balm, sage, or ground ivy. Coffee may sometimes be taken with impunity; but tea should be interdicted with inflexible severity; for no vegetable juice under heaven is more noxious to sedentary people. Let him also, for similar reasons, be prohibited the use of tobacco in all its forms. In the observations of diet and exercise, let him neither be mechanically regular, nor entirely eccentric. In the one case, he will be a slave to habit, which may create some inconvenience; in the other, he will form no habits at all, which may still be productive of greater.

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Blind.

30 Low spirits.

We have more than once hinted, during the course of this article, that the blind, as liable to all the inconveniences of sedentary life, are peculiarly subjected to that disorder which may be called *tædium vitæ* or low spirits. This indisposition may be said to comprehend in it all the other diseases and evils of human life; because, by its immediate influence on the mind, it aggravates the weight and bitterness of every calamity to which we are obnoxious. In a private letter, we have heard it described as a formidable precipice, in the regions of misery, between the awful gulfs of suicide on the one hand and phrenzy on the other; into either of which, a gentle breeze, according to the force of its impulse and the line of its direction, may irrecoverably plunge the unhappy victim; yet from both of which he may providentially escape. Though the shades of the metaphor may, perhaps, be unnaturally deepened, yet those who have felt the force of the malady will not fail to represent it by the most dreadful images which its own feelings can suggest. Parents and tutors therefore, if they have the least pretence to conscience or humanity, cannot be too careful in observing and obviating the first symptoms of this impending plague. If the limbs of your blind child or pupil be tremulous; if he is apt to start, and easily susceptible of surprise; if he finds it difficult to sleep; if his slumbers, when commenced, are frequently interrupted, and attended with perturbation; if his ordinary exercises appear to him more terrible and more insuperable than usual; if his appetite become languid and his digestion slow; if agreeable occurrences give him less pleasure, and adverse events more pain than they ought to inspire:—this is the crisis of vigorous interposition. The regimen and exercise above prescribed are the best preventives of this evil, and perhaps its best remedies when unhappily incurred. But if the symptoms should escape your attention till the patient is actually seized with the distemper, you may then, according to its depth and permanency, apply the cold bath, vitriolic acid, and Peruvian bark. Magnesia alba will, from time to time, be found useful to lenify the severe and corrosive acid, generated in the stomach; it is preferable to chalk, to crabs eyes, or any of the other absorbents, because of its laxative tendency. The tincture or infusion of wild valerian, pills of asafœtida, and white mustard-seed, are likewise prescribed. Care should be taken that the patient may never be suffered to remain costive, otherwise the function of digestion will be impeded. Gentle cathartics should therefore be administered; but with caution, that their operation may clear the bowels without weakening nature. Emetics may sometimes give the patient a temporary relief, by exerting and bracing the fibres of the stomach; but if used too frequently, they will have a contrary effect: previous to the use of bark, however, they should always be taken to prepare the vessel for its reception. The symptoms above enumerated would seem to indicate the origin of the distemper from extreme weakness or relaxation of nerves: that relaxation may be caused by severe and intemperate thought; by supine indolence; by excessive or habitual drinking; and above all, by venereal gratifications prematurely and frequently indulged, by which the approaches of this evil are accelerated, its continuance insured, and its poignancy augmented. Parents and tutors, therefore, as they value the welfare of their charge, and would answer to God for their conduct, should be scrupulously careful to observe when any of these illegitimate propensities inflame the youthful mind, to check, or rather elude them; not so much by severe reprehension and solemn interdict, as by endeavouring to preoccupy the soul, and engage the attention with other favourite amusements. Against every act of arbitrary power, the mind strongly and naturally revolts. She should therefore be rather allured to wisdom and virtue, by rational motives and gentle methods, than by cruel menaces and stern commands. Those who are afflicted with low spirits may be said to be doubly unfortunate; for they have not only their own internal sufferings to sustain, but the contempt and ridicule of a thoughtless and unfeeling world, by whom their complaints are thought to be imaginary, and their depression affected. Should the sarcastic or sceptical reader apologize for his want of humanity, by asking in what these internal sufferings consist, it will be easy to give him a clear and solid answer: They arise from a severe and acute feeling of nature's incapacity to discharge the vital functions with tolerable ease; from the sharp and constant irritation inflicted on the stomach and lower intestines by every thing not sweet or insipid that passes through them; and from a degree of sensibility too exquisite for the precarious and fluctuating state of our nature: these are the vindictive, inexorable demons that arm every thought with the stings of scorpions, and render the sense of existence itself insupportable. We have heard of hypochondriacs who thought themselves made of glass; and of others who believed their persons grown to a size so enormous, that they could not enter into any door: but it has never been our fortune to be personally acquainted with any of these fantastics. Those with whom we have conversed were rather inclined to exaggerate real, than to create imaginary, evils; rather to anticipate gloomy possibilities, than to dwell upon improbable or chimerical catastrophes: the tender parent, therefore, or the faithful guardian, will beware of treating them with neglect or levity. He will suit his conversation, as much as possible, to the present tone of their feelings; he will avoid all innovations in their management, except such as are absolutely necessary for their cure.

Be careful never to reason or expostulate with your patient on the nature of his malady. Tell him not that his uneasy feelings, far from being real, are the fictitious impositions of a depraved fancy. His disagreeable sensations will be more than sufficient to demonstrate the falsehood of your assertions: thus your argumentative and persuasive powers will not only be exerted in vain, but may considerably retard, if not finally prevent, his recovery; and may leave such indelible prepossessions against you, in his mind, as no length of time, no vicissitudes of life, will ever be able to efface. Opium has also been recommended; but, excepting desperate cases, it will be found a fallacious and dangerous remedy:—fallacious, because the ease it gives is only temporary, and infallibly succeeded by sharper paroxysms:—dangerous, because it may be rendered habitual, and subject the patient to unmixed torment when omitted. Though we have already inculcated a regimen and exercise which appeared proper

per for the blind in general, and not incompatible with peculiar situations, it still seems necessary to add a few results of painful experience upon these subjects, as being particularly conducive to the present ease and future amendment of such as labour under the diseases now in question. And first, let it be observed, that animal food is their proper nutriment, as being of easiest digestion; better too, if well done upon the spit or gridiron: for instead of being allowed to imbibe adventitious fluids, it should be as much as possible drained of its own; neither should it be too fat: beef, mutton, or fowls arrived at maturity, give the stomach least labour; veal, lamb, chickens, and every other kind of young meat, answer the purposes of nature with more difficulty, as the parts are not only too succulent, but prevented by their softness and lubricity from acting forcibly one upon another to facilitate the efforts of the stomach in digestion. Of all vegetable substances, white bread is perhaps the only ingredient which they can eat with the greatest impunity; and even this would still be safer were the paste formed with as little water as possible, and prepared without fermentation. Whether eggs are vegetable or animal substances, let physicians determine; but this we know, that by people in low spirits they may be eaten, even at supper, with great impunity. Every other herb or root is not only extremely flatulent, but productive of that sharp and intense acid for which we have formerly prescribed magnesia as the best remedy. Patients of this description should rather be frequent than liberal in their meals, and scrupulously careful of all heterogeneous mixture. Their most eligible beverage except simple water, if they can afford it, is port-wine, as being least convertible into that poignant fluid: porter likewise, if not stale, may, by its strength and bitterness, assist the action of the stomach. Neither of these fermented liquors should be taken in large quantities at once: let the clamours of nature be satisfied, and no more; for if the spirits are unnaturally elated, they will be certain to sink proportionably when the stimulus ceases to operate. The moderate use of genuine rum or brandy, properly diluted, when the other liquors cannot be had, may be productive of good effects, but should never be used at or near natural periods of repose; because, even when diluted, they occasion a febricity or pyrexia, incompatible with sound and refreshing sleep. Care should likewise be taken that the patient may never be too much warmed, either by clothes or exercise, especially when in bed. Exertions of body, particularly in the open air, are indispensably necessary for promoting digestion and acquiring strength; but should never be carried to fatigue. The mind should likewise be diverted from attention to itself and its disorder, by reading and conversation. But there is an uncommon degree of discernment and delicacy requisite in the topics, that they may neither be too cheerful nor too serious, for the state of the mind, when they are applied. Neither let these injunctions be esteemed trivial: such little attentions, uniformly and tenderly exerted for their satisfaction, will contribute in no small degree to their present tranquillity, and of consequence to their future restoration. We have thought it necessary to expatiate thus far, on a subject gloomy and forbidding in itself, but of sufficient importance to demand particular attention; and, besides, what we have said may not only be useful to the blind in particular, but applicable to all those who labour under the same depression. It only remains to add, that the order, the periods, and the quantities, in which the remedies above enumerated should be applied, must be determined by wisdom and experience, or regulated by the advice of a skilful and vigilant physician. We are sorry that truth obliges us to acknowledge, that we have found the faculty less intelligent in this disease, and less attentive to its various aspects, than could be wished, or than its malignity requires.

31 Natural curiosity to be gratified when possible; when otherwise, a reason to be given.

The natural curiosity of children renders them extremely and indefatigably inquisitive. This disposition is often peculiarly prevalent in the blind. Parents and tutors, therefore, should gratify it whenever their answers can be intelligible to the pupil; when it is otherwise, let them candidly confess the impossibility or impropriety of answering his questions. At this period, if their hearts be tender and their powers inventive, they may render his amusements the vehicles, and his toys the instruments, of improvement: why, for instance, may not the centrifugal and centripetal forces be illustrated from the motion of a top, or the nature and power of elasticity by the rebound of a ball? These hints may lead to others, which, if happily improved and applied, may wonderfully facilitate the progress of knowledge. Nor will the violence of exercise, and the tumult of play, be productive of such perils and accidents as may be apprehended.

For the encouragement of such parents as choose to take these advices with regard to exercise, let us inform them, that though, till the age of twenty, some blind persons were on most occasions permitted to walk, to run, to play at large, they have yet escaped without any corporeal injury from these excursions.

32 The blind not to be indulged in promiscuous company.

Parents of middle, or of higher rank, who are so unfortunate as to have blind children, ought, by all possible means, to keep them out of vulgar company. The herd of mankind have a wanton malignity, which eternally impels them to impose upon the blind, and to enjoy the painful situation in which these impositions place them. This is a stricture upon the humanity of our species, which nothing but the love of truth and the dictates of benevolence could have extorted from us. But we (F) have known some who have suffered so much from this diabolical mirth in their own persons, that it is natural for us, by all the means in our power, to prevent others from becoming its victims.

Blind people have infinitely more to fear from the levity and ignorance, than from the selfishness and ill-nature, of mankind. In serious and important negociations, pride and compassion suspend the efforts of knavery or spleen; and that very infirmity, which so frequently renders the blind defenceless to the arts of the

(F) The author of these observations, though he chooses to express himself in this manner, is blind.

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the insidious, or to the attempts of malice, is a powerful incentive to pity, which is capable of disarming fury itself. Villany, which frequently piques itself more upon the arts by which it prevails, than upon the advantages which it obtains, may often with contempt reject the blind, as subjects beneath the dignity of its operation; but the ill-natured buffoon considers the most malicious effects of his merriment as a mere jest, without reflecting on the shame or indignation which they inspire when inflicted on a sensible temper.

33 They must not be permitted to hear marvellous and frightful tales.

But vulgar credulity and ignorance are no less dangerous to those who want sight, than the false and mechanical wit so universally practised in common life. We know, we sympathetically feel, the strong propensity of every illiterate mind, to relate or to believe whatever is marvellous and dreadful. These impressions, when early imbibed, can scarcely be eradicated by all the conspiring efforts of mature reason and confirmed experience. Those philosophers who have attempted to break the alliance between darkness and spectres, were certainly inspired by laudable motives. But they must give us leave to assert, that there is a natural and essential connection betwixt night and *orcus*. Were we endued with senses to advertise us of every noxious object before its contiguity could render it formidable, our panics would probably be less frequent and sensible than we really feel them. Darkness and silence, therefore, have something dreadful in them, because they supersede the vigilance of those senses which give us the earliest notices of things. If you talk to a blind boy of invisible beings, let benevolence be an inseparable ingredient in their character. You may, if you please, tell him of departed spirits, anxious for the welfare of their surviving friends; of ministering angels, who descend with pleasure from heaven to execute the purposes of their Maker's benignity; you may even regale his imagination with the sportive gambols and innocent frolics of fairies; but let him hear as seldom as possible, even in stories which he knows to be fabulous, of vindictive ghosts, vindictive fiends, or avenging furies. They seize and pre-occupy every avenue of terror which is open in the soul; nor are they easily dispossessed. Sooner should we hope to exorcise a ghost, or appease a fury, than to obliterate their images in a warm and susceptible imagination, where they have been habitually impressed, and where these feelings cannot be dissipated by external phenomena.

34 The association between darkness and spectres founded in nature.

35 The method of dissipating the fears of the blind.

If horrors of this kind should agitate the heart of a blind boy, which may happen notwithstanding the most strenuous endeavours to prevent it, the stories which he has heard will be most effectually discredited by ridicule. This, however, must be cautiously applied, by gentle and delicate gradations. If he is inspired with terror by effects upon his senses, the causes of which he cannot investigate, indefatigable pains must be taken to explain these phenomena, and to confirm that explication, whenever it can be done, by the testimony of his own senses, and his own experience. The exertion of his locomotive and mechanical powers (the rights of which we have formerly endeavoured to assert) will sensibly contribute to dispel these terrors.

36 The invention of the blind may be assisted, but neither anticipated not checked.

His inventive faculties ought likewise to be indulged with the same freedom. The data which they explore may be presented in such a manner, as to render discoveries easy: but still let invention be allowed to cooperate. The internal triumph and exultation which the mind feels from the attainment and conviction of new truths heighten their charms, impress them deep on the memory, and give them an influence in practice of which they could not otherwise have boasted.

There are a sort of people in the world, whose views and education have been strictly confined to one province, and whose conversation is of consequence limited and technical. These, in literary intercourse, or fashionable life, are treated with universal contempt, and branded with the odious name of *mere men of business*. Nor is it any wonder that the conversation of such should prove nauseous and disgusting. It would be arrogance in them to expect, that indifferent persons should either enter into their private interests, or the peculiarities of their craft, with a warmth equal to their own. We have known the intrusion of such a person involve a numerous company in gloom, and terminate the freedom and vivacity of agreeable discourse in lazy yawning and discontented silence. Of all innocent characters, this ought to be avoided by the blind; because of all others, it is the character which they run the greatest hazard of adopting. The limitation of their powers naturally contracts their views and pursuits, and, as it were, concentrates their whole intellectual faculties in one, or at best in few objects. Care should therefore be taken to afford the mind a theatre for its exertions, as extensive as possible, without diverting it from one great end, which, in order to excel, it ought for ever to have in prospect.

37 The manners of the blind.

There are few sciences in which the blind have not distinguished themselves: even those whose acquisition seemed essentially to depend upon vision, have at last yielded to genius and industry, though deprived of that advantage. Mr Saunderson, whom we formerly mentioned, has left behind him the most striking evidences of astonishing proficiency in those retired and abstract branches of mathematics which appeared least accessible to persons of his infirmity. Sculpture (G) and painting are not, perhaps, the most practicable arts for a blind man: yet he is not excluded from the pleasing creation and extensive regions of fancy. However unaccountable it may appear to the abstract philosophers, yet nothing is more certain in fact, than that a blind man may, by the inspiration of the muses, or, to strip the figure of its mythological dress, may, by the efforts of a cultivated genius, exhibit in poetry the most natural images and animated descriptions, even of visible objects,

(G) Yet there are instances of persons who have been enabled to take the figure and idea of a face by the touch, and mould it in wax with the utmost exactness; as was the case of the blind sculptor mentioned by De Piles, who thus took the likeness of the duke de Bracciano in a dark cellar, and made a marble statue of King Charles I. with great elegance and justness. Vid. *De Piles* Cours de Peint. p. 329. and *Wolf.* Psychol. Rat. § 162.

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Blind. jects, without either incurring or deserving the imputation of plagiarism.

In the sister art of music, there are, at present, living and noble instances how far the blind may proceed.

If we look into former periods, we shall find illustrious and pregnant examples, how amply nature has capacitated the blind to excel both in the scientific and practical departments of music. In the 16th century, when the progress of improvement both in melody and harmony was rapid and conspicuous, Franciscus Salinas was eminently distinguished. He was born A. D. 1513, at Burgos in Spain; and was son to the treasurer of that city. Though afflicted with incurable blindness, he was profoundly skilled both in the theory and practice of music. As a performer, he is celebrated by his cotemporaries with the highest encomiums. As a theorist, his book, if we may believe Sir John Hawkins, is equal in value to any now extant in any language. Though he was deprived of sight in his earliest infancy, he does not content himself to delineate the various phenomena in music, but the principles from whence they result, the relations of sound, the nature of arithmetical, geometrical, and harmonical ratios, which at that period were esteemed essential to the theory of music, with a degree of intelligence which would have deserved admiration though he had been in full possession of every sense requisite for these disquisitions. He was taken to Rome in the retinue of Petrus Sarmentus archbishop of Compostella; and having passed twenty years in Italy, he returned to Salamanca, where he obtained the professorship of music, an office at that time equally respectable and lucrative. Having discharged it with reputation and success for some time, he died at the venerable age of 77.

In the same period flourished Caspar Crumbhorn, blind from the third year of his age: yet he composed several pieces in many parts with so much success, and performed both upon the flute and violin so exquisitely, that he was distinguished by Augustus elector of Saxony. But preferring his native Silesia to every other country, he returned thither, and was appointed organist of the church of St Peter and Paul in the city of Lignitz, where he likewise had often the direction of the musical college, and died June 11. 1621.

To these might be added Martini Pesenti of Venice, a composer of vocal and instrumental music almost of all kinds, though blind from his nativity; with other examples equally worthy of public attention. But if vulgar prejudice is capable of blushing at its own contemptible character, or of yielding to conviction, those already quoted are more than sufficient to show the musical jugglers of our time, who are generally as absolute strangers to learning and taste as to virtue, that their art is no monopoly with which those alone who see are invested by the irreversible decree of heaven.

For Saunderson's method of calculation, both in arithmetic and algebra, see the account prefixed to his own treatise on that subject. But there is a much fuller and more circumstantial detail both of its nature and its various uses, given by M. Diderot in his "Letter concerning the Blind, for the use of those who see," which we shall here translate.

"It is much easier (says that author) to use signs already invented, than to become their inventor; as one is forced to do, when engaged in circumstances for which he is not provided. Of what advantage might not this be to Saunderson to find a palpable arithmetic already prepared for him at five years of age, which he might have otherwise felt the necessity of inventing for himself at the advanced period of twenty-five! This Saunderson, Madam, is an author deprived of sight, with whom it may not be foreign to our purpose to amuse you. They relate prodigies of him; and of these prodigies there is not one, which his progress in the belles lettres, and his mathematical attainments, do not render credible. Blind. 35 Saunderson's plan of notation.

"The same instrument served him for algebraical calculations, and for the construction of rectilineal figures. You would not perhaps be sorry that I should give you an explanation of it, if you thought your mind previously qualified to understand it: and you shall soon perceive that it presupposes no intellectual preparations of which you are not already mistress: and that it would be extremely useful to you if you should ever be seized with the inclination of making long calculations by touch.

"Imagine to yourself a square, such as you see fig. 1. divided into four equal parts by perpendicular lines at the sides, in such a manner, that it may present you the nine points 1, 2, 3, 4, 5, 6, 7, 8, 9. Suppose this square pierced with nine holes capable of receiving pins of two kinds, all of equal length and thickness, but some with heads a little larger than the others. Plate XCIII.

"The pins with large heads are never placed anywhere else but in the centre of the square; those with smaller heads never but at the sides, except in one single case, which is that of making the figure 1, where none are placed at the sides. The sign of 0 is made by placing a pin with a large head in the centre of the little square, without putting any other pin at the side*. The number 1 is represented by a pin with a small head placed in the centre of the square, without putting any other pin at the sides; the number 2, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 1: the number 3, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 2: the number 4, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 3: the number 5, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 4: the number 6, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 5: the number 7, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 6: the number 8, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 7: the number 9, by a pin with a large head placed in the centre of the square, and by a pin with a small head placed on one of the sides at the point 8.

* See fig. 1.

"Here

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Blind.

"Here are plainly ten different expressions obvious to the touch, of which every one answers to one of our ten arithmetical characters. Imagine now a table as large as you please, divided into small squares, horizontally ranged, and separated one from the other at similar distances, as you see it in fig. 3. Thus you will have the instrument of Saunderson.

39 This notation applied to numerical operations.

"You may easily conceive that there is not any number which one cannot express upon this table; and, by consequence, no arithmetical operation which one cannot execute upon it.

"Let it be proposed, for instance, to find the sum, or to work the addition of the nine numbers following.

1	2	3	4	5
2	3	4	5	6
3	4	5	6	7
4	5	6	7	8
5	6	7	8	9
6	7	8	9	0
7	8	9	0	1
8	9	0	1	2
9	0	1	2	3

"I express them on the table in the order as they are dictated to me; the first figure at the left of the first number, upon the first square to the left of the first line; the second figure to the left of the first number, upon the second square to the left of the same line; and so of the rest.

"I place the second number upon the second row of squares, units beneath units, and tens beneath tens, &c.

"I place the third number upon the third row of squares, and so of the rest. Then with my fingers running over each of the rows vertically from the bottom to the top, beginning with that which is nearest to my right, I work the addition of the numbers which are expressed, and mark the surplus of the tens at the foot of that column. I then pass to the second column, advancing towards the left; upon which I operate in the same manner; from thence to the third; and thus in succession I finish my addition.

40 The same instrument applied to the construction of rectilineal figures.

"We shall now see how the same table served him for demonstrating the properties of rectilineal figures. Let us suppose this proposition to be demonstrated, That parallelograms which have the same basis and the same height are equal in their surfaces. He placed his pins as may be seen in fig. 4. He gave names to the angular points, and finished his demonstration with his fingers.

"If we suppose that Saunderson only employed pins with large heads to mark the limits of his figures, around these he might arrange his pins with small heads in nine different manners, all of which were familiar to him. Thus he scarcely found any embarrassment but in those cases where the great number of angular points which he was under a necessity of naming in his demonstration obliged him to recur to the letters of the alphabet. We are not informed how he employed them.

"We only know that his fingers ran over the board with astonishing agility; that he undertook with success the longest calculations; that he could interrupt the series, and discover his mistakes; that he proved them with the greatest ease; and that his labours required infinitely less time than one could have imagined, by the exactness and promptitude with which he prepared his instruments and disposed his table.

41 Preparation of the instrument.

"This preparation consisted in placing pins with large heads in the centres of all the squares: having done this, no more remained to him than to fix their values by pins of smaller heads, except in cases where it was necessary to mark a unit; then he placed in the centre of a square a pin with a small head, in the place of a pin with a large head with which it had been occupied.

"Sometimes, instead of forming an entire line with these pins, he contented himself with placing some of them at all the angular points, or points of intersection; around which he tied silk threads, which finished the formation of the limits of his figures." See fig. 4.

It may be added by way of improvement, that for the division of one series of numbers from another, a thin piece of timber in the form of a ruler with which lines are drawn, having a pin at each end for the holes in the squares, might be interposed between the two series to be distinguished.

This geometrician left other instruments behind him; but as we do not know their uses, we need not add their descriptions.

It must be owned, that by the notation here exhibited, every modification of number may be expressed, and of consequence every arithmetical operation successfully performed; but we have been recently favoured with another form of palpable arithmetic, which appears to us equally comprehensive and much more simple than that of Saunderson. It was originally invented, and is still used in calculation, by Dr Henry Moyes; a gentleman whom we had formerly occasion to mention with merited applause in this article, and whose character and attainments we have endeavoured more fully to illustrate than had been done in the former edition, as well from personal knowledge as from the anecdotes of Dr Bew, as the most eligible introduction to the account of his notation, given in the words of his own letter, and exemplified in a figure copied from a drawing directed by himself.

"To the Editor of the Encyclopædia Britannica.

42 Dr Moyes's form of a palpable notation.

"Sir, In compliance with your request, I send you the following brief account of a palpable notation which I have generally used for these 20 years to assist my memory in numerical computations. When I began to study the principles of arithmetic, which I did at an early period of life, I soon discovered, to my mortification, that a person entirely deprived of sight could scarcely proceed in that useful science without the aid of palpable symbols representing the ten numerical characters. Being at that time unacquainted with the writings of Saunderson, in which a palpable notation is described, I embraced the obvious, though, as I afterwards found, imperfect expedient of cutting into the form of the numerical characters thin pieces of wood or metal. By arranging these on the surface of a board, I could readily represent any given number, not only to the touch, but also to the eye; and by covering the board with a lamina of wax, my symbols were prevented from changing their places, they adhering to the board from the slightest pressure. By this contrivance,

Blind.

contrivance, I could solve, though slowly, any problem in the science of numbers; but it soon occurred to me, that my notation, consisting of ten species of symbols or characters, was much more complicated than was absolutely necessary, and that any given number might be distinctly expressed by three species of pegs alone. To illustrate my meaning, let A, B, C, D, (fig. 5.), represent a square piece of mahogany a foot broad and an inch in thickness; let the sides AB, BC, CD, DA, be each divided into 24 equal parts; let every two opposite divisions be joined by a groove cut in the board sufficiently deep to be felt with the finger, and let the board be perforated at each intersection with an instrument a tenth of an inch in diameter.

"The surface of the board being thus divided into 576 little squares, with a small perforation at each of their angles, let three sets of pegs or pins, resembling those represented in the plate at the figures 6, 7, 8, be so fitted to the holes in the board, that when stuck into them they may keep their positions like those of a fiddle, and require some force to turn them round. The head of each peg belonging to the first set is a right-angled triangle about one-tenth of an inch in thickness; the head of each peg belonging to the second set differs only from the former in having a small notch in its sloping side or hypothenuse; and the head of each peg belonging to the third set is a square, of which the breadth should be equal to the base of the triangle of the other two. These pegs should be kept in a case consisting of three boxes or cells, each cell being allotted to a set, and the case must be placed close by the board previous to the commencement of every operation. Each set should consist of 60 or 70 pegs (at least when employed in long calculations); and when the work is finished, they should be collected from the board and carefully restored to their respective boxes.

"Things being thus prepared, let a peg of the first set be fixed into the board, and it will acquire four different values according to its position respecting the calculator. When its sloping side is turned towards the left, it denotes one, or the first digit; when turned upwards, or from the calculator, it denotes two, or the second digit; when turned to the right, it represents three; and when turned downwards, or towards the calculator, it denotes four, or the fourth digit. Five is denoted by a peg of the second set, having its sloping side or hypothenuse turned to the left; six, by the same turned upwards; seven, by the same turned to the right; and eight, by the same turned directly down, or towards the body of the calculalor. Nine is expressed by a peg of the third set when its edges are directed to right and left; and the same peg expresses the cypher when its edges are directed up and down. By three different pegs the relative values of the ten digits may therefore be distinctly expressed with facility; and by a sufficient number of each set, the steps and result of the longest calculation may be clearly represented to the sense of feeling. It seems unnecessary to illustrate this by an example; suffice it to express in our characters the present year of the Christian era 1788: Take a peg of the first set, and fix it in the board with its sloping side turned towards the left, equal to one; take now a peg of the second set and fix it in the next hole in the same groove, proceeding as usual from left to right, with its sloping side turned to the right, equal to 7; next take a peg of the same set, and fix it in the next hole, with its sloping side turned downwards, equal to 8; lastly, take another peg of the same set, and place it in the next hole in the same position, equal to 8; and the whole will express the number required.

"When it is necessary to express a vulgar fraction, I place the numerator in the groove immediately above, and the denominator in that immediately below the groove in which the integers stand; and in decimal arithmetic an empty hole in the integer groove represents the comma or decimal point. By similar breaks I also denote pounds, shillings, pence, &c. and by the same expedient I separate in division the divisor and quotient from the dividend.

"This notation, which supplies me completely with coefficients and indices in algebra and fluxions, seems much superior to any of the kind hitherto made public in the west of Europe. That invented and described by Mr Grenville, having no less than ten sets of pegs, is by much too complicated for general practice; and that which we owe to the celebrated Saunderson is apt to puzzle and embarrass the calculator, as the pegs representing the numerical digits can seldom or never be in the same straight line. If you agree with me that the above notation may promote the knowledge, and therefore the happiness, of persons denied the benefit of sight, you have my consent to give it a place in the present edition of your valuable work. I am, Sir, with respect, your obedient servant, HENRY MOYES."

We have seen the machine above mentioned, which was exhibited to the society for the improvement of polite arts, &c. by Mr Grenville, who is himself also deprived of sight. But though this has met with the approbation of Mr Stanley, we cannot forbear to think it less simple in its structure than that of Dr Moyes's, more multiform in its apparatus, and of consequence more laborious and complex in the process of its operation; for where every single peg has only one power, and acquires no diversity of value from its position, their forms must be indefinitely varied and their numbers prodigiously multiplied; which must cost both the memory and judgment of the pupil numberless painful and fatiguing exertions before he contracts a habit of using the instrument with promptitude and success. On these accounts, a particular description of it is omitted in this place.

43
A new mathematical instrument proposed.

In the higher parts of mathematics, such as conic sections, the same solid figures which are mediums of perception to those who see, may perform the same useful office to the blind. But, for the structure of superficial figures, we should imagine, that a kind of matter might be found soft enough to be easily susceptible of impressions, yet hard enough to retain them till effaced by an equal pressure. Suppose, for instance, a table were formed, four feet broad and eight in length; for the figures, that they may be the more sensible to the touch, ought to be larger than ordinary. Suppose this table had brims, or a moulding round it, rising an inch above the surface: let the whole expanse, then, be filled with bees-wax, and the surface above pressed extremely

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Blind.

extremely even with a polished board, formed exactly to fit the space within the mouldings. This board will always be necessary to efface the figures employed in former propositions, and prepare the surface for new ones. We think we have pondered the minutest inconvenience that can arise from this method of delineating and conceiving geometrical truths; and, after all, the table appears to us the best and the least troublesome apparatus which a blind man can use. We can see no reason why general ideas of geography or topography might not be conveyed to him in the same manner, by spheres composed of or covered with the same impressible matter.

44 Geographical instruments proposed for the blind.

Such were the mediums that occurred to the author, when this article was originally written, for conveying to persons deprived of sight those remote and complicated truths which vision alone was thought capable of representing; but a work has lately been published at Paris which supersedes every former attempt to promote or facilitate the improvement of the blind. The invention of a plan so arduous in its appearance and so practicable in its execution, demanded the highest exertions of the noblest genius to produce it, and the most strenuous efforts of indefatigable humanity to render it effectual. It is entitled, "An Essay on the Education of the Blind." Its object is to teach them, by palpable characters impressed on paper, not only the liberal arts and sciences, but likewise the principles of mechanical operation, in such a manner, that those who have no genius for literary improvement may yet become respectable, useful, and independent members of society, in the capacity of common artisans. By these tangible signatures they are taught to read, to write, and to print; they are likewise instructed in geometry, in algebra, geography, and, in short, in every branch of natural philosophy. Nor are their efforts circumscribed by mere utility; a taste for the fine arts has likewise been cultivated among them. They have been taught to read music with their fingers as others do with their eyes; and though they cannot at once feel the notes and perform them upon an instrument, yet are they capable of acquiring any lesson with as much exactness and rapidity as those who enjoy all the advantages of light. But we shall give a more particular account of the wonderful topics contained in this essay. In his first chapter, the author discovers the end proposed by that delineation of culture which he offers to the blind; it is to enlarge their sphere of knowledge, and of consequence to increase their capacities and improve their powers of action, so that they may become happy and independent in themselves, and useful and agreeable to others. The 2d chapter contains an answer to the objections urged against the general utility of this institution. These objections are candidly stated, and answered in the most satisfactory manner: but were we to recapitulate them in detail, it would protract this article to a length much beyond its due proportion, even upon the extended plan of the Encyclopædia. The 3d chapter treats of reading as adapted to the practice of the blind. The 4th chapter consists of answers to various objections against the method of reading proposed for the blind; but these, for reasons formerly given, we cannot with propriety delineate in this article. In the 5th chapter is shown the art of printing as practised by the blind for their peculiar use. In the 6th chapter is described the manner of teaching the blind the art of printing for those that see. In the 7th is represented the manner of teaching the blind to write. The 8th chapter explains the method of teaching the blind arithmetic; the 9th, geography; the 10th, music. The 11th, contains an account of the mechanic arts in which the blind are employed, and of the way by which they are formed for such occupations. The 12th shows in general the proper manner of instructing the blind, and draws a parallel between their education and that of the deaf and dumb. Chapter 13th treats of the method of instructing them in the languages, mathematics, history, &c. What remains of the book is taken up with notes which illustrate each particular chapter; a short historical account of the rise, the progress, and the present state, of the academy for the formation of the blind; an ode on the cultivation of the blind, by one that laboured under that affliction; an extract from the register of the royal academy of sciences; opinion of the printers; models of the various pieces which blind children are capable of printing; and an account of the exercises performed by blind children in presence of the king, queen, and royal family, during the Christmas solemnities 1786. Thus having given a cursory view of the various topics contained in the essay, we proceed to give some account of the manner in which the blind print and write.

45 Account of a new plan for the improvement of the blind.

46 Printing performed by the blind.

The blind compositor, then, has a box for every alphabetical character in use; on the outside of these boxes are palpably marked the peculiar character belonging to each; they are filled with types, which he chooses and sets as they are called for, but not in the position in which they are to be read; on the contrary, they are inverted as objects are seen painted on the retina of an eye by an optician. Having thus fixed and arranged his types, he chooses a page of the strongest paper that can be found, which he gently moistens in a degree sufficient to render it more easily susceptible of impressions, without being dilacerated or worn by the shock which it must afterwards undergo. He then lays it upon the types; and by the cautious operation of the press, or by the easy strokes of a little hammer, which are frequently repeated over the whole expanse, he causes the impression of the type to rise on the opposite side of the paper, where, when dry, it continues not only obvious to the sight but the touch, and is far from being easily effaced. On the upper side of the paper, the letters appear in their proper position, and their sensible elevation above the common surface renders it practicable for the blind to read them with their fingers.

47 Their manner of writing, &c.

Their manner of writing is analogous to this operation: the pupil, by repeated experiments, having familiarised himself to the forms of the letters, both in their inverted and in their proper position, gradually learns to delineate them upon paper, moistened as before, with the point of an iron pen, which has no split, and which is just sharp enough to impress without piercing the paper: thus, on the side next to the writer's hand, the letters are formed sunk and inverted; but when the paper is turned they appear right and *in relievo*. Thus the blind are enabled to form and decypher, not only the characters required in common language, but also mathematical diagrams, arithmetical and geographical processes,

processes, and all the characters used in the written language of music. If this account should appear incredible to any of our readers, let him be informed, that the author of this article has conversed with two gentlemen of learning and veracity who saw the blind perform all the wonders here recapitulated with astonishing success, to the universal satisfaction of numberless spectators whom curiosity and compassion impelled to visit the academy, that they might behold with their own eyes a spectacle so interesting to humanity. Let the incredulous be also informed, that the composer of the article has in his own hands a copy of this work now reviewed, which is printed and bound by the blind themselves. They exhibit at their own academy every Wednesday and Saturday between one and two o'clock at noon, to crowds of charitable admirers, by whose liberal donations the institution is now chiefly supported.

48 The blind susceptible of astronomy.

The knowledge of astronomy might likewise be of infinite use, both by enlarging the blind person's ideas of the universe, and by giving him higher and more confirmed impressions of that energy by which the stars are moved, and of that design by which their motions are regulated. But these objects are too vast; their distances, their magnitudes, their periods of revolution, are too complex to be apprehended in the mind, or impressed in the memory, without sensible mediums. For this purpose, an orrery, or some machine of a similar construction, will be indispensably requisite.

49 Of natural philosophy.

The science of causes and effects might likewise yield him the most sublime and rational entertainment of which an intelligent being, in his present state, is susceptible. By this he might enter into the laws, the vicissitudes, the economy of nature. Nor is it absolutely necessary that he should be an ocular witness of the experiments by which these laws are detected and explained. He may safely take them for granted; and if, at any time, a particular experiment should prove faithless, he may, from general principles, be able to discover its fallacy, whether in the nature of the subject, the inaptitude of the instruments, or the process of the execution. The laws of motion, the various ratios or proportions of forces, whether simple or compound, he may calculate and ascertain by the same means and in the same method so happily used by Saunderson.

50 Of moral philosophy and theology.

Moral and theological knowledge he may easily obtain, either from books, or instructions delivered *viva voce*. The last, if communicated by one who understands and feels the subject, with a proper degree of perspicuity and sensibility, are infinitely the most eligible. By morals, we would not merely be understood to mean a regular and incalculable series of action, but the proper exertion and habitual arrangement of the whole internal economy, of which external actions are no more than mere expressions, and from which the highest and most permanent happiness alone can proceed. By theology, we do not mean that systematic or scholastic jargon, which too frequently usurps its venerable name; but those sublime and liberal ideas of the nature and government of a Supreme being, whether discoverable by nature or revealed in Scripture, which enforce every moral obligation, which teach us what is the ultimate good of our nature, which determine our efforts and animate our hopes in pursuing this most important of all objects. What Cicero says of the arts and sciences may with great propriety be applied to religion: *Nam cætera neque temporum sunt, neque ætatum omnium, neque locorum; at hæc studia adolescentiam alunt, senectutem oblectant, secundas res ornant, adversis perfugium ac solatium præbent; delectant domi, non impediunt foris; pernoctant nobiscum, peregrinantur, rusticantur.* Translated thus: 'For other 'studies are not suited to every time, to every age, and 'to every place: but these give strength in youth, and 'joy in old age; adorn prosperity, and are the support 'and consolation of adversity; at home they are delightful, and abroad they are easy; at night they are 'company to us; when we travel, they attend us; 'and in our rural retirements, they do not forsake 'us.'

To this may be added, that the joys of religion are for ever adequate to the largest capacity of a finite and progressive intelligence; and as they are boundless in extent, so they are endless in duration. We have already, more than once, observed, that the soul of a blind man is extremely obnoxious to melancholy and dejection. Where, therefore, can he find a more copious, intimate, permanent, and efficacious source of comfort than in religion? Let this then be inculcated with the utmost care and assiduity. Let the whole force of the soul be exerted in showing him that it is reasonable. Let all the noblest affections of the heart be employed in recommending it as amiable: for we will venture to assert, that the votary of religion alone is the man,—

Quem, si fractus illabatur orbis,
Impavidum ferient ruinæ:

Thus translated;

Whom, though with nature's wreck oppress'd,
Unmanly fears could ne'er infest.

When the situation of the blind, and its natural effects upon their characters, are considered; when we reflect how exquisite their distresses, how pungent their disappointments, how sensible their regrets, how tedious and gloomy their periods of solitude; we must be wretches indeed, if we can grudge either labour or expence in procuring them every source of entertainment, which, when procured, remains in their own power, and yields what may be in some measure termed *self-derived enjoyment*. These amusements are prolific of numberless advantages: they afford us at once entertainment and exertion; they teach us to explore a thousand resources for preservation and improvement, which would otherwise have escaped our attention; they render us awake and sensible to a thousand notices both of external and intellectual objects, which would otherwise have passed unobserved.

Thus far have we proceeded without mentioning philological learning; though we know it to be attainable by the blind in a high degree, and though we are conscious of its importance both to their use and ornament. But as it is not indispensable, and as its acquisition is tedious and operose, we thought it less necessary to be early and minutely specified. We cannot doubt that learning different languages adds to the treasure of our ideas, and renders those which we

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we possess more clear and definite. It must be acknowledged, that the possession of other languages elucidates our own. The technical terms of almost every science are exotic; and without clearly understanding those, we cannot properly possess the ideas of which they are the vehicles. But these motives are common to every candidate for philological improvement with the blind.

51 Of grammar.

The paths of grammar, however, are dry and rugged; and it will be necessary for the pedagogue, whoever he is, to take all the opportunities that offer of enlightening the darkness and polishing the asperities of the road. When, therefore, the intellect of the pupil begins to open and exert its penetration, it will be proper to show him how the nature, the forms, and arrangements, of words, flow from our ideas and their relations. Every substance must naturally be in some state; it must either act, or be acted upon. The actions which it performs or suffers must be performed or suffered in some definite manner or degree. It must likewise have some qualities, whether temporary and accidental, or natural and permanent. These qualities must likewise be susceptible of degrees. When different substances are considered in the same state, its common participation forms a connexion: when regarded in different states, that difference forms an opposition. The constant repetition of the names of substances and qualities produces a disagreeable monotony in language. They must therefore be implied in other words, which likewise in some cases serve to connect the parts of a sentence. There is a difference between such words as imply the connexion of sentences, and such as imply the connection of states or circumstances. Actions to be performed or suffered may be either positively affirmed of any substance, or merely attributed to them. Living and percipient substances have immediate sensations of pain or pleasure, which likewise are productive of desire and aversion. To these sentiments particular sounds are adapted, whether immediately inspired by nature, or resulting from association and tacit convention.

Thus we have a foundation for all the different parts of speech; and from their natures and offices their forms and arrangements may be deduced, according to the analogy of every language.

52 The blind susceptible of logic, history, and the *belles lettres*.

The art of reasoning, the knowledge of history, and a taste for the *belles lettres*, are easily attainable by the blind; and as they are copious funds of entertainment, they should be inculcated, though at the expence of care and labour.

53 A companion should be united to the blind by more than the ties of interest and conveniency.

The relations of persons subjected to this misfortune, if in easy circumstances, will find it highly conducive to the improvement of their charge, to select some one among his coevals, of a sound understanding, a sweet and patient temper, a docile mind, a warm heart, and a communicative disposition. These two should be taught to find their interest and happiness in their connexion with one another. Their bed, their board, their walks, their entertainments, their lessons, should be common. These are the best eyes with which art can endow a blind man: and if properly selected, they will on some occasions yield very little, in utility and perfection, to those of nature; nay, at some junctures they may be preferable.

54 Music one of the most proper employments for the blind. Mediocrity, however, pernicious.

If the blind must depend upon the exercise of their own powers for bread, we have already pointed out music as their easiest and most obvious province; but let it at the same time be remembered, that mediocrity in this art may prove the bitterest and most effectual curse which a parent can inflict upon his offspring, as it subjects them to every vicious impression or habit which may be imbibed or contracted from the lowest and most abandoned of mankind. If, your pupil therefore, be not endowed with natural talents exquisitely proper both for the theory and practice of this art, suffer him by no means to be initiated in it. If his natural genius favours your attempts, the spinet, harp, or organ, are the most proper instruments for him to begin: because by these instruments he may be made more easily acquainted with the extent of musical scales, with the powers of harmony, with the relations of which it is constituted, and of course with the theory of his art. It would be not only unnecessary, but impracticable, to carry him deep into the theory, before he has attained some facility in the practice. Let, therefore, his head and his hands (if we may use the expression) be taught to go *pari passu*. Let the one be instructed in the simplest elements, and the others conducted in the easiest operations, first: contemplation and exercise will produce light in the one and promptitude in the other. But as his capacity of speculation and powers of action become more and more mature, discoveries more abstract and retired, tasks more arduous and difficult, may be assigned him. He should be taught the names and gradations of the diatonic scale, the nature and use of time, the diversity of its modes whether simple or mixed. He should be taught the quantity or value of notes, not only with respect to their pitch, but to their duration. Yet, let him be instructed not to consider these durations as absolutely fixed, but variable according to the velocity of the movements in which they are placed. Thus we reckon a semibreve equal to 4 vibrations of a pendulum; a minim to 2; a crotchet to 1, &c. But if the number of aliquot parts, into which a semibreve is divided, be great, and consequently the value of each particular part small, the minim, crotchet, quaver, &c. will increase in their intrinsic durations, though they must always preserve the same proportions relatively one to another. He should never be habituated to take a piece of music, either from the sound of a voice or an instrument. His companion ought to read the music by the names and values of its characters, with the same exactness as the words in any other language. When he becomes a considerable adept in the art, tangible signs may be invented, by which he may not only be enabled to read, but even to set music for himself. Such exercises will render him infinitely more accurate, both in his principles and practice, than he would otherwise be.

There is a hint of such tangible signs given in Tansure's Musical Grammar, p. 93. and which, though (like the rest of the book) obscure and indigested, may be improved and applied with advantage.

For the sake of those in whose hands it may not be, we quote the passage at length.

55 Scheme of musical notation.

"As it is the pleasure of the Almighty, that some persons are destitute of *eye-sight*; in like manner it is

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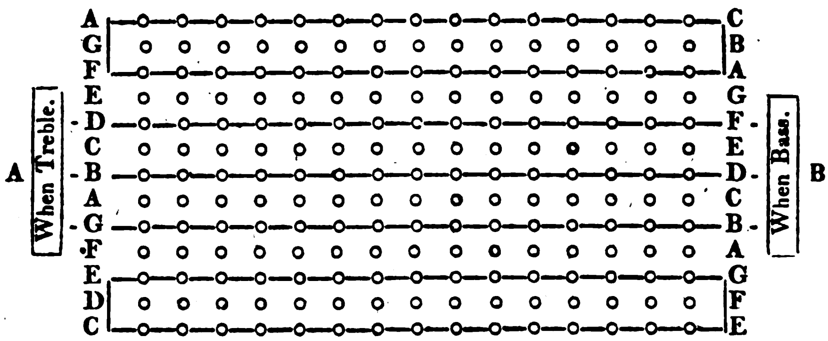
his infinite goodness to make them a double amends another way by giving them a greater share of memory, &c. whereby they become very dexterous in playing on musical instruments, mathematics, &c. as we may observe by Dr Stanley organist of St Andrew's Holborn in London, the blind professor of mathematics in the university of Cambridge, and many others too tedious here to mention, who were born *blind*, and never saw the least glance of light; yet God gave them such a light in *knowledge*, that they became the wonder of all such as had the benefit of seeing, &c.

"And as *blind persons*, at first, cannot possibly have so clear an idea of *notes* and *musical characters* as they that see them, until they are taught by a master or tutor: I have (for the good-will I bear to such unfortunate persons) contrived the following table; that, by *feeling*, they may understand notes, and learn any tune that shall be set them, in their master's absence.

A New Music-Table *for such as are* Blind.



Explanation.

"Let A—B be a smooth board, 3 or 4 feet long, 1 inch thick, and 9 inches wide, with 5 square ledges glued thereon, each being half an inch asunder, half an inch wide, and half an inch high; which rising ledges represent our 5 lines of music, and their spaces: and the 2 outward lines, being made a little lower, may serve as leger lines on occasion. The cyphers represent so many holes bored into every line and space, half an inch asunder; wherein *pegs* of different shapes are to be set, to represent the several sorts of notes and characters of the tune; which pegs the blind person may know by feeling, as well as he does his keys of the organ or harpsichord: so that, by keeping his fingers on the 5 lines, he feels the several pegs as they come on, and are set to represent the several sorts of notes, on both line and space; whilst his right hand strikes the respective key, &c. he first knowing the names of all his keys, his lines, spaces, and the mark of every peg. Let each peg be about half an inch high, when set in very fast. [N. B. The blind person must first be taught the names of the above lines and spaces in both the treble and bass cliffs; and that he must feel his treble with his right hand, and his bass with the left hand; each being contrary, as you may see by the letters of the above table, A and B; and must learn each part separate.]

"Of pegs, he must have a great number of every sort, to set his tune with, which he may mark as follows:

For a *Semibreve*, 4 top-notches.
Minim, 2 top-notches.
Crotchet, 1 top-notch.
Quaver, 1 corner cut off.
For a *Semiquaver*, 2 corners cut off.
Demisemiquaver, all 4 corners cut off.
Rests, a notch in the corner.
A *Flat*, 1 notch on the side.
Sharp, 2 notches on the side.
Point, 3 notches on the side.
Bar, a flat thin top.
Repeat, a sharp-pointed top, &c. &c. &c.

"But it is best for every performer to make and mark his own pegs; and deliver them one by one as they are called for by the person that sets his *tune*."

Thus far our author. We have already complained that Tansure's Musical Notation is imperfect; and perhaps every table or instrument of the same kind may be liable to the same censure, as not being comprehensive of all the characters in the written language of music, so that the blind reader may find no deficiency in acquiring any lesson: yet as the cushion of Mr Cheese appears to have more powers than any other instrument for the same purpose that has hitherto occurred to our observation, though attended with many formidable objections, we here insert it. It may possibly, however, be best for every blind adept in the musical art, after being sufficiently instructed in its theoretical and practical principles, to invent for himself a table, by which may be expressed all the various phenomena of music, in which, by varying the forms and positions of his pegs, he may habitually associate them with sounds, durations, rests, intervals, chords, cadences, da-capos, repeats, and all the various graces which give animation and expression to musical sounds: for thus, being the immediate creatures of his own imagination, they will more easily become familiar to his memory, and be more strongly and readily associated with the phenomena

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Blind.

phenomena which they are intended to signify, than if he had assumed the inventions of any other.

56
Cheese's machine, Pl. XCIII. fig. 9.

Mr Cheese's description of his machine for teaching music to people deprived of sight, and to enable them to preserve their compositions, in the act of composing, without the assistance of a copyist.—" That part of the machine which represents the book, or paper, is a small cushion stuffed, on a little frame; along which, is sewed a number of packthread strings at equal distances from each other; these represent the lines in a music book: the five which compose the stave, are made of large twine; and those which represent the leger or occasional lines, drawn through the heads of the notes, where the music exceeds the compass of the established stave, are made of small twine, and are on this machine of the same length as the others.

" If the practitioner only wishes to write harpsichord music, the cushion may be what length he pleases, and about five or six inches wide; the strings must be sewed in the following order; beginning with the first or lowest, near the edge of the cushion; four small ones, which correspond with the notes in the base of the instrument ff, rr, cc, ee: Next five large ones, for the stave which correspond with the lines in the book, or notes in the instrument g, b, d, f, r; one small one which represents the occasional line between the base and treble, or middle c; five large ones for the treble stave, which makes the notes e, g, b, d, f; three small ones, which represent the leger lines when the music goes in alt. These provide for the note a in alt, c in alt, and e in alt; in the space above which, next the edge of the cushion, the f in alt is wrote, when it is wanting, which completes the compass of the instrument.

" Those who only sing or play on single instruments, such as violins, &c. should have their cushions not above half the width of those above-mentioned, upon which there should be but one stave, and that in the following order:—Two small lines at bottom, five large ones in the middle, and three small ones at top. Neither of the outside lines of these small cushions should be sewed close to the edge, as there are notes supposed above and below. At either end of these small cushions, there should be a small wire staple, in order that any number of them may be combined together at pleasure, by running a rod through the staples: this will enable the practitioner to write what musicians call SCORE, in any number of parts he pleases; and by this means a thorough knowledge of the great works of Handel, and all other classical authors, may be acquired as well without sight as with it.

" The characters used to write on this machine are pins; some with two, three, or more heads; others bent in different forms—some, the heads taken off and the top beat flat; some of these are split; others the head taken off, and placed near the middle. The bars are pieces of wire crooked at each end; a double bar is made by placing two single ones close together; a double sharp and double flat in the same manner.

" The characters are kept in a box in the same style as the printer keeps his types; each different compartment of which must be marked with a character in writing signifying what each, contained in the several compartments, is intended to represent. That the master may be acquainted with them, the student must be taught to distinguish each of the characters contained in the box by the feel, as well as the names of each line and space upon the cushion. When he can do this readily, some music should be read to him, which it will be well for him to copy on the cushion: and when that is filled, let it be laid on the desk of the harpsichord before him; and then by feeling over a passage or sentence at a time, and afterwards playing it, his playings always commencing with the beginning of the piece, or at some particular part of it, this will soon enable him to recollect the whole, when the hands are taken off the cushion, to play what has been last felt. One of these characters, called a direct, must be placed against the note to be next felt: This will enable the student to go on again, after playing, without any difficulty. The person who reads the music, must be instructed not to call the lines or spaces by the letters which distinguish them, lest confusion may ensue, every eighth being the same; but must read in the following manner: first the name of the character must be mentioned, whether minim, crotchet, or quaver, &c. then the line or space; as for example, minim on the first line, crotchet on the first space, quaver on the second, &c. &c. When the music exceeds the compass of the stave, it must be particularly mentioned whether above or below, first calling the character, then the leger line or space.

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" The technical term at the beginning of each piece, is better remembered than wrote down on the machine: The accidental terms, which are best marked by placing some character, not much used, either above or below the note on which it happens, the ingenious mind will find out a method of doing for itself.

" This machine will not only teach music; but calling the characters letters, any one will be enabled to spell, read, or write down his sentiments on any subject, and even convey them to his friend without the assistance of a secretary. Arithmetic may be also taught upon this machine; as by calling the dot 1, and the pause 10, a complete set of figures will be formed.

" *Explanation of the figures.* A, B, C, D, the form of the cushion, which in its full size is about three feet long, and five inches and three quarters wide, having thereon a representation of musical notes, shown by different pins stuck on it. The lines a, b, c, d, e, are of large packthread; and the lines f, g, h, are of small twine.

" Pins, N° 1. A semibreve. 2. A semibreve rest. 3. A minim. 4. A minim rest. 5. Dots. 6. A crotchet. 7. A crotchet rest. 8. A quaver. 9. A quaver rest. 10. A sharp. 11. A semiquaver. 12. A semiquaver rest. 13. A demiquaver. 14. A demiquaver rest. 15. A flat. 16. A demisemiquaver. 17. A demisemiquaver rest. 18. A semidemiquaver. 19. A semidemiquaver rest. 20. A natural. 21. Bars. 22. A direct. 23. A tye. 24. Bass. 25. Tenor cliff. 26. Treble cliff. 27. A repeat. 28. Pause. 29. This character placed on any line or space signifies as many notes on that line or space as there are doubles on the pins; if turned upwards, it implies the same number ascending; if downward, that number descending. 30. A beat or inverted shake. 31. A shake; and when there is a dot placed over it, signifies a turned shake. Two dots placed over each other, above the notes, without this character, signify a turn only. 32. This character is used over the note to signify *forte*; and if a dot is placed

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placed above it, *fortissimo*; if the dot is placed above the note and below the character, it implies *crescendo*; if the character is placed below the note, it implies *piano*; and if a dot is placed under it, *pianissimo*; but if the dot is above the character, and below the note, it signifies *diminuendo*. In concertos, the inventor uses the same character placed above the note in the same manner, with two dots over it, to signify *toote*; and below the notes, with two dots under it, to signify *solo*: in vocal music, the same character above the notes, with three dots over it, signifies *symphony*; and below the notes, with three dots under it, signifies *song*."

It is certain, that when playing concertos, or, if you please, when performing in *score*, the blind must depend upon memory, and upon memory alone: but happily their retentive powers are remarkably strong; and there are few pieces in music which will be found either too intricate to be acquired, or too long to be remembered, by a person deprived of sight. Mr Stanley, the gentleman formerly mentioned by Tansure, performs what is still more astonishing. If our information, which we cannot doubt, be true, he accompanies any lesson with a thorough bass, though he never has heard it before. We have never yet heard of any person, though blessed with the full use of sight, and with all the advantages accruing from it, who could thus anticipate harmony before the chords were sounded, and accompany it in a manner suitable to its nature.

When he becomes a more profound theorist, if he has adopted the notion that music and geometry are congenial and inseparable (which, however, in our judgement is frivolous), he may peruse Malcolm's Essay on Music, and Treydell's Theory and Practice of Music. But if he chooses to hear the same principles delivered without that unnecessary parade and ostentation of profundity, let him be instructed by D'Alembert (see the article Music in this Dictionary); by Rameau, in his Principles of Composition; and by Rousseau's Musical Dictionary (the substance of which is engrossed in the present Work, either under the respective detached articles, or in the notes added to the article Music). It is true, that the forms and proportions of instruments, the thickness, length, and tension of musical strings, may be mathematically adjusted; their relations one to another may be determined by the coincidence of their vibrations, or by the number and velocity of these vibrations when dissonant; but experience and a good ear, are amply sufficient for these purposes. Yet, if the necessity of geometry in music should still remain an indelible article in his creed, he may peruse Dr Smith's Philosophical Principles of Harmony. There has also lately been published an explication of Tartini's theory, entitled, *The Principles and Power of Harmony*; which, after he has made considerable progress, may be read to him with sensible improvement.

57 Apostrophe to the public.

Thus we have endeavoured to form an estimate of the inconveniencies suffered, and the advantages possessed, by the blind; we have attempted to show, of what kind of culture their remaining faculties are susceptible, and what appeared to us the easiest and properest means of their improvement. We have illustrated not only its possibility, but its certainty, by incontestable facts, which demonstrate, even in the eyes of scepticism and incredulity, to what degrees of eminence, both in the mechanical and liberal arts, the blind may be carried. It now remains to demand a categorical answer from society, Whether it is more humane and eligible, that such unhappy persons should be suffered to languish out their lives in torpid and miserable obscurity, wretched in themselves, and burdensome to others; or to cultivate and improve their powers in such a manner, as that they may be qualified for internal enjoyment and public utility? Surely there is not a human being, who does not disgrace the works of God, that can be at any loss in answering this question. Have we not then a right to call the world to an account? have we not a right to demand, why rational beings, susceptible of felicity in themselves, and capable of transfusing happiness through the societies with whom they are connected, should be abandoned to a state of insignificance and misery? Is it possible that men who are every moment subjected to the same contingencies with which they behold their fellow-creatures afflicted, should not with all their souls endeavour to alleviate the misfortunes of their suffering brethren? Is the native and hereditary portion of human woe so light and supportable in itself, that we should neglect and despise those to whom it is embittered by accidental circumstances of horror and distress? You who are parents, who feel the strong and powerful pleadings of nature, do not, by a brutal negligence and insensibility, render the existence which you have given a curse to its possessors. Do not give them reason to upbraid your memory; and to answer those who ask what patrimony you have left them, that their sole inheritance was ignorance, incapacity, and indigence. You men of wealth and eminence, you whom Providence has rendered conspicuous on the theatre of nature, to whom it has given the noblest opportunities of participating the divine beatitude by the exercise of universal benevolence and genuine patriotism; yours is the glorious province of bringing neglected merit from obscurity, of healing the wounds inflicted by adverse fortune, and of cultivating those talents which may be exerted for your own advantage and the honour of your species. Thus you shall rise in the heraldry of heaven, and your names diffuse a lustre through the extent of space and the archives of eternity. Otherwise the temporary glare and parade of your situation can produce nothing else but a despicable mimicry of real and intrinsic greatness, and are no more than a splendid mask to cover what in itself is infamous or detestable.

By way of appendix to the preceding article, we shall add one or two very singular histories, with which it is hoped our readers will not be displeased.

An account of some remarkable particulars that happened to a lady after having had the confluent kind of smallpox.] "In the course of this disease, during which the lady was attended by the late Sir Hans Sloane, several threatening symptoms appeared, which however were at length overcome; and the patient being thought out of danger, took several doses of such purgative medicines as are usually administered in the decline of the disease, without any bad consequence.

"But in the evening of the day on which she had taken the last dose that was intended to be given her on

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 1.

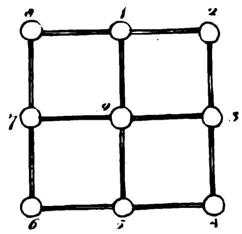


Fig. 2.

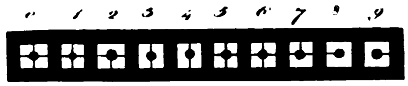


Fig. 5.

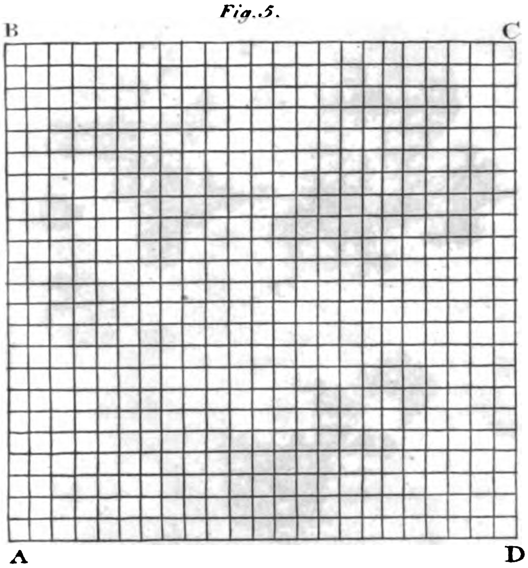


Fig. 3.

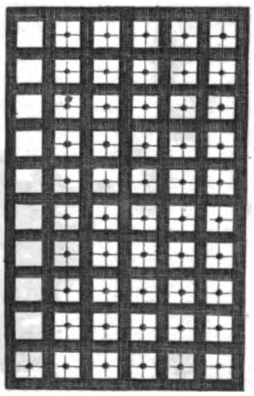


Fig. 4.

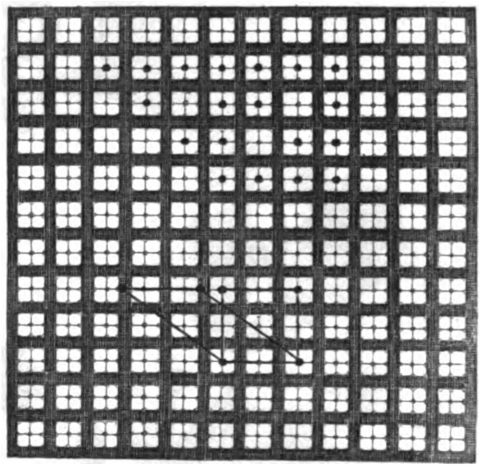
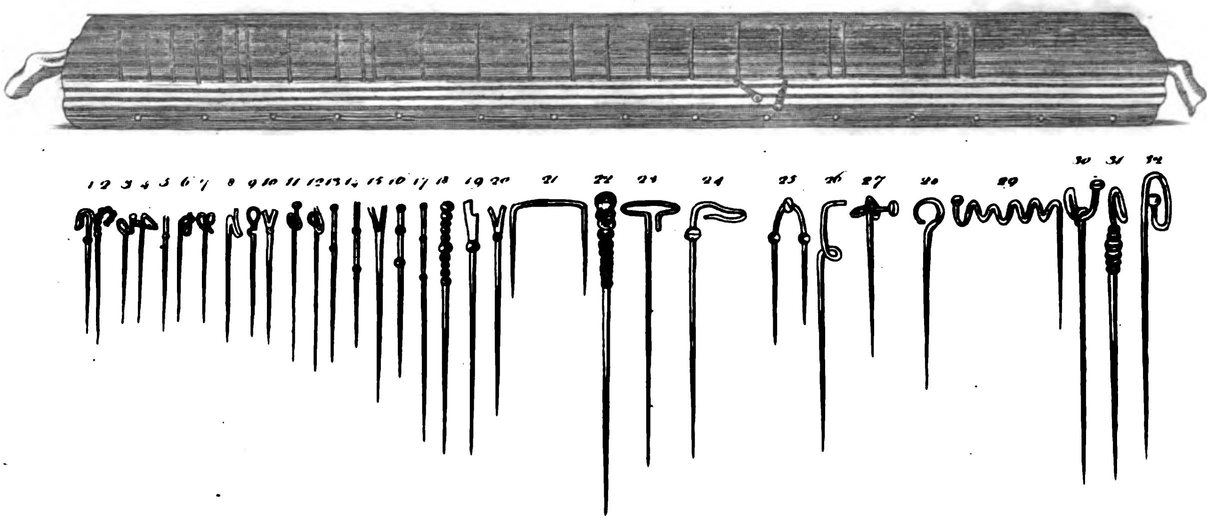


Fig. 9.



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on that occasion, she was suddenly seized with pains and convulsions in the bowels; the pain and other symptoms became gradually less violent as the force of the medicine abated, and by such remedies as were thought best adapted to the case, they seemed at length to be entirely subdued.

"They were, however, subdued only in appearance; for at eleven o'clock of the forenoon of the next day they returned with great violence, and continued some hours; when they went off, they left the muscles of the lower jaw so much relaxed, that it fell down, and the chin was supported on the breast. The strength of the patient was so much exhausted during this paroxysm, that she lay near two hours with no other signs of life than a very feeble respiration, which was often so difficult to be discerned that those about her concluded she was dead.

"From this time the fits returned periodically every day, at about the same hour. At first they seemed to affect her nearly in the same degree; but at length all the symptoms were aggravated, the convulsions became more general, and her arms were sometimes convulsed alternately; it also frequently happened, that the arm which was last convulsed remained extended and inflexible some hours after the struggles were over. Her neck was often twisted with such violence, that the face looked directly backwards, and the back part of the head was over the breast; the muscles of the countenance were also so contracted and writhed by the spasms, that the features were totally changed, and it was impossible to find any resemblance of her natural aspect by which she could be known. Her feet were not less distorted than her head; for they were twisted almost to dislocation at the instep, so that she could not walk but upon her ancles.

"To remove or mitigate these deplorable symptoms, many remedies were tried; and, among others, the cold bath: but either by the natural effect of the bath, or by some mismanagement in the bathing, the unhappy patient first became blind, and soon afterwards deaf and dumb. It is not easy to conceive what could increase the misery of deafness, dumbness, blindness, and frequent paroxysms of excruciating pain; yet a very considerable aggravation was added; for the loss of her sight, her hearing, and her speech, was followed by such a stricture of the muscles of her throat, that she could not swallow any kind of aliment either solid or liquid. It might reasonably be supposed that this circumstance, though it added to the degree of her misery, would have shortened its duration; yet in this condition she continued near three quarters of a year; and during that time was supported in a very uncommon manner, by chewing her food only; which having turned often, and kept long in her mouth, she was obliged at last to spit out. Liquors were likewise gargled about in her mouth for some time; and then returned in the same manner, no part of them having passed the throat by an act of deglutition: so that whatever was conveyed into the stomach, either of the juices of the solid food, or of liquids, was either gradually imbibed by the sponginess of the parts which they moistened, or trickled down in a very small quantity along the sides of the vessels.

"But there were other peculiarities in the case of this lady, yet more extraordinary. During the privation of her *sight* and *hearing*, her *touch* and her *smell* became so exquisite, that she could distinguish the different colours of silk and flowers, and was sensible when any stranger was in the room with her.

"After she became blind, and deaf, and dumb, it was not easy to contrive any method by which a question could be asked her, and an answer received. This, however, was at last effected, by talking with the fingers, at which she was uncommonly ready. But those who conversed with her in this manner, were obliged to express themselves by touching her hand and fingers instead of their own.

"A lady who was nearly related to her, having an apron on, that was embroidered with silk of different colours, asked her, in the manner which has been described, if she could tell what colour it was? and after applying her fingers attentively to the figures of the embroidery, she replied, that it was red, and blue, and green; which was true. The same lady having a pink coloured ribbon on her head, and being willing still further to satisfy her curiosity and her doubts, asked what colour that was! her cousin, after feeling some time, answered, that it was pink colour: this answer was yet more astonishing, because it showed not only a power of distinguishing different colours, but different kinds of the same colour: the ribbon was not only discovered to be red, but the red was discovered to be of the pale kind called a *pink*.

"This unhappy lady, conscious of her own uncommon infirmities, was extremely unwilling to be seen by strangers, and therefore generally retired to her chamber, where none but those of the family were likely to come. The same relation, who had by the experiment of the apron and ribbon discovered the exquisite sensibility of her *touch*, was soon after convinced by an accident, that her power of *smelling* was acute and refined in the same astonishing degree.

"Being one day visiting the family, she went up to her cousin's chamber, and after making herself known, she intreated her to go down, and sit with her among the rest of the family, assuring her that there was no other person present: to this she at length consented, and went down to the parlour door; but the moment the door was opened, she turned back, and retired to her own chamber much displeased; alleging, that there were strangers in the room, and that an attempt had been made to deceive her: it happened indeed that there were strangers in the room; but they had come in while the lady was above stairs, so that she did not know they were there. When she had satisfied her cousin of this particular, she was pacified; and being afterwards asked how she knew there were strangers in the room, she answered, by the smell.

"But though she could by this sense distinguish in general between persons with whom she was well acquainted and strangers, yet she could not so easily distinguish one of her acquaintance from another without other assistance. She generally distinguished her friends by feeling their hands; and when they came in, they used to present their hands to her, as a mean of making themselves known; the make and warmth of the hand produced, in general, the differences that she distinguished; but she sometimes used to span the wrist, and measure the fingers. A lady, with whom she was very well acquainted, coming in one very hot day, after

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having walked a mile, presented her hand as usual; she felt it longer than ordinary, and seemed to doubt whose it was; but after spanning the wrist, and measuring the fingers, she said, 'It is Mrs M. but she is warmer today than ever I felt her before.'

"To amuse herself in the mournful and perpetual solitude and darkness to which her disorder had reduced her, she used to work much at her needle; and it is remarkable, that her needle-work was uncommonly neat and exact: among many other pieces of her work that are preserved in the family, is a pin-cushion, which can scarcely be equalled. She used also sometimes to write: and her writing was yet more extraordinary than her needle-work: it was executed with the same regularity and exactness; the character was very pretty, the lines were all even, and the letters placed at equal distances from each other: but the most astonishing particular of all, with respect to her writing, is, that she could by some means discover when a letter had by some mistake been omitted, and would place it over that part of the word where it should have been inserted with a caret under it. It was her custom to sit up in bed at any hour of the night, either to write or to work, when her pain or any other cause kept her awake.

"These circumstances were so very extraordinary, that it was long doubted whether she had not some faint remains both of hearing and sight, and many experiments were made to ascertain the matter; some of these experiments she accidentally discovered, and the discovery always threw her into violent convulsions. The thought of being suspected of insincerity, or supposed capable of acting so wicked a part as to feign infirmities that were not inflicted, was an addition to her misery which she could not bear, and which never failed to produce an agony of mind not less visible than that of her body. A clergyman who found her one evening at work by a table with a candle upon it, put his hat between her eyes and the candle, in such a manner that it was impossible she could receive any benefit from the light of it if she had not been blind. She continued still at her work, with great tranquillity; till, putting up her hand suddenly to rub her forehead, she struck it against the hat, and discovered what was doing; upon which she was thrown into violent convulsions, and was not without great difficulty recovered. The family were by these experiments, and several accidental circumstances, fully convinced that she was totally deaf and blind; particularly by sitting unconcerned at her work, during a dreadful storm of thunder and lightning, though she was then facing the window, and always used to be much terrified in such circumstances. But Sir Hans Sloane, her physician, being still doubtful of the truth of facts which were scarce less than miraculous, he was permitted to satisfy himself by such experiments and observations as he thought proper; the issue of which was, that he pronounced her to be absolutely deaf and blind.

"She was at length sent to Bath, where she was in some measure relieved; her convulsions being less frequent, and her pains less acute: but she never recovered her speech, her sight, or her hearing, in the least degree.

"Many of the letters dated at Bath, in some of which there are instances of interlineations with a caret, the writer of this narrative hath seen, and they are now in the custody of the widow of one of her brothers, who, with many other persons, can support the facts here related, however wonderful, with such evidence as it would not only be injustice, but folly, to disbelieve."

An account of a French lady, blind from her infancy, who can read, write, and play at cards, &c.]—"A young gentlewoman of a good family in France, now in her 18th year †, lost her sight when only two years old, her mother having been advised to lay some pigeons blood on her eyes, to preserve them in the small-pox; whereas, so far from answering the end, it ate into them. Nature, however, may be said to have compensated for the unhappy mistake, by beauty of person, sweetness of temper, vivacity of genius, quickness of conception, and many talents which certainly much alleviate her misfortune.

† *Annual Register* for 1762.

"She plays at cards with the same readiness as others of the party. She first prepares the packs allotted to her, by pricking them in several parts; yet so imperceptibly, that the closest inspection can scarcely discern her indexes. She sorts the suits, and arranges the cards in their proper sequence, with the same precision, and nearly the same facility, as they who have their sight. All she requires of those who play with her, is to name every card as it is played; and these she retains so exactly, that she frequently performs some notable strokes, such as show a great combination and strong memory.

"The most wonderful circumstance is, that she should have learned to read and write; but even this is readily believed on knowing her method. In writing to her, no ink is used, but the letters are pricked down on the paper; and by the delicacy of her touch, feeling each letter she follows them successively, and reads every word with her finger ends. She herself in writing makes use of a pencil, as she could not know when her pen was dry; her guide on her paper is a small thin ruler and of the breadth of her writing. On finishing a letter, she wets it, so as to fix the traces of her pencil, that they be not obscured or effaced; then proceeds to fold and seal it, and write the direction; all by her own address, and without the assistance of any other person. Her writing is very straight, well cut, and the spelling no less correct. To reach this singular mechanism, the indefatigable cares of her affectionate mother were long employed, who accustomed her daughter to feel letters cut in cards or pasteboard, brought her to distinguish an A from a B, and thus the whole alphabet, and afterwords to spell words; then, by the remembrance of the shape of the letters, to delineate them on paper; and, lastly, to arrange them so as to form words and sentences.

"She has learned to play on the guitar, and has even contrived a way of pricking down the tunes as an assistance to her memory. So delicate are her organs, that in singing a tune, though new to her, she is able to name the notes.

"In figured dances she acquits herself extremely well, and in a minuet with inimitable ease and gracefulness. As for the works of her sex, she has a masterly hand; she sews and hems perfectly well; and in all her works she threads the needles for herself, however small.

"By the watch her touch never fails telling her exactly the hour and minute,"

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From this account, however, it would appear, that except reading and writing, the French lady has nothing to boast of in which she is not excelled by Mr Stanley already mentioned, if we may credit all that is reported of him. The works peculiar to her sex are gained mechanically; but the *distinguishing colours*, telling the precise time by a watch, naming the notes in music, and many other things depending upon the ear and touch, are said to be so familiar to him, that his friends cease to think them extraordinary. Attainments still more wonderful are ascribed to him; as, the naming the number of persons in a room on entering it; the directing his voice to each person in particular, even to strangers when they have once spoken; the missing any person absent, and telling who that person is; and, lastly, his being able to form just conceptions of youth, beauty, symmetry, and shape.

Pore-Blind, or *Pur-blind*. A person who is very shortsighted is said to be *pur-blind*.

Moon-Blind, denotes horses that lose their sight at certain times of the moon. See FARRIERY *Index*.

Blind Harry. See *Henry the Minstrel*.

Blind-Worm. See ANGUIS, OPHIOLOGY *Index*.

BLINDE, among mineralists, a species of lead-marcasite, by our miners called mock-ore, mock-lead, and wild lead, &c. The German mineralists call it *blende*, whence our denomination *blinde*. It answers to what in Agricola is called *Galena inanis*.

It usually lies immediately over the veins of lead-ore, in the mines which produce it, for it is not found in all. When the miners see this, they know the vein of ore is very near.

BLINDS, or BLINDES, in the art of war, a sort of defence commonly made of oziers, or branches interwoven, and laid across between two rows of stakes, about the height of a man, and four or five feet asunder, used particularly at the heads of trenches, when they are extended in front towards the glacis; serving to shelter the workmen, and prevent their being overlooked by the enemy.

BLINDING, a species of corporeal punishment anciently inflicted on thieves, adulterers, perjurers, and others; and from which the ancient Christians were not exempt. Sometimes lime and vinegar, or barely scalding vinegar, was poured into the eyes till their balls were consumed; sometimes a rope was twisted round the head till the eyes started out. In the middle age, they changed total blindness for a great darkness or diminution of sight; which they produced by holding a red-hot iron dish or bason before the eyes till their humours were dried and their coats shrivelled up.

The inhabitants of the city Apollonia executed it on their watch whom they found asleep.—Democritus (according to Plutarch, Cicero, and A. Gellius), put out his own eyes, that he might be less disturbed in his mental contemplations, when thus freed from the distraction of the objects of sight.

BLINDNESS, a privation of the sense of sight, arising from a total deprivation of its organs, or an involuntary obstruction of their functions. See the article BLIND.

Total Blindness, is that wherein all sight or perception, even of light, is wanting, as in the case of those who are said to be *stone-blind*. A blind man, by the civil law, cannot make a testament except under certain modifications; but in every case he is disabled from being a witness to a testament, on account of his blindness.

Partial Blindness, is that wherein some faint glimmering is left, as is always the case in people who have ripe cataracts, who are never so blind but they can discern day from night.

Perpetual Blindness, is that which remains alike under all the diversity of seasons, times, ages, &c.

Transient Blindness, is that which gives way of itself in due time, as that of whelps, which continues for several days, sometimes nine, rarely twelve, after they are littered. The Nogais Tartars, according to Father Du Ban the Jesuit, who lived among them, are born blind, and open not their eyes till several days.

Periodical Blindness, is that which comes and goes by turns, according to the season of the moon, time of day, and the like.

Diurnal Blindness, is called *hemeracopia*.

Nocturnal Blindness, called also *nyctalopia*, that which ensues on the setting of the sun in persons who see perfectly in the day, but become quite blind as soon as night comes on. Brigg, in Phil. Trans. N° 159. p. 560, where an instance of it is given. See a singular case of this kind related by Dr Samuel Pye, in the Medic. Observ. and Inquir. vol. i. p. 111.

The causes of blindness are either ordinary, as a decay of the optic nerve (an instance whereof we have in the Academy of Sciences, where upon opening the eye of a person long blind, the optic nerve was found extremely shrunk and decayed, and having no medulla in it); or some external violence, vicious conformation, growth of a cataract, *gutta serena*, small pox, or the like. See MEDICINE *Index*.

Extraordinary causes of blindness are malignant stenches, poisonous juices dropped into the eye, baneful vermin, long confinement in the dark, or the like. The ducks which breed under ground, and break out into the Zirchnitzer sea in Carniola after all great storms, are blind at their first eruption; but in some time come to their sight. The author of the Embassy of D. Garcias de Sylva Figueroa into Persia tells us, that in several parts of that kingdom are found vast numbers of blind people of all ages, sexes, and conditions; by reason of a species of little flies which prick the eyes and lips, and enter the nostrils, carrying certain blindness with them when they light on the eyes.

BLINDNESS, in *Farriery*, is a disease incident to horses, especially those of an iron gray or dapple-gray colour, when ridden too hard or backed too young. It may be discovered by the walk or step, which in a blind horse is always uncertain and unequal, because he dares not set down his feet boldly when led in one's hand; though if the same horse be mounted by an expert horseman, and the horse of himself be mettled, the fear of the spur will make him go more freely; so that his blindness can hardly be perceived. Another mark whereby a horse may be known to have lost his sight is, that upon hearing anybody enter the stable, he will prick up his ears, and move them backwards and forwards, as mistrusting every thing and being in continual alarm by the least noise. Dr Lower first showed the cause of the ordinary blindness in horses, which

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which is a spongy excrescence, growing in one, sometimes in two or three places of the *uvea*, which being at length overgrown, covers the pupil when the horse is brought into the light, though in a dark stable it dilates again.

BLINKS, among ancient sportsmen, denoted boughs broken down from trees, and thrown in the way where deer are likely to pass, to hinder their running, or rather to mark which way a deer runs, in order to guide the hunter.

BLINKING OF BEER, in Lincolnshire, signifies letting the wort stand for some time in the vat, till it hath acquired some degree of acidity, in order to dispose it to fine, and be the sooner ready for drinking.

BLISSOM, among husbandmen, corruptly called *blossom*, is the act of a ram when coupling with an ewe.

BLISTER, in *Medicine*, a thin bladder containing a watery humour, whether occasioned by burns and the like accidents, or by vesicatories applied to different parts of the body for that purpose.

BLITE. See BLITUM, BOTANY *Index*.

BLITH, a town of Nottinghamshire, in England, seated in W. Long. 0. 55. N. Lat. 53. 25.

BLITUM, BLITE, *Strawberry Spinach*. See BOTANY *Index*.

BLOATING, a puffing up or inflation of the exterior habit of the body, lodged chiefly in the adipose cells. It is the same with what physicians call an *emphysema*.

BLOCH, MARK ELEAZER, a German naturalist of Jewish extraction. See SUPPLEMENT.

BLOCK is used for a piece of marble as it comes out of the quarry, before it has assumed any form from the hand of a workman.

BLOCK, in the mechanic arts, a large piece of solid wood whereon to fasten work or to fashion it; strength and stability being the requisite properties. In this sense, we say a *chopping block; a sugar-finer's block; a smith's block*, on which his anvil is fastened, &c.

BLOCK, among cutters in wood, is a form made of pear-tree, box, or other hard and close-grained wood, free from knots, on which they cut their figures in relievo with knives, chissels, &c.

BLOCK, in *Falconry*, denotes the perch whereon a bird of prey is kept. This is to be covered with cloth.

BLOCKS, in sea-language, are pieces of wood belonging to ships, in which the shivers of pulleys are placed, and wherein the running-ropes go. Of these some are single, some double; and some have three, four, or five shivers in them. They are named and distinguished by the ropes they carry, and the uses they serve for.

BLOCK Machinery; machinery lately introduced into the naval dock-yards of Britain for manufacturing blocks. See SUPPLEMENT.

Mounting-BLOCK, an eminence usually of stone, cut in steps or notches, serving as a help to mount on horseback. These were much in use among the ancients, who were unacquainted with stirrups. The Romans erected them at proper stations along all their great roads.

BLOCK, *Daniel*, portrait painter, was born at Stettin in Pomerania in 1580, and gave early proofs of a good genius; which induced his parents to place him as a disciple with Jacob Scherer, a master capable of giving him the best directions, to qualify him for proceeding successfully in his profession. He chiefly painted portraits, in which (according to Sandrart) he was very eminent, and had the honour to paint the portraits of Christian IV. king of Denmark, and of Gustavus Adolphus king of Sweden. The extraordinary merit of this master recommended him to the esteem of the prince of Mecklenburg, who retained him in his service for 44 years; and by order of that prince, he painted the portraits of his whole family at full length, as large as life, and in the antique habit; by which works his reputation was established effectually. By the agreeable manner of his colouring, and the easy attitudes of his figures, his paintings became so acceptable to all persons of rank, that before the decline of life, he had acquired a very large fortune; but unfortunately he lost it all, in the compass of a few hours, by the sudden irruption of a plundering party, and with great difficulty his own life was preserved. He died in 1661.

BLOCKADE, in the art of war, the blocking up a place, by posting troops at all the avenues leading to it, to keep supplies of men and provisions from getting into it; and by these means to starve it out. See BLOCKADE, SUPPLEMENT.

To raise a BLOCKADE, is to force the troops that keep the place blocked up from their posts.

BLOCKLAND, ANTHONY DE MONTFORT, history and portrait painter, was born of a noble family at Montfort in 1532. He learned the art of painting in the school of Francis Floris, whose manner he always followed; and became an artist of great distinction, by endeavouring principally to imitate the taste of the Roman school in design and composition. His genius was best adapted to grand compositions, of which he designed many; some at Delft, but more at Utrecht. His designs had grandeur, the airs of his heads were noble, and the profiles of his female figures approached near to the taste of Parmigiano. Several of his works are in so good a taste, and particularly a Venus, and the history of Joseph and his brethren, that they seem to have been painted by a master educated in the school of Florence. He died in 1583.

BLOCZIL, a fortress of Overyssel in the United Provinces, seated on the river A, at the place where it falls into the Zuyder Zee. It has a port sufficient to contain 200 vessels, and serves to defend those ships that cross the sea. Its fortifications, which were considerable, have been allowed to fall to decay. E. Long. 6. 0. N. Lat. 52. 44.

BLOEMART, ABRAHAM, painter of landscape, cattle, history, and portrait, was born at Gorcum in 1564, according to Houbraken: but according to Sandrart, whose authority seems to claim the preference, he was born in 1567, and lived mostly at Utrecht. In his youth he applied himself diligently to design after the works of Francis Floris, and afterwards received instructions from several artists of no great repute; but the power of his own genius proved his principal director in the art of painting. He formed a manner peculiar to himself, making nature his model for many of the objects he painted, particularly his cattle, in which he excelled. He died in 1647. He left four sons

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sons who were all of them artists; but the most famous was *Cornelius*, the subject of the following article.

Bloemart, *Cornelius*, the youngest son of Abraham, was born in 1603 at Utrecht. The first principles of drawing and painting he learned from his father; but his natural inclination for the art of engraving was so powerful, that he applied himself wholly to the pursuit of it. He first studied under Crispin de Pas, an engraver much more famous for the neatness than the good taste of his works. Not satisfied with what he learned from this artist, he went to Rome, in order to perfect himself from the works of the greatest masters: And in that city (where the far greater part of his engravings were made) he died in a very advanced age.—" The manner of engraving, adopted by this excellent artist, appears to me (says Mr Strutt) to be not only quite original, but the source from which we may trace that style in which the greatest and best French masters excelled; those I mean who worked with the graver only. He covered the lights upon his distances, and the other parts of his plates which required tinting, with great care. The lights, whether on the distant hills, trees, buildings, or figures, in the engravings prior to his time, had been left quite clear, and by so many white spots scattered in various parts of the same design, the harmony was destroyed, the subject confused, and the principal figures prevented from relieving with any striking effect. By this judicious improvement, Bloemart gave to his prints a more clear and finished appearance, than all the laboured neatness even of Jerom Wierix had been able to produce. He drew correctly: but from his style of engraving, which was executed entirely with the graver, the extremities of his figures are heavy, and his heads are not always equally beautiful or expressive. With respect to the mechanical part of the works, few indeed have excelled him, either in clearness, or freedom of execution. His great fault, however, is want of variety. The naked parts of his figures, the draperies, and the back-ground, are equally neat, and engraved precisely in the same manner. Hence the effect is flat; and the flesh, for want of sufficient distinction, appears cold and silvery. His works are justly held in high estimation. They are very numerous, and many of them difficult to be procured."

BLOIS, a town of France, in the department of Loire and Cher, is seated on the banks of the river Loire, partly on a plain, and partly on an eminence, in the midst of one of the most agreeable countries of France. The castle is the ornament of this city. At the first view, it seems to be two distinct buildings; but it is joined by a passage cut out of the rock. Joining to this, on the west side, is the tower of *Chateau Regnaud*, so called because that lordship may be discovered from hence, though 20 miles distant. At the east end of this is another small tower, which is partly ancient and partly modern. That part of the castle which was built by the duke of Orleans, in the room of that which he demolished in 1632, is a superb edifice, but unfinished. The court, before it, where the church of St Saviour is built, is very large, and was formerly used for tournaments. The most remarkable thing in this castle is a fine long gallery, adorned with many curious and uncommon pieces; it is in the midst of two gardens, one of which is full of fruit-trees, and the other of parterres, fountains, cascades, and marble statues brought from Italy. Beyond these, there is a large park, where there is game in abundance. On all the gates of the city there is the image of the Virgin Mary, who they believe freed them from the plague in 1631. There are several parish-churches, chapters, and religious houses for both sexes. The church of St Solenne is the cathedral, and is the handsomest in the city. The front of the Jesuits church is decorated with three orders of architecture, the Doric, Ionic, and Corinthian; but there is only the Doric on the inside. The town-house is a tolerable building, and stands in a street which terminates at the quay, where there is a public walk that has a fine prospect on the Loire, over which there is a bridge that leads to the suburbs of Vienna. There are a few houses on the bridge, and a tower at each end to guard the entrance. About three quarters of a mile from the city, the water runs down the clefts of a rock into a large aqueduct, by which it is conveyed to a reservoir near the walls, and from hence distributed by leaden pipes to the several parts of the city. The country about Blois produces corn, wine, cattle, and game of every kind, and the waters a great quantity of fish. The meadows are so rich and fertile, that the cows yield excellent milk, good in consumptive cases, and which affords the best cream in the kingdom. About a league from Blois, there are mineral springs, which have the same virtues as those of Forges. The trade of Blois is chiefly in wine and brandy; but they also make some serges and stuffs at this place. It contained 13,000 inhabitants in 1815. Several kings have kept their courts at Blois; for which reason they speak the French language in perfection. E. Long. 1. 30. N. Lat. 47. 35.

BLOMARY, or Bloomary, in *Metallurgy*, the first forge through which iron passes, after it is melted out of the ore.

BLOEMEN, Peter Van, a celebrated painter, born at Antwerp, was brother to John Francis Van Bloemen, called by the Italians Orizonti, and lived for several years at Rome along with his brother. As soon as he found himself competently skilled in colouring and penciling, as well as in designing, he returned to his native city, where, in the year 1699, he was appointed director of the academy. The composition of this master is rich, and his pictures are generally filled with a number of figures. His subjects are, the marchings of squadrons of cavalry, encampments, artillery, battles, Italian fairs, markets, and festivals; in which he shewed great correctness in his design and in his drawing; and an elegance in the manner of dressing his figures, whom he frequently represented in oriental habits. He designed horses in an admirable style; and in his battles gave them abundance of spirit, graceful attitudes, and an expression that was full of life and nature. His landscapes are enriched with elegant architecture, with basso-relievos, and mutilated statues, in a noble taste; and rendered still more pleasing by a good tone of colour, by animals of different kinds, and excellent figures.—His best works are admired in all parts of Europe, and afford large prices: but it is to be observed, that some of his pictures seem rather to be too

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too much laboured or stiff, and (according to the artists phrase) smell of the palette; and those are proportionably less estimable.

BLOEMEN, *John Francis Van*. See ORIZONTI.

BLOEMEN, *Norbert Van*, brother of the preceding, was a painter of portraits and conversations; but in merit was very inferior to his brothers, although he had a good deal of employment.

BLOND, CHRISTOPHER LE, painter of portraits in miniature and all kinds of subjects on paper, was born in 1670. Very few circumstances relative to his education or life are mentioned by any writers till he was known at Rome in the year 1716, being at that time painter to the Count Martinetz, ambassador at the court of Rome. By the solicitation of Overbeke he was induced to go to Amsterdam, and in that city was employed to paint small portraits for bracelets, rings, and snuff-boxes; of which, although they were painted in water-colours, yet the colouring was as lively and natural as if they had been painted in oil. However, as he found his sight much impaired by the minuteness of his work, he discontinued water-colour painting, and attempted the use of oil with a reasonable degree of success. After he had resided for some years in the Low Countries, he went to England, and set up a new method of printing mezzotinto plates in colours so as to imitate the pictures of which they were copies. In this manner he executed in England, several large plates, from pictures of the greatest masters, and disposed of the prints by lottery. But those who obtained the prizes (Mr Strutt says) appear not to have held them in any very great estimation. "The prints (he adds) certainly possess some merit, exclusive of their novelty; but, in general, the colours are flat and dirty; the effect is neither striking nor judiciously managed; and the drawing is frequently very incorrect, especially in the extremities of his figures." Mr Pilkington speaks of them with greater approbation. "The artist (he says) imitated his models with so much skill, such exact resemblance, such correctness of outline, such similarity of colour and expression, that at first they amazed every beholder, who viewed them at a proper distance; and many of those prints are still extant, which are much esteemed by persons of good taste." And Mr Walpole observes, that some heads, coloured progressively, according to their several gradations, bear witness to the success and beauty of his invention. He had another merit to the public, with which few inventors begin; for he communicated his secret in a thin quarto, entitled *Coloritto*, or "The harmony of colouring in painting reduced to mechanical practice, under easy precepts and infallible rules." His method was performed by several mezzotinto plates for one piece, each expressing different shades and parts of the piece in different colours. He was not, however, it is said, the original inventor of that manner of managing colours, but took it from Lastman and others, who, with much greater regularity of morals, equal capacities, and more discreet conduct, had before undertaken it without success. Le Blond, whose head was continually full of schemes, next set on foot a project for copying the cartoons of Raphael in tapestry, and made drawings from the pictures for that purpose. Houses were built and looms erected at the Mulberry Ground at Chelsea; but the expences being too great, or the contributions not equal to the first expectations, the scheme was suddenly defeated, and Le Blond disappeared, to the no small dissatisfaction of those who were engaged with him. From hence he went to Paris, where, Basan informs us, he was in the year 1737; and in that city he died, 1740, in an hospital. Le Blond was also author of a treatise, in French, on ideal beauty. It was published in 1732, and has since been translated into English.

BLONDEL, DAVID, a Protestant minister, distinguished by his skill in ecclesiastical and civil history, was born at Chalons sur Marne, and was admitted minister at a synod of the Isle of France, in 1614. He wrote, 1. A defence of the reformed churches of France. 2. A work against the decretal epistles. 3. *De Episcopis et Presbyteris;* and other pieces. Bayle informs us, that he had a very singular way of studying; he lay on the ground, and had round about him the books which he wanted for the work he was about. He died in 1665, aged 64.

BLONDEL, *Francis*, regius professor of mathematics and architecture, was employed in several negociations, arrived at the dignity of marshal de camp and counsellor of state, and had the honour of being chosen to teach the dauphin the mathematics; he was also made member of the Academy of Sciences at Paris, and director of the Academy of Architecture. He died at Paris in 1688, aged 68. He wrote, 1. Notes on the Architecture of Savot. 2. A course of architecture and mathematics. 3. The art of throwing bombs. 4. A new manner of fortifying places. 5. A comparison between Pindar and Horace; and other works.

BLONDUS, FLAVIUS, an historian born at Forli, in Italy, in 1388, was secretary to Eugenius IV. and other popes. He composed a great many books; and, among others, a History from the year 400 to 1440. He died in 1463.

BLONIEZ, a town of Poland, in the province of Warsovia. E. Long. 20. 35. N. Lat. 52. 0.

BLOOD, a red liquor circulating through the vessels of the human body and the bodies of the larger animals, which appears immediately and essentially necessary to the preservation of life.

1 No animal without some liquid equivalent to blood.

Though there is no living creature as yet known whose life doth not immediately depend upon the circulation of some kind of fluid through its vessels, yet unless such fluid is of a red colour, it does not obtain the name of *blood*; and therefore such creatures as have a colourless or milky liquor circulating through their vessels, are called *exsanguious animals*.

2 Blood of different thickness in different animals.

The blood has a very different degree of thickness or viscidity in different animals, and even in the same animal at different times. Though it is in all cases endowed with a considerable degree of tenacity, yet in strong animals that tenacity is remarkably greater than in weak ones; and hence the blood of bulls was made use of by the ancients as a poison, its extreme viscidity rendering it totally indigestible by the powers of the human stomach. It is well known also by physicians, that there are some states of the human body in which the blood becomes vastly tenacious, so as in a great measure to refuse any intimate connection with water; and others, in which its crasis is almost totally dissolved, so as to appear, when drawn out of the body, like a fluid and half putrid mass. See MEDICINE *Index*.

3 That of bulls anciently used as a poison.

The

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Blood.

4 Appearance of the blood when drawn from a vein.

The common appearance of the blood when drawn from a vein of the human body is well known. It first seems a homogeneous red liquor; then it consolidates into one uniform mass; in a little time, a yellowish watery liquor begins to separate from it, which is more or less in quantity according to the state in which the blood happens to be; the red mass, in the mean time, contracts greatly in its dimensions, and increases in solidity. But this increase of solidity is likewise proportional to the state of the blood at the time: in strong people, if attacked with a violent inflammatory disease, the solid part is exceedingly tough, insomuch that Dr Huxham says he has sometimes found it almost like a piece of flesh itself; whereas, in other diseases, the solid part is very soft and tender, breaking in pieces with the slightest touch. The spontaneous separation of the blood into crassamentum, serum, and coagulable lymph, hath been already taken notice of under ANATOMY. See ANATOMY *Index*.

5 Blood chemically analysed.

The attention of physiologists hath been very much engaged by enquiries into the nature and composition of the blood, and accordingly it hath been examined in all possible ways. By a chemical analysis, it discovers the same principles with other animal substances; giving over in distillation a great quantity of phlegm, a volatile spirit, with much fetid oil; after which, there remains a charred matter, that, burnt in an open fire, leaves a white earth similar to calcined hartshorn.

6 Contains an acid, according to some chemists.

Some eminent chemists, Mr Homberg particularly, have asserted that blood contains an acid as well as an alkali, but that the former doth not arise till towards the end of the distillation: but what is very singular, and indeed must throw no small suspicion on the whole account is, that the acid and alkali, notwithstanding their great tendency on all other occasions to unite with each other, do here remain separate, so that the liquor may be even redistilled without their forming any neutral compound.

7 Experiment in confirmation of this.

An experiment in confirmation of this is recorded in the memoirs of the Royal Academy for 1712. Six pounds of human blood distilled to dryness with a gentle heat, were reduced to a pound and a half; after which, the mass was urged with a graduated fire, till the retort at last became red hot. The produce was 17 ounces of liquor; 12 of which were a red and very empyreumatic volatile spirit, the other five were oil. The caput mortuum was a light coal weighing four ounces and a half. On rectifying the volatile spirit in a small retort, about an ounce of red fetid liquor remained, which had a very acid smell, and turned the juice of tournsol red. Mr Homberg now imagined, that the acid contained in the blood of animals could not disengage itself perfectly by these distillations without addition. He therefore determined to distil human blood with an admixture of some other substance; but as earths contain a salt, which might render the operation uncertain, he determined to use only the caput mortuum of a former distillation of the same substance. For this purpose, four pounds of a coagulum of human blood being well mixed with a large quantity of this residuum, and the whole dried in the sun, it was put into a retort, and distilled with a fire, raised, towards the end of the operation, to the utmost violence. The oil being separated from the volatile spirit, the latter was rectified; and the consequence was, that there came over four pounds of a red acid liquor, that turned the tincture of tournsol very red. All the distillations of the aqueous liquors already mentioned, obtained by similar processes, being mixed together, and separated from their yet remaining oil, by careful dilution with water and filtration, they were at length distilled together; the liquor that came over was clear as water, and its first quantities contained a great deal of volatile salt, but the last two ounces were found to be as sour as distilled vinegar.—The same products were obtained from the blood of carnivorous animals, as well as from that of animals feeding solely upon vegetables.

8 Dr Lewis's account of the blood.

In Dr Lewis's notes on Newman's Chemistry we have the following account of the blood, and the parts into which it may be resolved. "Recent blood is equally fluid, and in taste somewhat saline. Viewed by a microscope, it appears composed of numerous red globules swimming in a transparent fluid. On standing for a little time, it separates into a thick crassamentum and fluid serum. By agitation, it continues fluid: A consistent polypous matter adheres to the stirrer, which by repeated ablution with water becomes white.—Received from the vein in warm water, it deposites a quantity of transparent filamentous matter, the red portion continuing dissolved in the water. On evaporating the fluid, a red powdery substance is left.—It congeals by frost, and becomes fluid again by warmth; after liquefaction, it quickly putrefies.—Fluid and florid blood, exposed to a temperate air, putrifies sooner than such as is more dense. Inspissated to dryness, it leaves a dark-coloured mass, amounting, at a medium, to about one fourth of the weight of the blood, of a bitter saline taste, easily inflammable, burning with a bluish flame. The exsiccated blood is not soluble in acid or alkaline liquors; but gives some tincture to water and to spirit of wine, and is more powerfully acted upon by dulcified spirit of nitre. Recent blood is coagulated by the mineral acids, and by most of the combinations of them with earthy and metallic bodies. With vegetable acids, and with solutions of neutral salts, it mingles equably without coagulation. Alkalies, both fixed and volatile, render it more fluid, and preserve it from coagulating.

"The serum of blood is more saline than the crassamentum, and does not so speedily putrefy. It freezes somewhat more difficultly than pure water; and its aqueous part evaporates, by a gentle warmth, somewhat more readily, leaving about one-twelfth of the weight of the serum of a solid yellowish pellucid matter. Exposed to heat a little greater than that of the human body, it coagulates into a solid mass, without any considerable evaporation. Both this coagulum and the inspissated serum are readily inflammable in the fire, not dissoluble in water, or in spirits of wine, in acid or in alkaline liquors."

9 Texture of the blood according to Leeuwenhoek.

But the texture of the blood discoverable by a microscope, hath engaged the attention of the learned much more than the chemical analysis ever did. Leeuwenhoek was the first who discovered, or fancied he discovered, that the blood, as it exists in the body of an animal, consists of a quantity of red globular particles swimming in a large quantity of transparent liquor. Each of these globules, he imagined, was composed of six smaller ones packed together. While the six continued to adhere, their colour was red; but when separated,

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Blood.

parated, they became yellow, and thus formed what is called the *serum*. He even pretended to have discovered that each of the serous globules consisted of six smaller ones, and that these when broken down constituted some more subtile and penetrating liquor than the serum, &c. This was for a long time received almost universally as an undoubted fact; and many theories were built upon it, and elaborate calculations made, of which (we hope) no account needs now be given, as the falsity of these pretended discoveries is generally allowed.

10 According to Father de Torre.

Father de Torre, with microscopes which he pretended were capable of magnifying to an incredible degree, found that the red particles of the blood were of an annular figure, with a perforation in the middle; and that the ring itself was formed of several joints. Some of these extraordinary magnifiers, however, being sent over to England, those who were appointed by the Royal Society to make trial of them found them totally useless, so that the credit of Father de Torre's discoveries must have rested principally on his own evidence.

11 According to Mr Hewson.

The falsity of his hypothesis, as well as that of Leeuwenhoek, was detected by the late Mr Hewson, whose microscopical experiments on the blood being the latest that have appeared, we shall transcribe the following particular account of them, given by himself in a letter to Dr Haygarth physician in Chester.——" The red particles of the blood, improperly called *globules*, are flat in all animals, and of very different sizes in different animals. In man they are small, as flat as a shilling, and appear to have a dark spot in the middle. In order to see them distinctly, I dilute the blood with fresh serum. My predecessors, not having thought of this, could not see them distinctly. And Leeuwenhoek in particular, imagining a round figure fittest for motion, concluded they must be round in the human body; though he and others allowed that in frogs, &c. where they viewed them distinctly from the blood being thinner, they were flat. Now I prove that they are flat in all animals. In the human blood, where these particles are small, it is difficult to determine what that black spot is which appears in the centre of each. Some have concluded that it was a perforation: but in a frog, where it is six times as large as in a man, it is easy to show that it is not a perforation, but on the contrary is a little solid, which is contained in the middle of a vesicle. Instead, therefore, of calling this part of the blood red *globules*, I should call it red *vesicles;* for each particle is a flat vesicle, with a little solid sphere in its centre.

" I find that the blood of all animals contains vesicles of this sort. In human blood there are millions of them; and they give it the red colour. But in insects they are white, and less numerous in proportion than in man and quadrupeds. As they are flat in all animals, I suspect that shape is a circumstance of importance, but can be altered by a mixture with different fluids. And I find that it is by a determinate quantity of neutral salt contained in the serum that this fluid is adapted to preserving these vesicles in their flat shape: for, if they be mixed with water, they become round, and dissolve perfectly; but add a little of any neutral salt to the water, and they remain in it, without any alteration in their shape, and without dissolving.

" Now, when it is considered, that the blood of all animals is filled with these particles, we must believe that they serve some very important purpose in the animal economy; and since they are so complicated in their structure, it is improbable they should be made by mechanical agitation in the lungs or blood-vessels, as has been suspected, but probably have some organs set apart for their formation. This I shall endeavour to prove, when I have explained their structure a little more particularly, and mentioned the manner in which I exhibit it. I take the blood of a toad or frog, in which they are very large; I mix it with the serum of human blood to dilute it; I find them appear all flat; so they do in the blood-vessels of this animal, as I have distinctly seen in the web between its toes, whilst the animal was alive and fixed in the microscope. Their appearance in these animals is not unlike slices of cucumber. I next mix a little of the blood with water, which immediately makes them all round, and then begins to dissolve them whilst they are round. I incline the stage of the microscope, so as to make them roll down it; and then I can distinctly see the solid in the middle fall from side to side like a pea in a bladder. A neutral salt added to them at this time brings them back to their flat shape: but if the salt be not added, the water gradually dissolves away the vesicle; and then the little sphere is left naked. Such is the composition of these particles. I have exhibited these experiments to a considerable number of my acquaintance, who all agree in their being satisfactory.

" The microscope I use is a single lens, and therefore as little likely to deceive us as a pair of spectacles, which, as is allowed by all who use them, do not disfigure objects, but only represent them larger.

" From farther experiments, I am convinced, that the use of the thymus and lymphatic glands is to make the middle solid pieces: and I can prove it in as satisfactory manner as you can do the use of any viscus in the human body; that is, by opening these glands, and examining the fluid contained in their cells, which I find to be full of these little solids. I moreover find, that the lymphatic vessels take them up from those glands, and convey them into the blood-vessels, which carry them to the spleen, in whose cells they have the vesicles laid over them; so that the thymus and lymphatic glands make the central particles, and the spleen makes the vesicles that surround them. That this is the use of the spleen appears from examining the lymph which is returned from its lymphatic vessels; for that lymph, contrary to what is observed in other parts of the body, is extremely red.

" But besides having these glands set apart for making the red vesicles of the blood, I find that they are also made in the lymphatic vessels in different parts of the body, whose coats have blood-vessels properly constructed for this secretion. So that the thymus and lymphatic glands are no more than appendages of the lymphatic system, for making the middle particles; and the spleen an appendage to the lymphatic vessels, for making the vesicles which contain these middle particles.

" I conjecture that it is the coagulable lymph which is converted into this red part of the blood, from a curious fact that has long been known: namely, that the blood in the splenic vein does not coagulate when exposed

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Blood.

posed to the air, as the blood of other veins does; so that it seems to be robbed of its coagulable lymph in passing through the spleen.

"It is very remarkable, that the spleen can be cut out of an animal, and the animal do well without it. I made the experiment on a dog, and kept him a year and a half without observing his health to be in the least impaired. From this some have concluded the spleen to be an useless weight; which is absurd, when we consider that all animals with red blood have it. Therefore it is more consistent with what we know of the animal economy, to conclude, that since an animal can do well without it, there is probably some part of the body that can supply its place.

"Insects have vesicles constructed in a similar way to ours, but differing in colour. But insects have neither spleen, thymus, nor lymphatic glands; and therefore in them probably these vesicles are entirely fabricated in the lymphatic vessels. But to us, and other of the more perfect animals, besides the lymphatic vessels, nature has given those glands, that a proper quantity of these important vesicles might be the better secured to us; just as she has given us two ears, the better to secure us hearing through life, though we can hear perfectly well with one."

12 Objection to his hypothesis.

This letter, we apprehend, contains the strength of Mr Hewson's evidence for his hypothesis; on which we shall only remark, that if the red globules are prepared in the manner above mentioned, and the lymphatic vessels are excretories of those glands where the red particles are formed; then if there is any vessel where all these excretories unite, in that vessel the lymph ought to appear very red, on account of the accumulated quantity of red globules brought thither from all parts of the body. But no such redness seems ever to have been taken notice of by any anatomist: this therefore must be an objection to Mr Hewson's hypothesis; and such a one, perhaps, as will not be easily removed.

13 Opinion of Dr Wilson.

Many other hypotheses have been invented concerning the formation of the red blood, and various opinions delivered concerning its red colour. In a lecture delivered at Newcastle in 1773, by Dr Wilson of that place, he asserts "that it is self-evidently the office of the veins to elaborate the fluids into that form and composition which we know by the name of *red blood*." The self-evidence, here, however, is by no means apparent to us; nor doth he at all point it out in an intelligible manner.—Dr Cullen, in his physiological part of The Institutions of Medicine, acknowledges that we know but little of the formation of any of the animal fluids; and concerning the microscopical observations, &c. on the blood, he gives his opinion in the following words, § ccliv. "The red globules have been considered as an oily matter, and from thence their distinct and globular appearance has been accounted for: but there is no direct proof of their oily nature; and their ready union with, and diffusibility in, water, renders it very improbable. As being microscopical objects only, they have been represented by different persons very differently. Some have thought them spherical bodies, but divisible into six parts, each of which in its separate state was also spherical; but other persons have not observed them to be thus divisible. To many observers they have appeared as perfectly spherical; while others judge them to be oblate spheroids, or lenticular. To some they have appeared as annular, and to others as containing a hollow vesicle. All this, with several other circumstances relating to them, very variously represented, show some uncertainty in microscopical observations; and it leaves me, who am not conversant in such observations, altogether uncertain with respect to the precise nature of this part of the blood. The chemical history of it is equally precarious; and, therefore, what has been hitherto said of the production and changes happening to these red globules, we choose to leave untouched.—We suppose that the red globules, when viewed singly, have very little colour; and that it is only when a certain number of them are laid upon one another, that the colour appears of a bright red: but this also hath its limits; so that when the number of globules laid on one another is considerable, the colour becomes of a darker red. Upon this supposition, the colour of the mass of blood will be brighter or darker as the colouring part is more or less diffused among the other parts of the mass; and we think this appears to be truly the case from every circumstance that attends the changes which have been at any time observed in the colour of the blood."

14 Of Dr Cullen.

15 He accounts for the colour of the blood from the number of red particles contained in it.

16 Colour of the blood accounted for from the action of the air.

Concerning the uncertainty of microscopical as well as chemical experiments, we shall not dispute; though the conclusion against them seems carried too far. But with regard to the colour of the blood, we apprehend it hath been known, almost, if not altogether, since the discovery of the circulation, that the florid or dark colour depends on the presence or absence of air, and not upon any number of globules. Thus the blood returning from the veins is of a dark colour. Though diluted with the fresh chyle from the subclavian vein, it continues of the same dark colour till it passes through the lungs, upon which it instantly assumes a very florid red; but it can never be proved that the globules in the pulmonary vein are at all less numerous than in the pulmonary artery.—That this change of colour may be effected by the air through membranes much thicker than we can suppose the vessels of the lungs to be, has been demonstrated by Dr Priestley, but whether the change is occasioned by the mere separation of some principle from the blood, or by the absorption of another in its stead, is not yet determined, though the latter is indeed acknowledged by Dr Priestley himself to be the more probable opinion. He even supposes the redness to be owing to a portion of dephlogisticated air absorbed in the lungs. It must therefore be the elastic principle of this air, which is absorbed, while the other combined with part of the phlogiston emitted by the blood is converted into fixed air.

17 Uses of the blood in animals.

18 The vital principle thought by some to reside in the blood.

This leads us to consider the uses to which the blood is subservient in the animal economy, and the changes that happen to it in respiration. The uses of this fluid are so various, and of such an important nature, that some have not scrupled to affirm the blood to be actually possessed of a living principle, and that the life of the whole body is derived from it. This opinion was first broached by the celebrated Harvey, the discoverer of the circulation: but in this he was never much followed; and the hypothesis itself, indeed, has been pretty much laid aside and neglected, till of late that it was revived by Mr J. Hunter, professor of anatomy

19 Mr Hunter's arguments in favour of this opinion.

in London. This gentleman supports his opinion by the following arguments: 1. The blood unites living parts, in some circumstances, as certainly as the yet recent juices of the branch of one tree unite it with that of another. Were either of these fluids to be considered as extraneous or dead matters, he thinks they would act as stimuli, and no union would take place in the animal or vegetable kingdom. This argument, Mr Hunter imagines, is still farther established by the following experiment. Having taken off the testicle from a living cock, he introduced it into the belly of a living hen. Many weeks afterwards, upon injecting the liver of the hen, he injected the testicle of the cock; which had come in contact with the liver, and adhered to it. He alleges, that in the nature of things, there is not a more intimate connection between life and a solid, than between life and a fluid. For although we are more accustomed to connect it with the one than the other, yet the only real difference which can be shown between a solid and a fluid is, that the particles of the one are less moveable among themselves than those of the other. Besides, we often see the same body fluid in one case and solid in another. 2. The blood becomes vascular like other living parts. Mr Hunter affirms, that, after amputations, the coagula in the extremities of arteries may be injected by injecting these arteries; and he has a preparation in which he thinks he can demonstrate vessels rising from the centre of what had been a coagulum of blood, and opening into the stream of the circulating blood. 3. Blood taken from the arm in the most intense cold which the human body can bear, raises the thermometer to the same height as blood taken in the most sultry heat. This he considers as a strong proof of the blood's being alive; as living bodies alone have the power of resisting great degrees both of heat and cold, and of maintaining in almost every situation, while in health, that temperature which we distinguish by the name of *animal heat*. 4. Blood is capable of being acted upon by a stimulus. In proof of this, he observes, that it coagulates from exposure, as certainly as the cavities of the abdomen and thorax inflame from the same cause. The more it is alive, that is, the more the animal is in health, it coagulates the sooner on exposure; and the more it has lost of its living principle, as in the case of violent inflammations, the less is it sensible to the stimulus produced from its being exposed, and it coagulates the later. 5. The blood preserves life in different parts of the body. When the nerves going to a part are tied or cut, the part becomes paralytic, and loses all power of motion; but it does not mortify. If the artery be cut, the part dies, and mortification ensues. What keeps it alive in the first case? Mr Hunter believes it is the living principle which alone can keep it alive; and he thinks that this phenomenon is inexplicable on any other supposition, than that life is supported by the blood. 6. Another argument he draws from the case of a fractured os humeri he had occasion to observe. A man was brought into St George's hospital for a simple fracture of the os humeri, and died about a month after the accident. As the bones had not united, Mr Hunter injected the arm after death. He found that the cavity between the extremities of the bones was filled up with blood which had coagulated. This blood was become vascular. In some places it was very much so. He does not maintain that all coagulated blood becomes vascular: and indeed the reason is obvious; for it is often thrown out and coagulated in parts where its becoming vascular could answer no end in the system: as, for example, in the cavities of aneurismal sacs. If it be supposed, that, in such cases as that just now mentioned, the vessels are not formed in the coagulum, but come from the neighbouring arteries, he thinks it equally an argument that the blood is alive; for the substance into which vessels shoot must be so. The very idea that such a quantity of dead matter as the whole mass of blood circulates in a living body, appears to him absurd.

20 Nervous system alone thought by some to contain the vital principle.

The system which at present stands opposed to that of Mr Hunter, considers the brain and nervous system as the fountain of life; and that, so far from receiving its life from the blood, the nervous system is capable of instantaneously changing the crasis of the blood, or any other animal fluid; and though the nervous system cannot continue its action for any length of time if the action of the blood-vessels is suspended, yet the heart and blood-vessels cannot act for a single moment without the influence of the nervous fluid. Hence, say they, it is plain, we must suppose the nervous system, and not the blood, to contain properly the life of the animal, and consequently to be the principal vital organ. The secretion of the vital fluid from the blood by means of the brain, is, by the supporters of this hypothesis, denied. They say, that any fluid secreted from the blood must be aqueous, inelastic, and inactive; whereas the nervous fluid is full of vigour, elastic, and volatile in the highest degree. The great necessity for the circulation of the blood through all parts of the body, notwithstanding the presence of the nervous fluid in the same parts, they say is, because some degree of tension is necessary to be given to the fibres, in order to fit them for the influx of the nervous fluid; and this tension they receive from the repletion of the blood-vessels, which are everywhere dispersed along with the nerves.

21 Decisive arguments in favour of Mr Hunter's opinion.

To follow this dispute through every argument that hath been, or that may be, used by both parties, would prove tedious, and to us appears in a great measure unnecessary, as the following short considerations seem to decide the matter absolutely against the patrons of the nervous system. In the first place, then, if we can prove the life of the human body to have existed in, or to have been communicated from a fluid to the nervous system, the analogical argument will be very strongly in favour of the supposition that the case is so still. Now, that the case once was so, is most evident; for the human body, as well as the body of every other living creature, in its first state, is well known to be a gelatinous mass, without muscles, nerves, or blood-vessels. Nevertheless, this gelatinous matter, even at that time, contained the nervous fluid. Of this there can be no doubt, because the nerves were formed out of it, and had their power originally from it; and what is remarkable, the brain is observed to be that part of the animal which is first formed. Of this gelatinous fluid we can give no other account, than that it was the nutritious matter from which the whole body appears to be formed. At the original formation of man, and other animals, therefore, the nutritious matter was the substratum of the whole body, consisting of muscles, nerves, blood-

Blood.

blood-vessels, &c. nay more, it was the immediate efficient cause of the nervous power itself. Why should it not be so now as well as then! Again, in the formation of the embryo, we see a vital principle existing as it were at large, and forming to itself a kind of regulator to its own motions, or a habitation in which it chooses to reside, rather than to act at random in the fluid. This habitation, or regulator, was undoubtedly the nervous system, and continues so to this moment; but at the same time, it is no less evident that a nutritious fluid was the immediate origin of these same nerves, and of that very nervous fluid. Now we know, that the fluid which in the womb nourishes the bodies of all embryo animals, is necessarily equivalent to the blood which nourishes the bodies of adult ones; and consequently, as soon as the blood became the only nutritious juice of the body, at the same time the vital or nervous fluid took up its residence there, and from the blood diffused itself along the nerves, where it was regulated exactly according to the model originally formed in the embryo. Perhaps it may be said, that the vital power, when once it hath taken possession of the human or any other body, requires no addition or supply, but continues there in the same quantity from first to last. If we suppose the nervous power to be immaterial, this will indeed be the case, and there is an end of reasoning upon the subject; but if we call this power a volatile and elastic fluid, it is plain that there will be more occasion for recruits to such a power than to any other fluid of the body, as its volatility and elasticity will promote its escape in great quantities through every part of the body. It may also be objected, that it is absurd to suppose any fluid, or mechanical cause, capable of putting matter in such a form as to direct its own motions in a particular way: but even of this we have a positive proof in the case of the electric fluid. For if any quantity of this matter has a tendency to go from one place to another where it meets with difficulty, through the air for instance, it will throw small conducting substances before it, in order to facilitate its progress. Also, if a number of small and light conducting substances are laid between two metallic bodies, so as to form a circle, for example; a shock of electricity will destroy that circle, and place the small conducting substances nearer to a straight line between the two metals, as if the fluid knew there was a shorter passage, and resolved to take that, if it should have occasion to return *. Lastly, it is universally allowed, that the brain is a secretory organ, made up of an infinite number of small glands, which have no other excretories than the medullary fibres and nerves. As a considerable quantity of blood is carried to the brain, and the minute arteries end in these small glands, it follows, that the fluid, whatever it is, must come from the blood. Now, there is no gland whatever, in the human, or any other body, but will discharge the fluid it is appointed to secrete, in a very considerable quantity, if its excretory is cut. Upon the cutting of a nerve, therefore, the fluid secreted by the brain ought to be discharged; but no such discharge is visible. A small quantity of glairy matter is indeed discharged from the large nerves; but this can be no other than the nutritious juice necessary for their support. This makes it plain, even to demonstration, that the fluid secreted in the brain is *invisible* in its nature; and as we know the nervous fluid hath its residence in the brain, it is very probable, to use no stronger impression, that it is the peculiar province of the brain to secrete this fluid from the blood, and consequently that the blood originally contains the vital principle.

* See *Electricity*.

22 Vivifying spirit supposed to be derived from the air.

After it is allowed that the blood contains the vital principle, it becomes another question, not very easily solved, Whence is this vital principle derived?—For this we can only discover two sources; namely, the chyle or aliment from which the blood is prepared, and respiration. The latter hath been commonly held as the principal source of the vital principle; and, for a long time, it was generally thought that there was a kind of vivifying spirit in the air, which being absorbed by the blood at each inspiration, communicated to that fluid the quality necessary for preserving animal life. As a proof of this it was urged, that life cannot be supported without respiration, and that air which hath been often breathed ceases to be capable of supporting life; because when once it has been totally deprived of its vivifying spirit, it can communicate none to the blood in any subsequent respirations.—This doctrine, however, hath been denied, and generally thought to be exploded by modern discoveries. Dr Hales brings several experiments against it; of which the following may serve for a specimen, and which we shall give in his own words.

23 This doctrine for some time generally denied.

24 Dr Hales's experiment against a vivifying spirit. *Statical Essays*, vol. i. p. 255.

"I tied a middle-sized dog alive on a table, and, having laid bare his windpipe, I cut it asunder just below the larynx, and fixed fast to it the small end of a common fosset: the other end of the fosset had a large bladder tied to it, which contained 162 cubic inches; and to the other end of the bladder was tied the great end of another fosset whose orifice was covered with a valve that opened inwards, so as to admit any air that was blown into the bladder, but none could return that way; yet, for further security, that passage was also stopped by a spigot.

"As soon as the first fosset was tied fast to the windpipe, the bladder was blown full of air through the other fosset; when the dog had breathed the air in the bladder to and fro for a minute or two, he then breathed very fast, and showed great uneasiness, as being almost suffocated.

"Then with my hand I pressed the bladder hard, so as to drive the air into his lungs with some force; and thereby made his abdomen rise by the pressure of the diaphragm, as in natural breathings; then taking alternately my hand off the bladder, the lungs with the abdomen subsided: I continued in this manner to make the dog breathe for an hour; during which time, I was obliged to blow fresh air into the bladder every five minutes, three parts in four of that air being either absorbed by the vapours in the lungs, or escaping through the ligatures upon my pressing hard on the bladder.

"During this hour, the dog was frequently near expiring, whenever I pressed the air but weakly into his lungs; as I found by his pulse, which was very plain to be felt in the great crural artery near the groin, which place an assistant held his finger on most part of the time: but the languid pulse was accelerated so as to beat fast, soon after I dilated the lungs much by pressing hard upon the bladder; especially when the motion of the lungs was promoted by pressing alternately

Blood.

the abdomen and the bladder, whereby both the contraction and dilatation of the lungs were increased.

And I could by this means rouse the languid pulse whenever I pleased, not only at the end of every five minutes, when more air was blown into the bladder from a man's lungs, but also towards the end of the five minutes, when the air was fullest of fumes.

At the end of the hour, I intended to try whether I could have by the same means kept the dog alive some time longer, when the bladder was filled with the fumes of burning brimstone; but being obliged to cease for a little time from pressing the air into his lungs, while matters were preparing for this additional experiment, in the mean time the dog died, which might otherwise have lived longer if I had continued to force the air into the lungs.

Now, though this experiment was so frequently disturbed, by being obliged to blow more air into the bladder 12 times during the hour; yet since he was almost suffocated in less than two minutes, by breathing of himself to and fro the first air in the bladder, he would have died in less than two minutes when one-fourth of the old air remained in the bladder immediately to taint the new air admitted from a man's lungs; so that his continuing to live through the whole hour, must be owing to the forcible dilatation of the lungs by compressing the bladder, and not to the vivifying spirit of the air."

25 Dr Priestley's opinion.

Dr Priestley at first concluded from his own observations, and no doubt very justly, that air which hath been often breathed becomes pernicious by its accumulated phlogiston, stimulating the lungs, and making the animal fall into convulsions. Respiration, therefore, he supposed to be a phlogistic process, in which the blood parts with its superfluous phlogiston. He did not say, that the blood receives nothing in exchange; but rather that it may receive some nitrous principle, which gives it the red colour; but as to a vivifying spirit, he doth not appear to have the least idea of any such thing being received at that time. Nay, in his first volume, p. 277. he expressly adopts the other hypothesis, namely, that the vital principle is received from the chyle. "My conjecture (says he) is, that animals have a power of converting phlogiston, from the state in which they receive it in their nutriment, into that state in which it is called the *electrical fluid*; that the brain, besides its other proper uses, is the great laboratory and repository for this purpose; that by means of the nerves, this great principle, thus exalted, is directed into the muscles, and forces them to act in the same manner as they are forced into action, when the electric fluid is thrown in them *ab extra*.

26 Dr Hales's experiment inconclusive.

These theories were opposed in the former edition of this work. With regard to Dr Hales's opinion, that the want of elasticity, or pressure, is the reason why phlogisticated air cannot support animal life, we apprehended it to be totally inconclusive, because it doth not at all appear that phlogisticated air wants elasticity; on the contrary, from Dr Priestley's experiments, it appears to be more elastic than common air. Besides, we know that the elasticity of every fluid must always be in proportion to the pressure upon it, as reaction is always equal to action. Supposing therefore the elasticity of any portion of air to be destroyed, the pressure of the superincumbent atmosphere will reduce it into a proportionably less bulk, and then it is equally elastic with the rest; for if it was not, it would behove it still to yield under the pressure. Hence we may see, that as the bladder made use of in Dr Hales's experiment was by no means sufficient to keep off the pressure of the external atmosphere, the death of the dog could not be fairly ascribed to want of elasticity in the tainted air. When he applied more force than the natural elasticity of the air, he kept the dog *alive*, as he calls it, for an hour; but we can by no means allow a mechanical circulation of the blood to be life, any more than we can allow a dead body to be alive on account of the motion of its arm or any other member by mechanical means. The experiment, however, is valuable, because it shows that respiration is one of the immediate mechanical agents by which the circulation of the blood is carried on; but in order to prove that the dog was really kept alive by this means, he ought to have recovered from the effects of the experiment. Had Dr Hales tried a similar experiment on himself, by taking the fosset in his mouth, closing his nostrils, and causing another person compress the bladder, we have not the least doubt that he would then have felt such a method of breathing not to be a way of preserving life, but of destroying it.

27 Cause of the diminution of air by phlogiston, &c.

As to Dr Priestley's conclusions, it was argued, that "though he found air diminished by admitting phlogiston to it, Dr Priestley finds the mere accession of any material substance can never diminish, but must increase, its bulk. The diminution, therefore, on the accession of phlogiston, is an evident proof that some part of the air is actually taken away. That the phlogiston received is not incorporated with the air is likewise evident, as well as that it takes up space in the tainted air, because, by agitation in water, the phlogistic matter separates from the air, and enters into the water. The consequence of this is, that the air is still farther diminished in bulk; and what remains is pure air, fit for supporting animal life, and of being farther diminished by phlogiston as before. It appears also certain, that phlogiston is not endowed with any inherent power by which it can expand itself; otherwise it would fly off *in vacuo*, which it is never known to do. Another circumstance we must also attend to is, that the action of phlogiston seems to be entirely confined to a particular part of the atmosphere; namely, that which is now so well known by the name of *fixed air*. This it entirely deprives of its elastic principle, so that it is actually no longer air, but becomes a solid substance, making a part, and that no inconsiderable one, of innumerable terrestrial substances, as chalk, limestone, &c.

That the justness of the conclusion about to be drawn from Dr Priestley's experiments may be more apparent, the phenomena were summed up in the two following propositions. "1. Phlogiston cannot act by itself without the assistance of air. 2. The emission of phlogiston is attended with the total destruction of the elasticity of a certain quantity of fixed air, which then ceases to be fluid. Hence we affirm, that it is not the phlogistic substance which acts upon the air, but the elastic principle in the fixed air contained in the common atmosphere that acts on the phlogistic substance. This elastic principle, entering the phlogistic body, displaces a quantity of phlogiston equivalent to its own quantity,

28 Why phlogistic substances part with their phlogiston.

quantity, and takes its place: and hence proceeds the first diminution of the air, not from an accession of phlogiston, but from an escape of the elastic principle belonging to fixed air. The phlogiston and fixed particles of the air now hang loose like smoke or vapour, and are ready to be attracted by any thing capable of imbibing them; and hence proceeds the second diminution by agitation in water.

29 Proof of a reception of the vivifying principle from the air.

"Now to apply this reasoning to the point in question: The blood is found to emit phlogiston from the lungs at every exspiration: therefore we affirm it hath received a proportional quantity of elastic vapour which it had not before. Again: The air expelled from the lungs is found to contain much of the fixable part floating loose, and capable of being attracted by lime-water, &c.; therefore we say, this elastic principle hath come from that part of the atmosphere. But, to put the matter beyond doubt, the very inspection of arterial and venous blood will show, that the first hath a quantity of elastic matter in it which the last wants; and as the brain as well as all other parts of the body are supplied with arterial blood, we think it abundantly evident, that this elastic principle is absolutely and essentially necessary to life; that it is continually expended thereon; and that it may be said with the utmost propriety, that every time we draw the air into our lungs, we receive a portion of vivifying or vital spirit from it into our blood. Add to all this, that many substances which are commonly observed to phlogisticate air, appear to receive an elastic spirit by so doing. Putrefying bodies swell; they would not do so *in vacuo*; and therefore we must conclude, that they receive this elastic principle which swells them from the external air; and experience shows that it is communicated by this fixable part of the atmosphere.

"The foregoing reasoning, which to us appeared sufficiently conclusive, leads to a very important discovery in natural philosophy, viz. That it is to the atmosphere, and to that particular part of it which goes by the name of *fixed air*, that we are every moment indebted for that vital spirit which animates our bodies, and is the immediate bond of union betwixt our immaterial spirit and this visible world.

30 Objection answered.

It may be asked indeed, If fixed air is capable of supplying this spirit in such plenty, how comes it to be so instantaneously fatal when breathed? The reply to this, however, is obvious: it communicates too great a degree of elasticity to the blood; whence the circulation is stopped, and instant death ensues. That this is really the case, appears from the following account of the symptoms observed on the dissection of persons who have been suffocated by this kind of air.

Edinburgh Medical Comment. vol. iii. p. 256.

31 Appearances on the dissection of those suffocated by fixed air.

"1. The vessels of the brain are gorged with blood, and the ventricles of that viscus are filled sometimes with a frothy, sometimes with a bloody, serosity. 2. The trunk of the pulmonary artery is much distended, and the lungs appear nearly in a natural state. 3. The right ventricle and auricle of the heart, the venæ cavæ, and jugular veins, are full of frothy blood. 4. Bloody serosity is often found in the bronchiæ. 5. The trunk of the pulmonary veins, and the left auricle, are either empty, or almost empty, of blood. 6. The blood found in the places that have been mentioned is generally fluid, and as it were in a dissolved state. It is easily extravasated into the cellular texture, of the head particularly, because it is in this part that it abounds most. 7. The epiglottis in suffocated persons is raised, and the glottis open and free. 8. The tongue is much swelled, and can hardly be contained within the mouth. 9. The eyes protrude, and preserve their lustre to the second or third day. They are often even brighter than natural. 10. The body preserves its heat for a long time. Nay the heat is sometimes greater than it is during life, or at least consistently with health. 11. The limbs are flexible for a long time after death. 12. The face is more swelled, and often more red than usual. 13. The neck and upper extremities are sometimes so much swelled, that they appear to be inflamed. These swellings, however, do not, like œdematous ones, preserve the impressions of the finger.

"This account seemed so much in favour of what we had already advanced concerning the action of fixed air, that no observation was made upon it farther than that this elastic principle would seem also to be the cause of animal heat; for as the blood evidently received a vast quantity of elastic fluid, it also received a much greater proportion of heat than usual." 32 Fixed air supposed the cause of animal heat.

Such was the mode of reasoning adopted at that time, derived from the discoveries which had been made in *Aerology*. Succeeding discoveries, however, have made it evident, that fixed air is not one of the natural component parts of our atmosphere, but that it consists of two different fluids; one of which has been called *phlogisticated*, the other *dephlogisticated*, *air*. It is the latter which supplies the vital principle; and the above reasoning still holds good, only substituting the words *dephlogisticated air* for *fixed air*. The poisonous quality of the latter seems also still to depend on its too easy decomposition; by which means the elastic principle is discharged into the blood in such quantity as to burst the small vessels, as has already been observed. This is shown indeed by the remedies most proper for the recovery of those who have suffered from the noxious qualities of fixed air. These consist in evacuation, and especially sprinkling the body with cold water, in order to take off the superfluous heat, and produce an universal contraction of the vessels. 33 This theory corrected.

It now remains only to give some account of the means by which the circulation of the blood is carried on in the living body. From the time of Harvey till very lately, this was supposed to be chiefly the muscular power of the heart and arteries, which by some physiologists have been thought to be prodigiously great; and accordingly many calculations, requiring no small degree of mathematical knowledge to understand them, have been made of the forces requisite to perform this circulation. Other physiologists, however, have thought proper to take in several auxiliary helps, as the motion of the muscles, respiration, &c.; and from Dr Hales's experiment above mentioned, it appears that respiration hath a considerable influence in this matter. It cannot, however, be the sole cause, seeing the circulation is carried on in animals which do not respire.—In 1773, Dr Wilson, in the lecture already quoted, suggested a new principle of motion, which we believe was never used before to account for the circulation of animal fluids. It is shortly this: "As the fluids of the human body do all of them suffer a continual waste, and consequently require a constant supply in proportion, we must look upon their going out of the body to be the 34 Circulation of the blood how carried on. 35 New hypothesis by Dr Wilson.

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the end of their motion, and on their entering into the body to be the beginning of it; and hence we are to look for the origin of all the motion of the fluids in that part of the system where the new supplies are taken in. This is the primæ viæ, where the lacteals absorb a fluid from the digested aliment, and convey it into the blood. The power by which this is accomplished, is necessarily independent of the heart, as having not the least connexion with it. It has been said to be the same with that which causes fluids rise in the capillary tubes; but though very probably the powers in both cases may be the same, there is this remarkable difference between them, that in the capillary tubes the fluids only rise to a certain height, and will not rise at all unless the tubes are empty. In the lacteals they rise in vessels already full, and continue to do so. Neither is the force whereby this absorption is performed to be accounted little; seeing the supply by the chyle must constantly be equal to the waste which is continually taking place in the fluids already contained in the vessels. We see also with what force an absorption of this kind sometimes takes place in other cases; thus ropes will absorb water with such strength as to raise immense weights fastened to them, and which no mechanical injection of water into small tubes could possibly accomplish. What is already said of the lacteals applies also to the lymphatics; and from thence we are almost tempted to conclude, that the case is the same with the sanguiferous veins also; that though there may be a continuation of some arteries into the veins corresponding with them, yet that for the most part these vessels extravasate the blood into small cavities, which is then taken up by the absorbent power of the veins, and returned to the heart.

"If, however, the vessels continued absolutely full, it would be impossible that any motion should be carried on in them; and to continue and regulate the circulation, the heart with its cavities, is provided. Let us suppose, that by the above-mentioned power the veins are all full, and the auricles or chambers into which the veins empty themselves are full also; where is the collected stream in the veins to go next? There is no room for more in the auricle. What must be done? The auricle contracts and empties itself. The consequence is a sudden vacuum equal to what the auricle could contain; the turgid veins, urged by the absorbing power above mentioned, rush their contents into the auricle to fill up the vacuum again; and all behind moving in the venous direction advances forward with so much force, that the veins near the heart sustain a pulsation from the regurgitation of the impetuous stream, when the auricle shuts upon it to empty itself. In short, the full auricle occupies a determinate quantity of space in the breast: when it is emptied, there is a non-resisting vacuum of so much space as was full before, and thither there is a mechanical nisus from the remotest filament of a vein over the whole body, which becomes conspicuous in the torrent that rushes every other moment from the mouth of the vena cava into this vacuum."

This is a short abstract of Dr Wilson's new theory of the circulation. According to him, this absorbing power of the veins is the principal agent, while the heart and arteries do no more than empty themselves of the blood with which they are filled by the veins. Even this cause, however, he says, would not be sufficient to carry on the circulation for a single moment, without the presence of another which he calls *life*, and does not consider as absolutely unmechanical, though we cannot reduce it either to mechanical rules or ideas. But as we apprehend all speculations concerning such causes must be arbitrary and without foundation, we forbear to give any account of the doctor's opinion on this subject.

36 Blood contains no air while in the bodies of animals.

It hath been a general opinion, that blood, as it exists in the bodies of animals, contains a considerable quantity of common air; and indeed it is certain, that blood, after it has been drawn from the veins of any animal, and afterwards placed under the receiver of an air-pump, yields a very considerable quantity of air upon exhausting the receiver: but if a portion of any blood-vessel is tied up so as to prevent the escape of its contents, and then cut out of the body and placed under a receiver, it will not swell, or show the least sign of its containing any quantity of air whatever.

37 Medicinal and other uses of blood.

Blood was formerly held in great esteem as a medicine for some particular diseases. Baths of the blood of infants have been recommended as an infallible remedy for the elephantiasis, &c.; and the blood of goats and some other animals was used by the Galenists, and is recommended even by Dr Mead in pleurisies: but the first abominable medicine, as well as the other, is now deservedly exploded. The principal use of blood in the arts is for making Prussian blue, or sometimes for clarifying certain liquors; it is also recommended in agriculture as an excellent manure for fruit-trees. A mixture of blood with lime makes an exceedingly strong cement; and hence it is of use in the preparation of some chemical lutes, the making floors *, &c. As a food it hath been disputed whether blood really affords any nourishment or not. The best judges, now, however, are generally agreed that it is very nutritious; and though out of the body, like the white of an egg, it is very insoluble, yet, like that too, *in* the body it is commonly of easy digestion. It is, however, highly alkalescent in hot climates: on which account the prohibition of it to the Israelites was very proper. Even in this country, when blood was used as food in great quantity, the scurvy was more frequent than at other times; but to a moderate use of it here no such objection takes place.

* See *Architecture*, N° 116.

In some countries, we are told that the barbarians were accustomed to intoxicate themselves by drinking the warm blood of animals; and as it has been shown that this fluid is the immediate reservoir of the vital principle, it seems by no means improbable that it may be possessed of an inebriating quality. Some expressions in Scripture seem to countenance this hypothesis.

Religious uses of BLOOD. Among the ancients blood was used for the sealing and ratifying covenants and alliances, which was done by the contracting parties drinking a little of each others blood; and for appeasing the manes of the dead; in order to which blood was offered on their tombs as part of the funeral ceremony.

The blood of victims was anciently the portion of the gods; and accordingly was poured or sprinkled on the altars in oblation to them.

The priests made another use of blood, viz. for divination:

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tion: the streaming of blood from the earth, fire, and the like, was held a prodigy or omen of evil.

The Roman priests were not unacquainted with the use of blood in miracles; they had their fluxes of blood from images, ready to serve a turn; witness that said to have streamed from the statue of Minerva at Modena, before the battle at that place. But we know not whether in this their successors have not gone beyond them. How many relations in ecclesiastical writers of Madonas, crucifixes, and wafers, bleeding? At least the liquefaction of the blood of St Januarius at Naples, repeated annually for so many ages, seems to transcend by far all the frauds of the Grecian or Roman priesthood. But the chemists at last got into the secret; and we find M. Neumann at Berlin to have performed the mirable of the liquefaction of dried blood, with all the circumstances of the Neapolitan experiment.

Among the schoolmen we find a famous dispute, under Pope Pius II. whether the blood of Christ, which fell from him in the three days passion, retained or lost the hypostatic union; and consequently whether it was the proper object of adoration. The Dominicans maintained the former, the Franciscans the latter. It seems the Dominican doctrine gained the ascendant, as being fitted to favour the profits of the monks; who becoming possessed some way or other of a few drops of this precious liquor, were secured of ample offerings from the deluded laity, who flocked to pay their homage to the sacred relic. Joseph of Arimathea is said to have first brought into Britain two silver vessels filled with the blood of Christ, which by his order was buried in his tomb. King Henry III. had a crystal, containing a portion of the same blood, sent him by the master of the temple of Jerusalem, attested with the seals of the patriarch; which treasure the king committed to the church of St Peter's, Westminster, and obtained from the bishops an indulgence of six years and 116 days to all that should visit it. Mat. Paris even assures us, that the king summoning his nobles and prelates to celebrate the feast of St Edward in St Peter's church, was chiefly *pro veneratione sancti sanguinis Christi nuper adepti*, "in veneration of the holy blood of Christ lately acquired." Divers others of our monasteries were possessed of this profitable relic; as the college of Bons Hommes at Ashridge, and the abbey of Hales, to whom it was given by Henry, son of Richard duke of Cornwall and king of the Romans. To it resorted a great concourse of people for devotion and adoration; till in 1538, as the Reformation took place, it was perceived to be only honey clarified and coloured with saffron, as was shown at St Paul's cross by the bishop of Rochester. The like discovery was made of the blood of Christ, found among the relics in the abbey of Feschamp in Normandy, pretended to have been preserved by Nicodemus, when he took the body from the cross, and given to that abbey by William duke of Normandy; it was buried by his son Richard, and again discovered in 1171, and attended with different miracles; but the cheat, which had been long winked at, was at length exposed, the relation of which is given by Speed.

Avenger of BLOOD, among the Jews, was the next of kin to the person murdered, who was to pursue the murderer.

Ecclesiastical judges retire, when judgment is to be given in *cases of blood*, by reason the church is supposed to abhor blood: it condemns no person to death; and its members become irregular, or disabled from their functions, by the effusion of blood.

Field of BLOOD, in Syriac *Aceldama*, was a field purchased by the Jews with the thirty pieces of silver which had been given to Judas for betraying his master, and which he had restored. It still serves for a burial-ground, in which all pilgrims who die in their pilgrimage at Jerusalem, are interred.

BLOOD-*Hound*, in *Zoology*, the canis sagax of Linnæus *, *le chien courant* of Buffon, the *sleuthounde* of the Scots: The hound or dog, with long, smooth, and pendulous ears. It was a dog of great use, and in high esteem with our ancestors: its employ was to recover any game that had escaped wounded from the hunter, or been killed and stole out of the forest. It was remarkable for the acuteness of its smell, tracing the lost beast by the blood it had spilt; from whence the name is derived. This species could, with the utmost certainty, discover the thief by following his footsteps, let the distance of his flight be ever so great, and through the most secret and thickest coverts; nor would it cease its pursuit till it had taken the felon. They were likewise used by Wallace and Bruce during the civil wars. The poetical historians of the two heroes frequently relate very curious passages on this subject; of the service these dogs were of to their masters, and the escapes they had from those of the enemy. The blood-hound was in great request on the confines of England and Scotland; where the borderers were continually preying on the herds and flocks of their neighbours. The true blood-hound was large, strong, muscular, broad-breasted, of a stern countenance, of a deep tan-colour, and generally marked with a black spot above each eye.

* See *Canis*.

BLOOD-*Shotten*. See OPHTHALMIA, MEDICINE *Index*.

BLOOD-*Spaven*. See FARRIERY *Index*.

Spitting of BLOOD, or *Hæmoptöe*. See MEDICINE *Index*.

Whole and Half BLOOD; a kinsman of the *whole blood* is he that is derived from the same couple of ancestors; whereas a person of *half blood* descends from either of them singly by a second marriage.

BLOOD *of Christ*, the name of a military order instituted at Mantua in 1608. The number of knights was restricted to 20, besides the grand-master. Their device was, *Domine, probasti me*; or, *Nihil hoc, triste, recepto*: "Lord, thou hast proved me;" or, "Fortified by this, no evil can prevail."

Precious BLOOD, a denomination given to a reformed congregation of Bernardine nuns at Paris, first established under that name in 1661.

Dragon's BLOOD. See DRAGON.

BLOOD-*Stone*. See HÆMATITES, MINERALOGY *Index*.

BLOOD-*Vessels*. See ANATOMY *Index*.

BLOOD-*White*, in ancient law writers, signifies *blood*, and a customary amercement paid as a composition for the shedding or drawing of blood. The word is also written *blodwhite*, *blodwita*, *blodwyta*, *bloodwit*, *blodwit*, *bloudwit*, and *bluidweit*. It is formed from the ancient Saxon *blud*, "blood," and *vite* or *wite*, "a fine or penalty." The word also denotes an exemption from this penalty,

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Blood.

penalty, granted by the king to certain persons and communities as a special favour. King Henry II. granted to all tenants within the honour of Wallingford—*Ut quieti sint de hidagio et blodwite et bredwite.*

Blood-Wort. See Rumex, Botany *Index.*

Blood, *Thomas*, generally known by the appellation of *Colonel Blood*, was a disbanded officer of Oliver Cromwell's, famous for his daring crimes and his good fortune. He was first distinguished by engaging in a conspiracy to surprise the castle of Dublin; which was defeated by the vigilance of the duke of Ormond, and some of his accomplices were executed. Escaping to England, he meditated revenge against Ormond; and actually seized him one night in his coach at St James's street, where he might have finished his purpose if he had not studied refinements in his vengeance. He bound him on horseback behind one of his associates, resolving to hang him at Tyburn, with a paper pinned to his breast: but, when they got into the fields, the duke, in his efforts for liberty, threw himself and the assassin, to whom he was fastened, to the ground; and, while they were struggling in the mire, he was rescued by his servants; but the authors of this attempt were not then discovered. A little after, in 1671, Blood formed a design of carrying off the crown and regalia from the Tower; a design to which he was prompted, as well by the surprising boldness of the enterprise, as by the views of profit. He was very near succeeding. He had bound and wounded Edwards the keeper of the jewel-office, and had got out of the Tower with his prey; but was overtaken and seized, with some of his associates. One of them was known to have been concerned in the attempt upon Ormond; and Blood was immediately concluded to be the ringleader. When questioned, he frankly avowed the enterprise; but refused to discover his accomplices. "The fear of death (he said) should never engage him either to deny a guilt or betray a friend." All these extraordinary circumstances made him the general subject of conversation; and the king was moved with an idle curiosity to see and speak with a person so noted for his courage and his crimes. Blood might now esteem himself secure of pardon; and he wanted not address to improve the opportunity. He told Charles, that he had been engaged, with others, in a design to kill him with a carabine above Battersea, where his majesty often went to bathe; that the cause of this resolution was the severity exercised over the consciences of the godly, in restraining the liberty of their religious assemblies: that when he had taken his stand among the reeds, full of these bloody resolutions, he found his heart checked with an awe of majesty; and he not only relented himself, but diverted his associates from their purpose: that he had long ago brought himself to an entire indifference about life, which he now gave for lost; yet could he not forbear warning the king of the danger which might attend his execution: that his associates had bound themselves by the strictest oaths to revenge the death of any of their confederacy; and that no precaution or power could secure any one from the effect of their desperate resolutions. Whether these considerations excited fear or admiration in the king, they confirmed his resolution of granting a pardon to Blood; but he thought it a requisite point of decency first to obtain the duke of Ormond's consent. Arlington came to Ormond in the king's name, and desired that he would not prosecute Blood, for reasons which he was commanded to give him. The duke replied, that his majesty's commands were the only reason that could be given: and being sufficient, he might therefore spare the rest. Charles carried his kindness to Blood still farther; he granted him an estate of 500l. a-year in Ireland; he encouraged his attendance about his person; he showed him great countenance; and many applied to him for promoting their pretensions at court. And while old Edwards, who had bravely ventured his life, and had been wounded in defending the crown and regalia, was forgotten and neglected, this man, who deserved only to be stared at and detested as a monster, became a kind of favourite. Blood enjoyed his pension about ten years, till being charged with fixing an imputation of a scandalous nature on the duke of Buckingham, he was thrown into prison, where he died August 24. 1680.

Blood || Bloss.

BLOODY, something belonging to or abounding with blood.

Bloody-Flux. See Medicine *Index.*

Bloody-Hand is when a trespasser is apprehended in a forest with his hands or other parts bloody; which is a circumstance of his having killed the deer, though he be not found chasing or hunting them.

Bloody-Rain. See Rain.

Bloody-Sweat. Many instances of this are recorded, in which it has been owing to bodily disorder, or extreme mental agitation and agony. See particularly Aristotle's Hist. Animal. lib. iii. cap. 19. apud Oper. tom. i. Thuanus Hist. Temp. &c. lib. ii. apud Oper. tom. i. Melanges d'Histoire et de Literature, &c. par M. V. Marville, tom. iii. p. 149. Acta Physico-Med. Norimbergæ, vol. i. p. 84. and vol. viii. p. 428.

Bloody-Urine. See Medicine *Index.*

BLOOM, a mass of iron after having undergone the first hammering called *blomary*. It has yet to undergo many hammerings before it become iron fit for the smith's use, and be first made what they call the *ancony*. See Ancony.

BLOOT, Peter, a Flemish painter, whose works are not frequently seen in these kingdoms; nor are they easily purchased in Holland, being carefully preserved in private collections, and are highly esteemed. The subjects he chose to paint were always taken from the lowest life; such as boors drinking, feasting, dancing, or quarrelling; shepherds piping, and sometimes the marriages of villagers. He was a faithful, and indeed too servile an imitator of nature; never departing from the actions, attitudes, or draperies of his models. He showed a good knowledge of the chiaroscuro and perspective; he had a delicate manner of penciling, and his colouring was mellow; but he had no idea of elegance: yet his pictures have in many respects great merit, and his defects seem rather imputable to the taste of his country than to his own genius; some of his works being for the lightness of the touch, the neatness of handling, and transparence of colour, equal to the best of his time. He died in 1667.

BLOSSOM, in a general sense, denotes the flower of any plant. See the article Flower.

Blossom, in a more proper sense, is restrained to the flowers of trees which they put forth in the spring, and

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as the forerunners of their fruit, otherwise called their *bloom*. The office of the blossom is partly to protect, and partly to draw nourishment to, the embryo fruit or seed.

Blossom, or *Peach-Coloured*, in the manege, a term applied to a horse that has his hair white, but intermixed all over with sorrel and bay hairs. Such horses are so insensible and hard, both in the mouth and the flanks, that they are scarcely valued; besides they are apt to turn blind.

BLOSSOMING of Plants, the act of blowing, or putting forth flowers or blossoms, called also *flowering*. The blossoming of the Glastonbury thorn piously on Christmas-day morning, is a vulgar error; owing to this, that the plant, besides the usual blossoming in the spring, sometimes puts forth a few white transient blossoms in the middle of winter. For the blossoming of the rose of Jericho on the same day, as it is commonly held in England, or in the time of midnight mass, as it is held in France, is somewhat more than an error, being really a fraud on one side, and a superstition on the other. This rose, whose leaves are only closed and shrivelled up in winter, will, at any time, upon setting its pedicle in water, expand and blossom a-new; because the pedicle being spongy imbibes the fluid apace, and thus fills and swells out the shrivelled leaves; which property some monks have turned to good account.

BLOTELING, or Blooteling, Abraham, an engraver who flourished about the year 1672. He was a native of Amsterdam, and designed as well as engraved. From the style of his etchings, which have great merit, he is supposed to have frequented the school of the Visschers. He came into England about the year 1672, or 1673, at the time the French invaded Holland; but he did not reside there long. He not only etched, but also scraped, several mezzotintos, which were much esteemed. Vertue informs us, that whilst he was in England, he received 30 guineas for an etching of the Duke of Norfolk. From hence he returned to Amsterdam, where, in all probability, he died. In the year 1685, he published at Amsterdam the *gems* of Leonardo Augustino, and etched the plates himself.

BLOUNT, Thomas, a learned English writer of the 17th century, born at Bordesley in Worcestershire. He had not the advantage of an university education; but, by strength of genius and great application, made a considerable progress in literature. Upon the breaking out of the popish plot in the reign of King Charles II. being much alarmed on account of his being a zealous Roman Catholic. he was seized with a palsy; and died in December, 1679, aged 61. He wrote, 1. The Academy of Eloquence, containing a complete English rhetoric. 2. Glossographia, or a dictionary interpreting such hard words, whether Hebrew, Greek, Latin, Italian, &c. as are now used in our refined English tongue, &c. 3. Boscobel; or the History of his Majesty's Escape after the Battle of Worcester. 4. A law dictionary. 5. Animadversions upon Sir Richard Baker's chronicle. 6. *Fragmenta Antiquitatis*; and other works.

Blount, *Sir Henry*, an English writer, born at his father's seat in Hertfordshire in 1602. After a regular education, he set out on his travels in 1634. He became acquainted with a janizary at Venice, and accompanied him into the Turkish dominions. Having been abroad two years, he returned and published a relation of his travels in the Levant, which went through several editions. He was knighted by Char. I. and was at the battle of Edge-Hill, at which time he is supposed to have had the charge of the young princes; but, after the king's death, was employed by the parliament, and by Cromwell. Yet after the restoration of the royal family he was appointed high sheriff of the county of Hertford, and from that time lived as a private gentleman above 20 years. He published, 1. An account of his travels. 2. Six comedies written by John Lilly, under the title of *Court Comedies*. 3. The Exchange Walk, a satire; and, 4. An Epistle in praise of Tobacco. He died October 9. 1682.

Blount, *Sir Thomas Pope*, baronet, an eminent writer, and the eldest son of the former, was born at Upper Holloway, in the county of Middlesex, September 12. 1649. He was educated under the eye of his father; and always distinguished himself as a lover of liberty, a sincere friend to his country, and a true patron of learning. He was advanced to the degree of baronet by King Charles II. in whose reign he was elected burgess for St Alban's in two parliaments, and was knight of the shire in three parliaments after the Revolution. He wrote in Latin, 1. A critique on the most celebrated writers. 2. Essays on several subjects. 3. A natural history, extracted out of the best modern writers; and, 4. Remarks upon poetry, with characters and censures of the most considerable poets, whether ancient or modern. He died June 30. 1697.

Blount, *Charles*, younger brother of Sir Thomas Pope Blount, had also an excellent capacity, and was an eminent writer. His *Anima Mundi*, or An Historical narration of the opinions of the ancients, concerning man's soul after this life, according to unenlightened nature, gave great offence, and was complained of to the bishop of London. But the work which rendered him most known, was his translation of Philostratus's Life of Apollonius Tyaneus, published in 1680; which was soon suppressed, as an attack on revealed religion. Another work of the same complexion he published the same year, called Great is Diana of the Ephesians, &c. in which, under colour of exposing superstition, he struck at revelation. In 1684, he printed a kind of Introduction to Polite Literature. In the warmth of his zeal for the Revolution, he wrote a pamphlet to prove King William and Queen Mary conquerors; which was condemned to be burnt by both houses of parliament. The close of his life was very unhappy. For, after the death of his wife, he became enamoured of her sister, who was only scrupulous against their union on account of their prior connexion by the marriage. On this subject he wrote a letter, as the case of a third person, with great learning and address. But the archbishop of Canterbury and other divines deciding against him, and the lady on this growing inflexible, threw him into a frenzy, in which he shot himself, in 1693. After his death, his miscellaneous pieces were collected and published.

BLOW, Dr John, a famous musician and composer, was born in 1648 at North Collingham in the county

Blow.

county of Nottingham; and was one of the first set of children after the Restoration, being bred up under Captain Henry Cook. He was also a pupil of Hingeston, organist to Oliver Cromwell, and after that of Dr Christopher Gibbons. On the 16th day of March, 1673, he was sworn one of the gentlemen of the chapel in the room of Roger Hill; and in July 1674, upon the decease of Mr Pelham Humphrey, was appointed master of the children of the chapel. In 1685, he was made one of his majesty's private music; and in 1687, was appointed almoner and master of the choristers of the cathedral church of St Paul. Blow was not a graduate of either university; but Archbishop Sancroft, in virtue of his own authority in that respect, conferred on him the degree of doctor in music. Upon the decease of Purcell in 1695, he became organist of Westminster-abbey. In the year 1699, he was appointed composer to his majesty, with a salary. Blow was a composer of anthems while a chapel-boy, and on the score of his merit, was distinguished by Charles II. The king admired very much a little duet of Carissimi to the words 'Dite o Cieli,' and asked of Blow if he could imitate it. Blow modestly answered he would try; and composed in the same measure, and the same key of D with a minor third, that fine song, 'Go perjured man.' The *Orpheus Britannicus* of Purcell had been published by his widow soon after his decease; and contained in it some of that author's finest songs: the favourable reception it met with was a motive with Blow to the publication, in the year 1700, of a work of the same kind, entitled *Amphion Anglicus*, containing compositions for one, two, three, and four voices, with accompaniments of instrumental music, and a thorough bass figured for the organ, harpsichord, or theorbolute. To this book are prefixed commendatory verses by sundry persons; and among them an ode, in the second stanza of which are the following lines:

> 'His *Gloria Patri* long ago reach'd Rome,
> 'Sung and rever'd too in St Peter's dome;
> 'A canon will outlive her jubilees to come.'

The canon here meant is that fine one to which the Gloria Patri in Dr Blow's gamut service is set. Dr Blow set to music an ode for St Cecilia's day, in 1684, the words by Mr Oldham, published together with one of Purcell on the same occasion performed the preceding year. He also composed and published a collection of lessons for the harpsichord or spinet, and an ode on the death of Purcell, written by Mr Dryden. There are also extant of his composition sundry hymns printed in the *Harmonia Sacra*, and a great number of catches in the latter editions of the Musical Companion. This great musician died in the year 1708, and lies buried in the north aisle of Westminster-abbey. On his monument is the canon above mentioned, engraven on a book with an inscription above it.

Blow, in a general sense, denotes a stroke given either with the hand, a weapon, or instrument. In fencing, blows differ from thrusts, as the former are given by striking, the latter by pushing.

Military Blow, alapa militaris, that given with a sword on the neck or shoulder of a candidate for knighthood, in the ceremony of dubbing him. The custom seems to have taken its rise from the ancient ceremony of manumission. In giving the blow, the prince used the formula *Esto bonus miles*, "Be a valiant soldier;" upon which the party rose a complete knight, and qualified to bear arms in his own right.

Blow

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Blubber.

Blow, in *Law*. See Battery.

Fly-Blows, the ova of flies deposited on flesh, or other substances proper for hatching them.

Blow-Pipe, in *Chemistry* and *Mineralogy*, an instrument by which the blast of the breath may be directed upon the flame of a lamp or candle, in such a manner as to vitrify any small portion of mineral substance; and thus the process of assaying in the dry way may be performed in a very short time, where either want of instruments or opportunity prevents other methods from being used.

Mr Bergman observes, that this instrument is extremely useful to chemists, as many experiments are daily neglected, either because they require furnaces and a large apparatus of vessels; from the want of time to examine them in the ordinary way; or from the quantity required in the common way for examination, when the matter may be too scarce or too dear. In all these cases the blow-pipe may be advantageously used; as, 1. Most of the experiments which can be performed in the large way may also be done with the blow-pipe. 2. The experiments which in the large way require many hours, may in this method be finished in a few minutes; and, 3. The smallest particle is sufficient. The only defect is, that the proportions cannot be determined with any precision; and therefore experiments on a large scale are still to be preferred. See Chemistry and Mineralogy *Index*. See also Blow-pipe, Supplement.

BLOWING, in a general sense, denotes an agitation of the air, whether performed with a pair of bellows, the mouth, a tube, or the like. Butchers have a practice of blowing up veal, especially the loins, as soon as killed, with a pipe made of a sheep's shank, to make it look larger and fairer.

Blowing of Glass, one of the methods of forming the various kinds of works in the glass manufacture. It is performed by dipping the point of an iron blowing pipe in the melted glass, and blowing through it with the mouth, according to the circumstances of the glass to be blown. See Glass.

Blowing of Tin, denotes the melting its ore, after being first burnt to destroy the mundic.

Blowing Machines. See also *Blowing Machines*, Supplement.

Blowing, among gardeners, denotes the action of flowers, whereby they open and display their leaves. In which sense, blowing amounts to much the same with flowering or blossoming.

The regular blowing season is in the spring; though some plants have other extraordinary times and manners of blowing, as the Glastonbury thorn. Divers flowers also, as the tulip, close every evening, and blow again in the morning. Annual plants blow sooner or later as their seeds are put in the ground; whence the curious in gardening sow some every month in summer, to have a constant succession of flowers. The blowing of roses may be retarded by shearing off the buds as they put forth.

BLUBBER, denotes the fat of whales and other large sea-animals, whereof is made train-oil. It is properly

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properly the *adeps* of the animal: it lies immediately under the skin, and over the muscular flesh. In the porpoise it is firm and full of fibres, and invests the body about an inch thick. In the whale its thickness is ordinarily six inches; but about the under lip, it is found two or three feet thick. The whole quantity yielded by one of these animals ordinarily amounts to 40 or 50, sometimes to 80 or more, hundred weight. The use of blubber to the animal seems to be partly to poise the body, and render it equiponderant to the water; partly to keep off the water at some distance from the blood, the immediate contact whereof would be apt to chill it; and partly also for the same use that clothes serve us, to keep the fish warm, by reflecting or reverberating the hot steams of the body, and so redoubling the heat: since all fat bodies are, by experience, found less sensible of the impressions of cold than lean ones. Its use in trade and manufactures is to furnish train-oil, which it does by boiling down. Formerly this was performed ashore in the country where the whales were caught: but of late the fishers do not go ashore; they bring the blubber home stowed in casks, and afterwards boil it down in the preparation of the oil.

Sea-Blubber. See Medusa.

BLUE, one of the seven colours into which the rays of light divide themselves when refracted through a glass prism. For an account of the particular structure of bodies by which they appear of a blue colour, see the article Chromatics.—The principal blues used in painting are Prussian blue, bice, saunders blue, azure, or smalt, verditer, &c.; for the preparation of which, see *Colour-Making*.—In dyeing, the principal ingredients for giving a blue colour, are indigo and woad. See Dyeing.

Blue Colour of the Sky. See Sky.

Blue-Bird. See Motacilla, Ornithology *Index*.

Blue-Fish. See Coryphena, Ichthyology *Index*.

Blue Japan. Take gum-water, what quantity you please, and white-lead a sufficient quantity; grind them well upon a porphyry; then take isinglass size what quantity you please, of the finest and best smalt, a sufficient quantity; mix them well; to which add, of your white-lead, before ground, so much as may give it a sufficient body. Mix all these together to the consistence of a paint.

Blue John, among miners, a kind of mineral which has lately been fabricated into vases and other ornamental figures. It is of the same quality with the cubical spar, with respect to its fusibility in the fire. It loses its colour, and becomes white in a moderate heat: the weight of a cubic foot of the bluest kind is 3180 ounces, and that of the least blue is 3140 ounces. This substance began first to be applied to use about 18 years ago at one of the oldest mines in Derbyshire, called *Odin mine*, probably from its being dedicated to Odin the great god of the northern nations, at the foot of a high mountain called *Mam-Tor* in Castleton. Here the greatest quantities are still found; the largest pieces are sold for 9l. a ton, the middle-sized for 6l. and the least for 50s.

Prussian Blue. See Chemistry *Index*.

BLUING, the act or art of communicating a blue colour to bodies otherwise destitute thereof. Laundresses blue their linen with smalt; dyers their stuffs and wools with woad or indigo.

Bluing of Metals is performed by heating them in the fire till they assume a blue colour; particularly practised by gilders, who blue their metals before they apply the gold and silver leaf.

Bluing of Iron, a method of beautifying that metal sometimes practised; as for mourning buckles, swords, and the like. The manner is thus: Take a piece of grindstone or whetstone, and rub hard on the work, to take off the black scurf from it: then heat it in the fire; and as it grows hot, the colour changes by degrees, coming first to light, then to a darker gold colour, and lastly to a blue. Sometimes they also grind indigo and salad-oil together; and rub the mixture on the work with a woollen rag, while it is heating, leaving it to cool of itself. Among sculptors we also find mention of bluing a figure of bronze, by which is meant the heating of it, to prepare it for the application of gold-leaf, because of the bluish cast it acquires in the operation.

BLUFF-head, among sailors. A ship is said to be bluff-headed that has an upright stern.

BLUNDERBUSS, a short fire-arm with a wide bore, capable of holding a number of bullets at once.

BLUSHING, a suffusion or redness of the cheeks, excited by a sense of shame, on account of consciousness of some failing or imperfection.

Blushing is supposed to be produced from a kind of consent or sympathy between several parts of the body, occasioned by the same nerve being extended to them all. Thus the fifth pair of nerves being branched from the brain to the eye, ear, muscles of the lips, cheeks, palate, tongue, and nose; a thing seen or heard that is shameful, affects the cheeks with blushes, driving the blood into the minute vessels thereof, at the same time that it affects the eye and ear. For the same reason it is, as Mr Derham observes, that a savoury thing seen or smelt affects the glands and parts of the mouth: if a thing heard be pleasing, it affects the muscles of the face with laughter: if melancholy, it exerts itself on the glands of the eyes, and occasions weeping, &c. And to the same cause Dr Willis ascribes the pleasure of kissing.

BOA, or Boæ, -arum, in *Ancient Geography*, an island on the coast of Illyricum over against Tragurium. A place of banishment for condemned persons; now called *Bua*, an island in the Adriatic, joined to the continent and to Tragurium, now *Tran*, by a bridge.

Boa. See Ophiology *Index*.

BOADADA bashee, in the Turkish military orders, an officer of the janizaries whose business it is to walk every day about the principal parts of the city, with a number of janizaries to attend him, to keep order, and see that all things are regular, even to the dress. This office is for three months, and from this the person is usually advanced to be a serach.

BOADICEA, a valiant British queen in the time of Nero, the emperor, wife to Prasutagus king of the Iceni in Britain, who by his will left the emperor and his own daughters co-heirs to his great treasures, in expectation of procuring by that means Nero's protection for his family and people: but he was no sooner dead, than the emperor's officers seized all. Boadicea opposed these unjust proceedings; which was resented to

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to such a pitch of brutality, that they ordered the lady to be publicly whipped, and her daughters to be ravished by the soldiers. The Britons took arms, with Boadicea at their head, to shake off the Roman yoke; and made a general and bloody massacre of the Romans in all parts. The whole province of Britain would have been lost, if Suetonius Paulinus had not hastened from the isle of Mona to London, and with 10,000 men engaged the Britons. The battle was fought for a long time with great vigour and doubtful success, till at last victory inclined to the Romans. Boadicea, who had behaved with all the bravery imaginable, despatched herself by poison.

BOAR, in the manege. A horse is said to boar when he shoots out his nose as high as his ears, and tosses his nose in the wind.

BOAR, a male swine. See SUS.

The wild boar, among huntsmen, has several names, according to its different ages: the first year, it is called *a pig of the saunder;* the second it is called *a hog;* the third, *a hog-steer;* and the fourth, *a boar;* when leaving the saunder, he is called a *singler* or *sangler*. The boar generally lives to 25 or 30 years, if he escapes accidents. The time of going to rut is in December, and lasts about three weeks. They feed on all sorts of fruits, and on the roots of many plants; the root of fern in particular seems a great favourite with them; and when they frequent places near the sea-coasts, they will descend to the shores, and demolish the tenderer shell-fish in very great numbers. Their general places of rest are among the thickest bushes that can be found: and they are not easily put out of them, but will stand the bay a long time. In April and May they sleep more sound than at any other time of the year, and this is therefore the successful time for the taking them in the toils. When a boar is roused out of the thicket, he always goes from it, if possible, the same way by which he came to it; and when he is once up, he will never stop till he comes to some place of more security. If it happens that a saunder of them are found together, when any one breaks away, the rest all follow the same way. When the boar is hunted in the wood where he was bred, he will scarcely ever be brought to quit it; he will sometimes make towards the sides to listen to the noise of the dogs, but retires into the middle again, and usually dies or escapes there. When it happens that a boar runs a-head, he will not be stopped or put out of his way, by man or beast, so long as he has any strength left. He makes no doubles or crossings when chased; and, when killed, makes no noise, if an old boar; the sows and pigs will squeak when wounded.

The season for hunting the wild boar begins in September, and ends in December, when they go to rut. If it be a large boar, and one that has lain long at rest, he must be hunted with a great number of dogs, and those such as will keep close to him; and the huntsman, with his spear, should always be riding in among them, and charging the boar as often as he can, to discourage him: such a boar as this, with five or six couple of dogs, will run to the first convenient place of shelter, and there stand at bay and make at them as they attempt to come up with him. There ought always to be relays also set of the best and staunchest hounds in the kennel; for if they are of young eager dogs, they will be apt to seize him, and be killed or spoiled before the rest come up. The putting collars with bells about the dogs necks is a great security for them; for the boar will not so soon strike at them when they have these, but will rather run before them. The huntsmen generally kill the boar with their swords or spears: but great caution is necessary in making the blows; for he is very apt to catch them upon his snout or tusks; and if wounded and not killed, he will attack the huntsman in the most furious manner. The place to give the wound with the spear is either between the eyes in the middle of the forehead, or in the shoulder; both these places make the wound mortal.

When this creature makes at the hunter, there is nothing for it but courage and address; if he flies for it, he is surely overtaken and killed. If the boar comes straight up, he is to be received at the point of the spear: but if he makes doubles and windings, he is to be watched very cautiously, for he will attempt getting hold of the spear in his mouth; and if he does so, nothing can save the huntsman but another person attacking him behind; he will on this attack the second person, and the first must then attack him again: two people will thus have enough to do with him; and were it not for the forks of the boar-spears that make it impossible to press forward upon them, the huntsman who gives the creature his death wound, would seldom escape falling a sacrifice to his revenge for it. The modern way of boar-hunting is generally to dispatch the creature by all the huntsmen striking him at once; but the ancient Roman way was, for a person on foot, armed with a spear, to keep the creature at bay; and in this case the boar would run of himself upon the spear to come at the huntsman, and push forward till the spear pierced him through.

The hinder claws of a boar are called *guards.* In the corn, he is said to *feed;* in the meadows or fallow-fields, to *rout, worm,* or *fern;* in a close, to *grass.* The boar is farrowed with as many teeth as he will ever have; his teeth only increasing in bigness, not in number: among these there are four called *tushes,* or *tusks;* the two biggest of which do not hurt when he strikes, but serve only to whet the other two lowest, with which the beast defends himself, and frequently kills, as being greater and longer than the rest.

It is very remarkable, that these creatures in the West Indies are subject to the stone; few of them are absolutely free from it, yet scarcely any have the stones of any considerable size. It is common to find a great number in the same bladder; and they are usually of about a scruple weight, are angular, and very regular, each having five angles.

Among the ancient Romans boar's flesh was a delicacy; a boar served up whole was a dish of state.

The boar was sometimes also the military ensign borne by the Roman armies, in lieu of the eagle.

Among physicians, a boar's bladder has been reputed a specific for the epilepsy. The tush of the wild boar still passes with some as of great efficacy in quinsies and pleurisies.

BOARD, a long piece of timber, sawed thin for building and several other purposes. See TIMBER.

Deal-boards are generally imported into England ready sawed, because done cheaper abroad, in regard

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we want saw-mills. Cap-boards are imported from Sweden and Dantzic. Oak-boards chiefly from Sweden and Holland; some from Dantzic. We also import white boards for shoemakers; mill and scale-boards, &c. for divers artificers. Scale-board is a thinner sort, used for the covers of primers, thin boxes, and the like. It is made with large planes; but might probably be sawed with mills to advantage.

Board is also used for a kind of table or bench, whereon several artificers perform their work. In this sense we say a work-*board*, shop-*board*, tailor's-*board*, &c.

Board is also used for a flat machine, or *frame*, used in certain games, and the like. In this sense, we say a draught-*board*, a chess-*board*, a shovel *board*, and the like.

Board, *Bureau*, is also used for an office where accounts are taken, payments ordered, and the like. In this sense, we say the *board* of works, *board* of ordnance, *board* of treasury, and the like.

Board, among seamen. *To go aboard*, signifies to go into the ship. *To slip by the board*, is to slip down by the ship's side. *Board and board*, is when two ships come so near as to touch one another, or when they lie side by side. *To make a board*, is to turn to windward; and the longer your boards are, the more you work into the wind. *To board it up*, is to beat it up, sometimes upon one tack and sometimes upon another. *She makes a good board*, that is, the ship advances much at one tack. *The weather board*, is that side of the ship which is to windward.

BOARDING, in a naval engagement, is a desperate and furious assault made by one ship on another, after having found every other method to reduce her ineffectual: it may be performed in different places of the ship, according to their circumstances and situation, by the assailant detaching a number of men armed with pistols and cutlasses on the decks of his antagonist, who stands in the same predicament with a city stormed by the besiegers. This expedient, however, is rarely attempted by king's ships, which generally decide the combat without grappling each other; but is chiefly practised by privateers, which, bearing down on the enemy's quarter or broadside, drop from the bowsprit, which projects over the defendant's deck, an earthen shell, called a *stink-pot*, charged with fiery and suffocating combustibles, which immediately bursts, catches fire, and fills the deck with insufferable stench and smoke: in the middle of the confusion thus occasioned, the privateer's crew rush aboard, under cover of the smoke, and easily overpower the astonished enemy, unless they have close quarters to which they can retreat and beat them off the deck.

BOAT, a small open vessel, conducted on the water by rowing or sailing. The construction, machinery, and even the names of boats, are very different, according to the various purposes for which they are calculated, and the services on which they are to be employed. Thus they are occasionally slight or strong, sharp or flat bottomed, open or decked, plain or ornamented; as they may be designed for swiftness or burden, for deep or shallow water, for sailing in a harbour or at sea, and for convenience or pleasure.

The largest boat that usually accompanies a ship is the *long-boat*, which is generally furnished with a mast and sails: those which are fitted for men of war, may be occasionally decked, armed, and equipped, for cruising short distances against merchant ships of the enemy, or smugglers, or for impressing seamen, &c. The *barges* are next in order, which are longer, slighter, and narrower: they are employed to carry the principal sea-officers, as admirals, and captains of ships of war, and are very unfit for sea. *Pinnaces* exactly resemble barges, only that they are somewhat smaller, and never row more than eight oars; whereas a barge properly never rows less than ten. These are for the accommodation of the lieutenants, &c. *Cutters* of a ship, are broader, deeper, and shorter, than the barges and pinnaces; they are fitter for sailing, and are commonly employed in carrying stores, provisions, passengers, &c. to and from the ship. In the structure of this sort of boats, the lower edge of every plank in the side overlays the upper edge of the plank below, which is called by ship-wrights *clinch-work*. *Yawls* are something less than cutters, nearly of the same form, and used for similar services; they are generally rowed with six oars.

The above boats more particularly belong to men of war; as merchant-ships have seldom more than two, viz. a long-boat and yawl: when they have a third, it is generally calculated for the countries to which they trade, and varies in its construction accordingly. Merchant-ships employed in the Mediterranean find it more convenient to use a *lanch*, which is longer, more flat-bottomed, and better adapted every way to the harbours of that sea, than a long-boat.

A *wherry* is a light sharp boat, used in a river or harbour for carrying passengers from place to place. *Punts* are a sort of oblong flat-bottomed boats, nearly resembling floating stages; they are used by ship-wrights and caulkers, for breaming, caulking, or repairing a ship's bottom. A *moses* is a very flat broad boat, used by merchant-ships amongst the Caribbee islands, to bring hogsheads of sugar off from the sea beach to the shipping which are anchored in the roads. A *felucca* is a strong passage-boat used in the Mediterranean, from 10 to 16 banks of oars. The natives of Barbary often employ boats of this sort as cruisers.

For the larger sort of boats, see the articles Craft, Cutter, Pe·iagua, and Shallop.

Of all the small boats, a *Norway yawl* seems to be the best calculated for a high sea, as it will often venture out to a great distance from the coast of that country, when a stout ship can hardly carry any sail.

An account of several trials made on a Boat, *or Sloop, fit for inland navigation, coasting voyages, and short passages by sea, which is not, like ordinary vessels, liable to be overset or sunk by winds, waves, water-spouts, or too heavy a load; contrived and constructed by Monsieur Bernieres, director of the bridges and causeways in France,* &c. &c.] Some of these trials were made on the first of August 1777, at the gate of the Invalids in Paris, in the presense of the provost of the merchants, of the body of the town, and a numerous concourse of spectators of all conditions.

The experiments were made in the way of comparison with another common boat of the same place, and of equal size. Both boats had been built ten years, and their exterior forms appeared to be exactly similar. The common boat contained only eight men, who rocked it and made it incline so much to one side, that it it presently filled with water, and sunk; so that the men were obliged to save themselves by swimming; a thing common in all vessels of the same kind, either from the imprudence of those who are in them, the strength of the waves or wind, a violent or unexpected shock, their being overloaded, or overpowered in any other way.

The same men who had just escaped from the boat which sunk, got into the boat of M. Bernieres; rocked it, and filled it, as they had done the other, with water. But, instead of sinking to the bottom, though brim full, it bore being rowed about the river, loaded as it was with men and water, without any danger to the people in it.

M. Bernieres carried the trial still farther. He ordered a mast to be erected in this same boat, when filled with water; and to the top of the mast had a rope fastened, and drawn till the end of the mast touched the surface of the river, so that the boat was entirely on one side, a position into which neither winds nor waves could bring her; yet as soon as the men who had hauled her into this situation let go the rope, the boat and mast recovered themselves perfectly in less than the quarter of a second; a convincing proof that the boat could neither be sunk nor overturned, and that it afforded the greatest possible security in every way. These experiments appeared to give the greater pleasure to the public, as the advantages of the discovery are not only so sensible, but of the first importance to mankind.

Boat-Bill. See Cancroma.

Boat-Insect. See Notonecta, Entomology *Index*.

BOATING, a kind of punishment in use among the ancient Persians for capital offenders. The manner of boating was thus: the person condemned to it being laid on his back in a boat, and having his hands stretched out, and tied fast on each side of it, had another boat put over him, his head being left out through a place fit for it. In this posture they fed him, till the worms, which were bred in the excrements he voided as he thus lay, ate out his bowels, and so caused his death, which was usually 20 days in effecting, the criminal lying all this while in most exquisite torments.

BOATSWAIN, the officer who has the boats, sails, rigging, colours, anchors, and cables, committed to his charge.

It is the duty of the boatswain particularly to direct whatever relates to the rigging of a ship, after she is equipped from a royal dock-yard. Thus he is to observe that the masts are properly supported by their shrouds, stays, and back-stays, so that each of those ropes may sustain a proportional effort, when the mást is strained by the violence of the wind, or the agitation of the ship. He ought also to take care that the blocks and running-ropes are regularly placed, so as to answer the purposes for which they are intended; and that the sails are properly fitted to their yards and stays, and well furled or reefed when occasion requires.

It is likewise his office to summon the crew to their duty; to assist with his mates in the necessary business of the ship; and to relieve the watch when it expires. He ought frequently to examine the condition of the masts, sails, and rigging; and remove whatever may be judged unfit for service, or supply what is deficient: and he is ordered by his instructions to perform this duty with as little noise as possible.

Boatswain's Mate has the peculiar command of the long-boat, for the setting forth of anchors, weighing or fetching home an anchor, warping, towing, or mooring; and is to give an account of his store.

BOB, a term used for the ball of a short pendulum.

BOBARTIA. See Botany *Index*.

BOBBIN, a small piece of wood turned in the form of a cylinder, with a little border jutting out at each end, bored through to receive a small iron pivot. It serves to spin with the spinning-wheel, or to wind thread, worsted, hair, cotton, silk, gold, and silver.

BOBBING, among fishermen, a particular manner of catching eels, different from sniggling. Bobbing for eels is thus performed: They scour well some large lobs, and with a needle run a twisted silk through them from end to end, taking so many as that they may warp them about a board a dozen times at least: then they tie them fast with the two ends of the silk, that they may hang in so many hanks; which done, they fasten all to a strong cord, and, about a handful and a half above the worms, fix a plummet three quarters of a pound weight, and make the cord fast to a strong pole. With this apparatus fishing in muddy water they feel the eels tug lustily at the bait; when they think they have swallowed it sufficiently, they gently draw up the rope to the top, and bring them ashore.

BOBIO, an episcopal town of Italy, in the Sardinian part of the Milanese, seated on the river Trebia, in E. Long. 9. 30. N. Lat. 44. 48.

BOCA-chica, the strait or entrance into the harbour of Carthagena in South America. It is defended by several forts belonging to the Spaniards, all which were taken by the English in 1741; they were nevertheless obliged to raise the siege of Carthagena in a short time after.

Boca-del-Drago, a strait so called, between the island of Trinidad and Andalusia, in the province of Terra Firma in South America.

BOCANUM, in *Ancient Geography*, a town of Mauritania Tingitana, to the south of Mount Atlas; said to be that of Morocco in Africa. W. Long. 9. 0. N. Lat. 31. 0.

BOCCA, in glass-making, the round hole in the working furnace, by which the metal is taken out of the great pots, and by which the pots are put into the furnace. This is to be stopped with a cover made of earth and brick, and removeable at pleasure, to preserve the eyes of the workmen from the violence of the heat.

BOCCACE, or Boccacio, John, one of the most polite and learned writers of his age, was born in Tuscany in 1313. His father first placed him with a merchant; but as he gave signs of genius, he was put afterward to study the canon law: he lost almost as much time at this as at the last occupation; and thought of nothing but poetry. He came under the instruction of Petrarch; but did not so entirely devote himself to poetry, as to forget other studies. In the prosecution of these, however, as he sought everywhere for the best masters, and had not an income sufficient for his expences, he was reduced to such circumstances as to stand in need of the bounty of others; he was particularly obliged to Petrarch, who furnished him with money as well as books, and assisted him in many other respects. Boccace was a great admirer of

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the Greek language: he found means to get Homer translated into Latin for his own use; and procured a professor's chair at Florence for Leontius Pylatus, in order to explain this poet. The republic of Florence honoured Boccace with the freedom of that city; and employed him in public affairs, particularly to negociate the return of Petrarch: but this poet not only refused to return to Florence, but persuaded Boccace also to retire from thence, on account of the factions which prevailed in that republic. Having quitted Florence, he went to several places in Italy, and stopped at last at the court of Naples, where King Robert gave him a very kind reception. He conceived a violent affection for the natural daughter of that prince, which made him remain a considerable time at Naples. He also made a long stay in Sicily, where he was in high favour with Queen Joan. He returned to Florence when the troubles were a little appeased: but not liking the course of life he must have followed there, he retired to Certaldo; and, far from the noise of business, he spent his time in study agreeably to his own humour. His great application brought on him an indisposition, of which he died in 1376. He wrote several books, some learned and serious, others of gallantry and full of stories. It is by his *Decameron* chiefly that he has immortalized himself. Petrarch found so many charms in this composition, that he was at the pains to translate it into Latin for his own satisfaction.

BOCCALE, or BOCAL, a liquid measure used at Rome, answering to what among us is called a bottle, being equivalent to about an English quart. Seven boccales and a half make the rubbia.

BOCCALINI, TRAJAN, a celebrated satirical writer, born at Rome, who, in the beginning of the 17th century, obtained the admiration of all Italy by his refined and delicate criticisms. Sovereign princes themselves did not escape the lash of his satire. The cardinals Borghese and Gætan having declared themselves his protectors, he published his *Ragguaglio di Parnasso*, and *La Secretaria di Apollo*, which is the continuation of the former. These two works were received by the public with uncommon applause. He there feigns, that Apollo, holding his court at Parnassus, heard the complaints of the whole world, and did justice according as the cases required. He at length printed his *Pietra de Parangone;* wherein he attacks the court of Spain, setting forth their designs against the liberty of Italy, and inveighing particularly against them for the tyranny they exercised in the kingdom of Naples. The Spaniards complained of him in form, and were determined at any rate to be revenged. Boccalini was frightened, and retired to Venice; but was there assassinated in a very strange manner. He lodged with one of his friends, who having got up early one morning, left Boccalini in bed: a minute after, some armed men entered his chamber, and gave him so many blows with bags full of sand, that they left him for dead; so that his friend returning some time after, found him speechless. Great search was made at Venice for the authors of this murder; and though they were never discovered, it was universally believed that they were employed by the court of Spain.

BOCCARELLA, in the glass-manufacture, a small hole or aperture of the furnace, one of which is placed on each side of the bocca, almost horizontally with it. Out of them the servitors take coloured or finer metal from the piling pot.

BOCCIARDI, CLEMENTE, called *Clementone*, history and portrait painter, was born at Genoa in 1620, and was the disciple of Bernardo Strozzi, an artist of good reputation; but he found in himself so strong an ambition to arrive at excellence in his profession, that he left Genoa and went to Rome; there to explore that true sublimity of style, which can only be obtained by a judicious observation of the ancient sculptures and the works of the celebrated modern artists. By the guidance of an excellent genius, and also by a most industrious application to design, he discovered the art of uniting and blending the antique and modern gusto in a style that at once exhibited both gracefulness and strength. Most of the works of this master (except his portraits, which were lively, natural, and graceful) are in the chapels of Genoa, Pisa, and other cities of Italy; of which places they are, at this day, accounted the greatest ornaments, and are most exceedingly esteemed.

BOCCONI, SYLVIO, a celebrated natural historian, born at Palermo in Sicily. After he had gone through the usual course of studies, he applied himself chiefly to natural history, in which he made a most surprising progress. He was afterwards ordained priest, and entered into the Cistercian order, at which time he changed his Christian name *Paul* into that of *Sylvio*. This new way of life did not in the least divert him from his favourite study: for he pursued it with greater vigour than ever, and travelled not only over Sicily, but likewise visited the isle of Malta, Italy, the Low Countries, England, France, Germany, Poland, and several other nations; and, in 1696, was admitted a member of the academy of the virtuosi in Germany. Upon his return to Sicily, he retired to a convent of his own order near Palermo; where he died in 1704, being 71 years of age. He left many curious works.

BOCCONIA, GREATER TREE CELANDINE. See BOTANY *Index*.

BOCHART, SAMUEL, one of the most learned men in the 17th century, was born at Roan in Normandy. He made a very early progress in learning, and became a great proficient in the oriental languages. He was many years pastor of a Protestant church at Caen; where he was tutor to Wentworth Dillon earl of Roscommon, author of the Essay on Translated Verse. Here he particularly distinguished himself by his public disputations with Father Veron, a very famous controvertist. The dispute was held in the castle of Caen, in the presence of a great number of Catholics and Protestants. Bochart came off with great honour and reputation: which were not a little increased in the year 1646, upon the publication of his *Phaleg* and *Canaan*, which are the titles of the two parts of his *Geographia Sacra*. He acquired also great fame by his *Hierozoicon*, printed in London in 1675. This treats *de animalibus sacræ scripturæ*. The great learning he displayed in his works rendered him esteemed not only among those of his own profession, but amongst all lovers of knowledge of whatever denomination. In 1652, the queen of Sweden invited him to Stockholm, where she gave him many proofs of her regard and esteem. At his return to Caen, he resumed the functions of the ministry,

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stry, and was received into the acadamy of that city. His learning was not his principal qualification, he had a modesty equal to it; and hence enjoyed his great reputation in tranquillity, sheltered from those unhappy quarrels which so many other learned men draw upon themselves. He died suddenly while he was speaking in the above academy, on the 16th of May, 1667, aged 78. A complete edition of his works was published in Holland, in two volumes folio, 1712.

BOCHIUS, or BOCQUI, JOHN, a Latin poet, born at Brussels in 1555. He travelled into Italy, Germany, Poland and Muscovy, and at his return became secretary to the duke of Parma. He died on the 13th of January, 1609. The critics in the Netherlands set so great a value on his poetry, that they gave him the name of the *Belgic Virgil*. He wrote, 1. *De Belgii Principatu*. 2. *Parodia Heroica Psalmorum Davidicorum*. 3. *Observationes Physicæ, Ethicæ, Politicæ, et Historicæ, in Psalmos*. 4. *Vita Davidis*. 5. *Orationes*. 6. *Poemata*.

BOCHETTA, a place of Italy, famous in the war of 1746 and 1747. It is a chain of mountains over which the great road lies from Lombardy to Genoa; and on the very peak of the highest mountain is a narrow pass, which will hardly admit three men to go abreast. This pass is properly called the *Bochetta;* for the defence of which there are three forts. It is the key of the city of Genoa; and was taken in 1746 by the imperialists; by which means they opened a way to that city.

BOCKHOLT, a town of Germany in the circle of Westphalia and principality of Munster, capital of a small district, and subject to Prussia. E. Long. 6. 20. N. Lat. 51. 40.

BOCKING, a very large village of Essex in England, adjoining to Braintree, from which it is separated only by a small stream. Its church is a deanery, and very large; and there are here two or three meeting-houses; but the market is kept at Braintree. It contained 2544 inhabitants in 1811. There is a large manufactory of baize, chiefly for exportation, which gives employment to a great number of men, women, and children. It is 42 miles north-east of London.

BOCK-LAND, in the Saxons time, is what we now call *freehold lands*, held by the better sort of persons by charter or deed in writing; by which name it was distinguished from *folkland* or copy-hold land, holden by the common people without writing.

BODERIA, or BODOTRIA, the ancient name for the frith of Forth in Scotland.

BODIN, JOHN, native of Angiers, one of the ablest men in France in the 16th century, famous for his *Method of History*, his *Republic*, and other works. He was in great favour with Henry III. who imprisoned John de Serre for writing an injurious piece against Bodin, and forbade him upon pain of death to publish it. But his favour was not of long continuance. The duke of Alençon, however, gave him several employments; and carried him to England with him as one of his counsellors, where he had the pleasure and glory to see his books *de Republica* read publicly in the university of Cambridge, having been translated into Latin by the English. He had written them in French. In the Ragguaglio of Boccalini he is condemned as an atheist to the fire, for having said in his books that liberty of conscience ought to be granted to sectaries. He declared himself pretty freely against those who asserted that the authority of monarchs is unlimited; but yet he displeased the republicans. Upon the death of the duke of Alençon, Bodin retired to Laon, where he married. He had an office in the presidial of this city; and in Charles IX.'s time he was the king's solicitor, with a commission for the forests of Normandy. He died of the plague at Laon, in 1596.

BODKIN, a small instrument made of steel, bone, ivory, &c. used for making holes.

BODLEY, SIR THOMAS, founder of the Bodleian library at Oxford, was born at Exeter in Devonshire, in 1544. When he was about 12 years of age, his father, Mr John Bodley, being a Protestant, was obliged to leave the kingdom. He settled at Geneva with his family, and continued there till the death of Queen Mary. In that university, then in its infancy, young Bodley studied the learned languages, &c. under several eminent professors. On the accession of Queen Elizabeth, he returned with his father to England; and was soon after entered of Magdalen college in Oxford. In 1563, he took the degree of bachelor of arts, and the year following was admitted fellow of Merton college. In 1565, he read a Greek lecture in the hall of that college. He took a master of arts degree the year after, and read natural philosophy in the public schools. In 1569, he was one of the proctors of the university, and for some time after officiated as public orator. In the year 1576, he quitted Oxford, and made the tour of Europe; but returned to his college after four years absence. He became gentleman-usher to Queen Elizabeth, in the year 1583; and in 1585 he married the widow of Mr Bell, daughter of Mr Carew of Bristol, a lady of considerable fortune. Mr Bodley was soon after sent ambassador to the king of Denmark, and other German princes. He was next charged with an important commission to Henry III. of France; and in 1588, went ambassador to the United Provinces, where he continued till the year 1597. On his return to England, finding his preferment obstructed by the jarring interests of Burleigh and Essex, he retired from court, and could never afterwards be prevailed on to accept of any employment. He now began the foundation of the Bodleian library, which was completed in 1599. Soon after the accession of King James I. he received the honour of knighthood, and died in the year 1612. He was buried in the choir of Merton college. His monument is of black and white marble, on which stands his effigy in a scholar's gown, surrounded with books. At the four corners are the emblematical figures of Grammar, Rhetoric, Music, and Arithmetic; two angels, &c.; with a short inscription, signifying his age and time of his death. Sir Thomas Bodley was a polite scholar, an able statesman, and a worthy man. Mr Granger observes, that he merited much as a man of letters; but incomparably more in the ample provision he made for literature, in which he stands unrivalled; and that his library is a mausoleum which will perpetuate his memory as long as books themselves endure. Sir Thomas wrote his own Life to the year 1609; which, together with the first draught of the Statutes, and his Letters, have been published from the originals

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originals in the Bodleian library, by Mr Thomas Hearn, in 1703.

BODMIN, a town of Cornwall in England, seated in a bottom between two high hills, which renders the air very unwholesome. It consists chiefly of one street, and the many decayed houses show that it has once been a place of greater note. It is a mayor-town, sends two members to parliament, and had formerly the privilege of the coinage of tin. Population 2050 in 1811. W. Long. 4. 5. N. Lat. 50. 32.

BODON, a fortified town of Bulgaria, in Turkey in Europe, with an archbishop's see. It is seated on the Danube, in E. Long. 25. 24. N. Lat. 45. 10.

BODROCH, a town of Hungary, seated on the north-east shore of the river Danube, in E. Long. 20. 20. N. Lat. 46. 15.

BODRUN. See TEOS.

BODY, in *Physics*, an extended solid substance, of itself utterly passive and inactive, indifferent either to motion or rest.

Colour of BODIES. See CHROMATICS.

BODY, with regard to animals, is used in opposition to soul, in which sense it makes the subject of anatomy. The height of the human body is said to be different in different parts of the day; ordinarily it is an inch more in the morning than at night *. The body ceases to grow in height when the bones are arrived at a degree of firmness and rigidity which will not allow of farther extension by the effort of the heart and motion of the blood.

* Phil. Trans. No. 283.

BODY, among painters, as to *bear a body*, a term signifying that the colours are of such a nature, as to be capable of being ground so fine, and mixing with the oil so entirely, as to seem only a very thick oil of the same colour.

BODY, in the manege. A horse is chiefly said to have a *good body*, when he is full in the flank. If the last of the short ribs be at a considerable distance from the haunch-bone, although such horses may for a time have pretty good bodies, yet, if they are much laboured, they will lose them: and these are properly the horses that have no flank. It is also a general rule, that a man should not buy a light-bodied horse, and one that is fiery, because he will soon destroy himself.

BODY, in the art of war, a number of forces, horse and foot, united and marching under one commander.

Main BODY *of an Army*, the troops encamped in the centre between the two wings, and generally infantry; the other two bodies are the vanguard and the rear-guard; these being the three into which an army, ranged in order of battle, is divided.

BODY, in matters of literature, denotes much the same with system, being a collection of every thing belonging to a particular science or art, disposed in proper order: thus we say, a body of divinity, law, physic, &c.

Body-Corporate. See CORPORATION.

BOECE, or BOETHIUS, HECTOR, the historian, was born at Dundee about the year 1470, studied at Aberdeen, and afterwards in the university of Paris. There he became acquainted with Erasmus, and laid the foundation of a friendship which was so honourable to him. In 1500 he was recalled to Aberdeen by Bishop Elphingston, who made him principal of that university. Gratitude for this promotion engaged him to write with particular attention the Life of that prelate. It appeared in the history of the diocese of Aberdeen; and may be considered, perhaps, as the most valuable portion of that work. His History of Scotland, a more useful undertaking, was first published in the year 1526. In 1574 it underwent a second impression, and was enriched with the 18th book and a part of the 19th. A farther continuation of it was executed by Joannes Ferrerius Pedemontanus. Boece died about the year 1550. He has been compared, and not without reason, to Geoffroy of Monmouth. He had a propensity to fable and exaggeration; a fault which the elegance of his expression does not compensate. His judgment was not equal to his genius; and his fictions as a historian are a contrast to his probity as a man. John Ballenden, archdeacon of Murray, translated his history into the Scottish language at the desire of James V. This translation William Harrison converted, though with imperfections, into English; and his associate Hollingshed published his work in his chronicle, with additions and improvements by the ingenious Francis Thynne.

BOEDROMIA, in antiquity, solemn feasts held at Athens in memory of the succour brought by Ion to the Athenians, when invaded by Eumolpus son of Neptune in the reign of Erectheus. Plutarch gives another account of the Boedromia; which, according to him, were celebrated in memory of the victory obtained by Theseus over the Amazons, in the month Boedromion.

BOEDROMION, in *Chronology*, the third month of the Athenian year, answering to the latter part of our August and beginning of September.

BOEHMEN, JACOB, called the *Teutonic philosopher*, was a noted visionary of the 17th century, born in a village of Germany near Gorlitz, in 1575. He was bred a shoemaker: and marrying, supported a large family by this occupation; until, after amusing himself with chemistry, a visionary turn of mind, heated by sermons and German divinity, got the better of his common sense, and produced raptures and notions of divine illumination. These he first gave vent to in 1612, by a treatise entitled Aurora, or the Rising of the Sun; being a mixture of astrology, philosophy, chemistry, and divinity, written in a quaint obscure style. This being censured by the magistrates of Gorlitz, he remained silent for seven years; but improving that interval by pursuing the flights of his imagination, he resumed his pen; and resolving to redeem the time he had lost, in the remaining five years of his life, he published above 20 books, which greatly needed what he concluded with, *A Table of his Principles, or a Key to his Writings*; though this has not proved sufficient to render them intelligible to common apprehensions. The key above mentioned appeared in 1624, and he did not long survive it. For early in the morning of the 18th of November that year, he called one of his sons, and asked him "if he also heard that excellent music?" to which being answered in the negative, he ordered the door to be set open, that the music might be the better heard. He asked afterwards what o'clock it was? and being told it had struck two, he said "It is not yet my time; my time is three hours hence." In the interim he was heard to speak these words:

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"O thou strong God of hosts, deliver me according to thy will! O thou crucified Lord Jesus, have mercy upon me, and receive me into thy kingdom!" When it was near six o'clock, he took his leave of his wife and sons, and blessed them, and said, "Now I go hence into paradise;" then bidding his son turn him, he immediately expired his last breath in a deep sigh. A great number of persons have been misled by the visions of this fanatic, notwithstanding his talents in involving the plainest things in mystery and enigmatical jargon. Among others, the famous Quirinus Kahlman may be reckoned the principal of his followers in Germany: who says, he had learned more being alone in his study, from Boehmen, than he could have learned from all the wise men of that age together; and, that we may not be in the dark as to what sort of knowledge this was, he acquaints us, that amidst an infinite number of visions it happened, that, being snatched out of his study, he saw thousands of thousands of lights rising round about him. Nor has he been without admirers, and those in no small number, in England: among the foremost of whom stands the famous Mr William Law, author of *Christian Perfection*, &c. who has favoured his countrymen with an English edition of Jacob Boehmen's works in 2 vols. 4to.

BOEOTIA, the name of two ancient kingdoms, one of which was founded or rather restored by Cadmus, and named by him *Bœotia*, from the ox which is said to have directed him to the place where he built the capital of his new kingdom, better known afterwards by the name of *Thebes*. But as the inhabitants were scarcely ever distinguished as a nation by the name of *Bœotians*, but of *Thebans*, we refer to the article THEBES for their history, &c.

The other Bœotia was in Thessaly, and is said to have been founded by Bœotus the son of Neptune and brother of Æolus, by Arne the daughter of Æolus king of Æolis. This last, having sent his daughter to Metapontum a city of Italy, she was there delivered of those two sons, the eldest of whom she called after her father's name *Æolus;* and he possessed himself of the islands in the Tyrrhenian, now the Tuscan sea, and built the city of Lipara. Bœotus the younger son went to his grandfather and succeeded him in his kingdom, called it after his own name, and the capital city, *Arne*, from his mother. All that we know of these Bœotians is, that they held this settlement upwards of 200 years; and that the Thessalians expelled them from it; upon which they came and took possession of that country, which till then had been called *Cadmeis*, and gave it the name of *Bœotia*. Diodorus and Homer tell us, that these Bœotians signalized themselves at the Trojan war; and the latter adds, that five of Bœotus's grandsons, viz. Peneleus, Leitus, Prothœnor, Arcesilaus, and Clonius, were the chiefs who led the Bœotian troops thither.

BOERHAAVE, HERMAN, one of the greatest physicians, as well as the best men, that this or perhaps any age has ever produced, was born in 1668, at Vorhout, a village near Leyden. At the age of 16 he found himself without parents, protection, advice, or fortune. He had already studied theology and the other ecclesiastical sciences, with the design of devoting himself to a clerical life; but the science of nature, which equally engaged his attention, soon engrossed his whole time. This illustrious person, whose name afterwards spread throughout the world, and who left at his death above 200,000l. could at that time barely live by his labours, and was compelled to teach mathematics to obtain necessaries. But in 1693, being received doctor in the science of physic, he began practice; and his merit being at length discovered, many powerful friends patronized him, and procured him three valuable employments: the first was that of professor of medicine in the university of Leyden; the second, that of professor of chemistry; and, thirdly, that of professor of botany. The Academy of Sciences at Paris, and the Royal Society at London, invited him to become one of their members. He communicated to each his discoveries in chemistry. The city of Leyden became in his time the school of Europe for this science, as well as for medicine and botany. All the princes of Europe sent him disciples, who found in this skilful professor, not only an indefatigable teacher, but even a tender father, who encouraged them to pursue their labours, consoled them in their afflictions, and solaced them in their wants. When Peter the Great went to Holland in 1715, to instruct himself in maritime affairs, he also attended Boerhaave to receive his lessons. His reputation was spread as far as China: a mandarin wrote to him with this inscription, "To the illustrious Boerhaave, physician in Europe;" and the letter came regularly to him. The city of Leyden has raised a monument in the church of St Peter, to the salutary genius of Boerhaave, *Salutifero Boerhaavii genio sacrum*. It consists of an urn upon a pedestal of black marble: six heads, four of which represent the four ages of life, and the two sciences in which Boerhaave excelled, form a group issuing between the urn and its supporters. The capital of this basis is decorated with a drapery of white marble, in which the artist has shown the different emblems of disorders and their remedies. Above, upon the surface of the pedestal, is the medallion of Boerhaave: at the extremity of the frame, a ribband displays the favourite motto of this learned man: *Simplex sigillum veri*, "Truth unarrayed."

From the time of the learned Hippocrates, no physician has more justly merited the esteem of his cotemporaries, and the thanks of posterity, than Boerhaave. He united to an uncommon genius, and extraordinary talents, the qualities of the heart, which gave them so great a value to society. He made a decent, simple, and venerable appearance, particularly when age had changed the colour of his hair. He was an eloquent orator, and declaimed with dignity and grace. He taught very methodically, and with great precision; he never tired his auditors, but they always regretted that his discourses were finished. He would sometimes give them a lively turn with raillery; but his raillery was refined and ingenious, and it enlivened the subject he treated of, without carrying with it any thing severe or satirical. A declared foe to all excess, he considered decent mirth as the salt of life. It was the daily practice of this eminent person, through his whole life, as soon as he rose in the morning, which was generally very early, to retire for an hour to private prayer and meditation on some part of the Scriptures. He often told his friends, when they asked him how it was possible

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sible for him to go through so much fatigue? that it was *this* which gave him spirit and vigour in the business of the day. *This* he therefore recommended as *the best rule* he could give: for nothing, he said, could tend more to the health of the body than the tranquillity of the mind; and that he knew nothing which could support himself, or his fellow-creatures, amidst the various distresses of life, but a well grounded confidence in the supreme Being upon the principles of Christianity. This was strongly exemplified in his own illness in 1722, which can hardly be told without horror; and by which the course of his lectures as well as his practice was long interrupted. He was for five months confined to his bed by the gout, where he lay upon his back without daring to attempt the least motion; because any effort renewed his torments, which were so exquisite, that he was at length not only deprived of motion but of sense. Here his medical art was at a stand; nothing could be attempted, because nothing could be proposed with the least prospect of success. But, having (in the sixth month of his illness) obtained some remission, he determined to try whether the juice of fumitory, endive, or succory, taken thrice a-day in large quantity, (viz. above half a pint each dose), might not contribute to his relief; and by a perseverance in this method he was wonderfully recovered. This patience of Boerhaave's was founded not on vain reasonings, like that of which the Stoics boasted; but on a religious composure of mind, and Christian resignation to the will of God.

Of his sagacity and the wonderful penetration with which he often discovered and described, at the first sight of a patient, such distempers as betray themselves by no symptoms to common eyes, such surprising accounts have been given, as scarcely can be credited though attested beyond all doubt. Yet this great master of medical knowledge was so far from having presumptuous confidence in his abilities, or from being puffed up by his riches, that he was condescending to all, and remarkably diligent in his profession: and he often used to say that the life of a patient (if trifled with or neglected) would one day be required at the hand of the physician. He always called the poor his *best patients;* for God (said he) is their paymaster. The activity of his mind sparkled visibly in his eyes. He was always cheerful, and desirous of promoting every valuable end of conversation; and the excellency of the Christian religion was frequently the subject of it: for he asserted, on all proper occasions, the divine authority and sacred efficacy of the Scriptures; and maintained, that they only could give peace of mind, that sweet and sacred peace which passeth all understanding; since none can conceive it but he who has it; and none can have it but by divine communication. He never regarded calumny nor detraction (for Boerhaave himself had enemies), nor ever thought it necessary to confute them. "They are sparks (said he) which, if you do not blow, will go out of themselves. The surest remedy against scandal, is to *live it down* by a perseverance in well-doing; and by praying to God that he would cure the distempered minds of those who traduce and injure us." Being once asked by a friend, who had often admired his patience under great provocations, whether he knew what it was to be angry, and by what means he had so entirely suppressed that impetuous and ungovernable passion? he answered, with the utmost frankness and sincerity, that he was naturally quick of resentment: but that he had, by daily prayer and meditation, at length attained to this mastery over himself.

About the middle of the year 1737, he felt the first approaches of that fatal illness which brought him to the grave, viz. a disorder in his breast, which was at times very painful, often threatening him with immediate suffocation, and terminated in an universal dropsy: but during this afflictive and lingering illness, his constancy and firmness did not forsake him; he neither intermitted the necessary cares of life, nor forgot the proper preparations of death. About three weeks before his dissolution, when the Rev. Mr Schultens, one of the most learned and exemplary divines of the age, attended him at his country-house, the doctor desired his prayers, and afterwards entered into a most remarkably judicious discourse with him on the spiritual and immaterial nature of the soul; and this he illustrated to Mr Schultens with wonderful perspicuity, by a description of the effects which the infirmities of his body had upon his faculties; which yet they did not so oppress or vanquish, but his soul was always master of itself, and always resigned to the pleasure of its Maker—and then he added, "He who loves God ought to think nothing desirable but what is most pleasing to the supreme goodness." These were his sentiments, and such was his conduct in this state of weakness and pain. As death approached nearer, he was so far from terror or confusion, that he seemed less sensible of pain, and more cheerful under his torments, which continued till the 23d day of September, 1738, on which he died (much honoured and lamented) between four and five in the morning, in the 70th year of his age—often recommending to the bye-standers a careful observation of St John's precepts concerning the love of God, and the love of man, as frequently inculcated in his first epistle, particularly in the fifth chapter. His funeral oration was spoken in Latin before the university of Leyden, to a very numerous audience, by Mr Schultens, and afterwards published at their particular desire. He wrote, 1. *Institutiones Medicæ.* 2. *Aphorismi de cognoscendis et curandis Morbis.* 3. *Institutiones et Experimenta Chemiæ.* 4. *Libellus de Materia Medica, et remediorum formulis quæ serviunt aphorismus.* Swieten published, *Commentaries upon his Aphorisms*, in 5 vols 4to; and several other works, all greatly esteemed.

BOERHAAVIA. See Botany *Index*.

BOESCHOT, a town of the Netherlands, in the province of Brabant, seated on the river Nethe, in E. Long. 4. 45. N. Lat. 51. 5.

BOETHIUS, or Boetius, Flavius Anicius Manlius Torquatus Severinus, a prose as well as poetical writer of the 6th century, born of one of the noblest families of the city of Rome. The time of his birth is related to have been about that period in the Roman history when Augustulus, whose fears had induced him to a resignation of the empire, was banished, and Odoacer king of the Herulians began to reign in Italy, viz. in the year of Christ 476, or somewhat after. The father of Boetius dying while he was yet an infant, his relations undertook the care of his education and the direction of his studies. His excellent parts were soon discovered; and,

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and, as well to enrich his mind with the study of philosophy as to perfect himself in the Greek language, he was sent to Athens. Returning young to Rome, he was soon distinguished for his learning and virtue, and promoted to the principal dignities in the state, and at length to the consulate. Living in great affluence and splendour, he addicted himself to the study of theology, mathematics, ethics, and logic; and how great a master he became in each of these branches of learning, appears from those works of his now extant. The great offices which he bore in the state, and his consummate wisdom and inflexible integrity, procured him such a share in the public councils, as proved in the end his destruction: for as he employed his interest with the king for the protection and encouragement of deserving men, so he exerted his utmost efforts in the detection of fraud, the repressing of violence, and the defence of the state against invaders. At this time Theodoric the Goth had attempted to ravage Campania; and it was owing to the vigilance and resolution of Boetius that this country was preserved from destruction. At length, having murdered Odoacer, Theodoric became king of Italy, where he governed 33 years with prudence and moderation, during which time Boetius possessed a large share of his esteem and confidence. It happened about this time that Justin, the emperor of the east, upon his succeeding to Anastasius, made an edict condemning all the Arians, except the Goths, to perpetual banishment from the eastern empire: in this edict Hormisda bishop of Rome, and also the senate, concurred. But Theodoric, who, as being a Goth, was an Arian, was extremely troubled at it; and conceived an aversion against the senate for the share they had borne in this proscription. Of this disposition in the king, three men of profligate lives and desperate fortunes, Gaudentius, Opilio, and Basilius, took advantage. Having entertained a secret desire of revenge against Boetius, for having been instrumental in the dismission of the latter from a lucrative employment under the king, they accused him of several crimes; such as the stifling a charge, the end whereof was to involve the whole senate in the guilt of treason; and an attempt, by dethroning the king, to restore the liberty of Italy; and, lastly, they suggested, that, to acquire the honours he was in possession of, Boetius had had recourse to magical art. Boetius was at this time at a great distance from Rome; however, Theodoric transmitted the complaint to the senate, enforcing it with a suggestion that the safety, as well of the people as the prince, was rendered very precarious by this supposed design to exterminate the Goths. The senate, perhaps fearing the resentment of the king, and having nothing to hope from the success of an enterprise which, supposing it ever to have been meditated, was now rendered abortive, without summoning him to his defence, condemned Boetius to death. The king, however, apprehending some bad consequence from the execution of a sentence so flagrantly unjust, mitigated it to banishment. The place of his exile was Ticinum, now the city of Pavia, in Italy. Being in that place separated from his relations, who had not been permitted to follow him into his retirement, he endeavoured to derive from philosophy those comforts which that alone was capable of affording to one in his forlorn situation, sequestered from his friends, in the power of his enemies, and at the mercy of a capricious tyrant; and accordingly he there composed that valuable discourse, entitled, *De Consolatione Philosophiæ.* About two years after his banishment Boetius was beheaded in prison by the command of Theodoric. His tomb is to be seen in the church of St Augustine, at Pavia, near the steps of the chancel.

The extensive learning and eloquence of this great man are conspicuous in his works, which seem to have been collected with great care: an edition of them was printed at Venice, in one volume folio, in 1499. In 1570, Glareanus, of Basil, collated that with several manuscripts, and published it, with a few various readings in the margin. His chief performance is that above mentioned, *De Consolatione Philosophiæ;* a work well known in the learned world, and to which the afflicted have often applied. In particular, our Saxon King Alfred, whose reign, though happy upon the whole, was attended with great vicissitudes of fortune, had recourse to it at a time when his distresses compelled him to seek retirement: and that he might the better impress upon his mind the noble sentiments inculcated in it, he made a complete translation of it into the Saxon language, which, within these few years, has been given to the world in its proper character. And Camden relates, that Queen Elizabeth, during the time of her confinement by her sister Mary, to mitigate her grief, read and afterwards translated it into very elegant English. But it deserves also particular notice, that he is the most considerable of all the Latin writers on music; and that his treatise *De Musica* supplied for some centuries the want of those Greek manuscripts which were supposed to have been lost.

BOG properly signifies a quagmire, covered with grass, but not solid enough to support the weight of the body; in which sense it differs only from marshes or fens, as a part from the whole: some even restrain the term *bog* to quagmires pent up between two hills; whereas fens lie in champaign and low countries, where the descent is very small.—To drain boggy lands, a good method is, to make trenches of a sufficient depth to carry off the moisture; and if these are partly filled up with rough stones, and then covered with thorn-bushes and straw, to keep the earth from filling up the interstices, a stratum of good earth and turf may be laid over all; the cavities among the stones will give passage to the water, and the turf will grow at top.

Bog, or *Bog of Gight*, a small town of Scotland, seated near the mouth of the river Spey, in W. Long. 2. 23. N. Lat. 57. 48.

BOGALCUND, a province of Hindostan. See Supplement.

BOGARMITÆ. See Bogomili.

BOGHO, or Bueil, a town in the county of Nice in Piedmont, situated in the frontiers of France, in E. Long. 6. 45. N. Lat. 44. 12.

BOGLIO, a district in the territories of the duke of Savoy, lying on the river Tinca on the frontiers of Provence; the capital is of the same name.

Boglio, a town of Piedmont, and county of Nice, being the capital of a territory of the same name. E. Long. 6. 55. N. Lat. 44. 5.

BOGOMILI, or Bogarmitæ, in church history, a

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a sect of heretics, which sprung up about the year 1179. They held, that the use of churches, of the sacrament of the Lord's Supper, and all prayer, except the Lord's prayer, ought to be abolished; that the baptism of catholics is imperfect; that the persons of the Trinity are unequal; and that they oftentimes made themselves visible to those of their sect. They said, that devils dwelt in the churches, and that Satan had resided in the temple of Solomon from the destruction of Jerusalem to their own time.

BOGOTA, or SANTA FE DE BOGOTA, the capital of New Granada in South America, belonging to Spain. It was taken by the Independents under Bolivar in 1819. W. Long. 74. 10. N. Lat. 4. 35.

BOGUDIANA (Pliny), a part of the Mauritania Tingitana in Africa. According to Cluverius, it is the *Tingitana*, anciently so called from King Bogud.

BOHADDIN, an eminent Arabian writer. See SUPPLEMENT.

BOHEA, in commerce, one of the coarsest kinds of tea that come from China. See THEA.

BOHEMIA, a kingdom of Europe subject to the house of Austria, and surrounded on every side with woods and mountains as with a natural rampart. It is bounded on the east by Moravia and part of Silesia, on the north by Lusatia and Upper Saxony, on the west by Franconia, and on the south by Bavaria. Although this kingdom is situated in the middle of Germany, and its king is an elector of the empire, it has nevertheless its particular assemblies, customs, and language, different from the Germans. It is one of the most elevated countries of Europe: for no river enters into it, though many have their source there; the chief of which are the Elbe, the Oder, the Vistula, and the Morava. Its greatest length is 200 miles, its breadth 180, and it comprehends an area of 20,000 square miles. The climate of the interior is temperate and healthy, but on the frontiers it is raw and inclement, on account of the high grounds. The soil is generally rich. Besides corn, flax, hemp, hops, saffron, it produces wine, though only in small quantity. Nearly one-third of the country is covered with wood. It is rich in minerals. Its gold mines are exhausted: but it has mines of silver, iron, mercury, copper, lead, cobalt, zinc, calamine, antimony, pit coal; and its mines of tin are next in value to those of Cornwall. Its manufactures consist of yarn, linen, cambric, stockings, lace, woollen stuffs, glass, cotton and silk stuffs, leather, &c. and amounted in value in 1792 to 3,630,000l. sterling, of which about a third is exported.

Bohemia is the most populous of all the Austrian dominions beyond the Alps. The number of inhabitants in 1789 was 2,852,463, and in 1817 it was 3,236,140. The Bohemian nobility consist of 10 princes, 110 counts, 82 barons, and 238 knights. The original language of the people is a dialect of the Sclavonian; but German is spoken in all the large towns. The established religion is the Roman Catholic; but there are about 100,000 dissenters, consisting of Jews, Lutherans, and Calvinists. There is a university at Prague, the chief town, and there are about 2200 schools in the country.

The name *Bohemia*, in the German language, signifies the *home* or *abode of the Boii*, a people of ancient Gaul, who under their leader Sergovesus settled in that country about 500 years before the Christian era. These Boii were soon after expelled by the Marcomanni, a nation of the Suevi, who were afterwards subdued by the Sclavi, a people of Scythia, whose language is still spoken in Bohemia and Moravia. Notwithstanding this expulsion of the Boii, the present inhabitants are still called *Bohemians* by foreigners, but the natives call themselves *Zechs*. At first they were governed by dukes; but the emperor Otho I. conquered the duke of Bohemia, and reduced the province under the empire. Afterwards Henry V. gave the title of *king* to Ladislaus duke of Bohemia; and since that time these kings have been electors and chief cup-bearers of the empire, and the kingdom has been elective; which privileges have been confirmed by the golden bull. Formerly the kings of Bohemia received the kingdom as a fief of the empire, which ceremony was practised upon the frontiers; after which the standards of the principalities of which it is composed were given to them, without being torn and given to the people, as is done with the ensigns of the other fiefs of the empire. Ferdinand I. of Austria, having married Anne, sister of Louis, last king of Bohemia, who died without issue, and being elected king, that kingdom has remained in his family ever since. But the crown is conferred with some appearance of election; which right the states of Bohemia still pretend to claim, notwithstanding that, by the treaty of Westphalia, Bohemia is declared hereditary in the house of Austria.

The king of Bohemia was formerly the first secular elector, and gave his opinion after the elector of Cologne. The states of Bohemia have never been comprehended in the government or in the circles of the empire; they are not subject to any of its jurisdictions, nor to the Roman months, taxes, or public contributions; and they owed nothing to the empire but what the king voluntarily imposed upon himself. The government of Bohemia is different from that of all other states, the affairs of the kingdom being managed by six different courts. First, the council of the regency, or the great royal council, in which presides the great judge or burgrave of Bohemia, and who has under him 18 lieutenants of the king and other assessors. Secondly, The council or superior chamber of justice, at which the great master of the kingdom is president. Thirdly, The chamber of fiefs. Fourthly, The new tribunals to judge the appeals of the German vassals in their differences on the account of fiefs; which court has also its president, vice-president, and assessors. Fifthly, The royal chamber of finances, which has a president and vice-president. Sixthly, The chancery, which always follows the court. Besides, every circle of Bohemia is governed by two bailiffs, who administer justice in their prefecture. The states are composed of the clergy, lords, nobles, and burghers. As to Moravia, there is a grand bailiff who governs it in the name of the king of Bohemia, as margrave of Moravia. He is at the head of the royal council, which is composed of three assessors, and in which all is transacted in the name of the king. This province is divided into five circles, each of which has a bailiff. There are, besides, other officers of justice, who have a right of judging only at certain times, and in particular cases, where an appeal is allowed.

Bohemia was divided by the emperor Charles IV. into 12 provinces, in each of which he ordered two captains to be appointed every year for the administration of the government. The same emperor caused the church of Prague to be erected into an archbishopric, with

Bohemia ‖ Boiemum.

with this advantage, that the archbishop of Prague should have the prerogative that the archbishop of Mentz formerly enjoyed, viz. of crowning the king of Bohemia. The duchy of Silesia, the marquisate of Moravia, and that of Lusatia, formerly held of this crown; but now only that of Moravia, which is incorporated with the kingdom of Bohemia, and is in the possession of the house of Austria. The total revenue of Bohemia is about 2,000,000l. sterling; and its peace establishment amounts to 50,000 or 60,000 men.

The only remarkable occurrence in the Bohemian history is the rebellion of the disciples of John Huss, and Jerome of Prague, on account of their leaders having been burnt as heretics. This occasioned a bloody war of 16 years continuance; for a particular account of which, see the article Hussites.

BOHEMIAN bole. See Bole.

Bohemian Brethren, a sect of Christian reformers which sprung up in Bohemia in the year 1467. They treated the pope and cardinals as antichrist, and the church of Rome as the whore spoken of in the Revelation. They rejected the sacraments of the Romish church, and chose laymen for their ministers. They held the Scriptures to be the only rule of faith, and rejected the popish ceremonies in the celebration of the mass, nor did they make use of any other prayer than the Lord's Prayer. They consecrated leavened bread. They allowed no adoration but of Jesus Christ, in the communion. They rebaptized all such as joined themselves to their congregation. They abhorred the worship of saints and images, prayers for the dead, celibacy, vows, and fasts; and kept none of the festivals but Christmas, Easter, and Whitsuntide.

In 1504, they were accused by the Catholics to King Ladislaus II. who published an edict against them, forbidding them to hold any meeting either privately or publicly. When Luther declared himself against the church of Rome, the Bohemian Brethren endeavoured to join his party. At first, that reformer showed a great aversion to them; but the Bohemians sending their deputies to him in 1523 with a full account of their doctrines, he acknowledged that they were a society of Christians whose doctrines came nearest to the purity of the gospel. The sect published another confession of faith in 1535, in which they renounced anabaptism, which they at first practised: upon which a union was concluded with the Lutherans, and afterwards with the Zuinglians, whose opinions from thenceforth they continued to follow.

BOHOL, one of the Philippine islands in Asia, lying to the northward of Mindanao, in E. Long. 122. 5. N. Lat. 10. 0.

BOIANO, a town of Italy, in the kingdom of Naples, and county of Molese, with a bishop's see. It is seated at the foot of the Apennines, near the river Tiferno, in E. Long. 14. 38. N. Lat. 41. 30.

BOIARDO, Matteo Maria, of Ferrara, count of Scandiano, celebrated for his Italian poems, lived in the 15th century. His principal work is his *Orlando inamorato*. His Latin eclogues and sonnets are also much admired.

BOJARS, denote Russian noblemen. See Russia.

BOIEMUM, in *Ancient Geography*, a part of Germany, surrounded with the Montes Sudeti (Ptolemy); now called Bohemia. It took its name from the Boii, a people of Gaul, who removed thither before Cæsar's expedition into that country, (Cæsar); though he seems to err in the name. The Boii were afterwards driven out by the Marcomanni, and settled in the west of Vindelicia, which was afterwards called Bayern, and hence the name Bavaria.

Boiemum ‖ Boileau.

BOII, (Cæsar); a people of Celtica, extending from the Ligeris to the Elaver, whence came the Boii of Gallia Cisalpina, whose migration is related by Livy.

Boii. See Bohemia.

BOIGUACU, in *Zoology*, a synonyme of the boa constrictor. See Boa, Ophiology *Index*.

BOIL, or Furuncle. See the *Index* subjoined to Medicine and Surgery.

BOILEAU, Sieur Nicholas Despreaux, a celebrated French poet, was born at Paris in 1636. After he had gone through his course of polite literature and philosophy, his relations engaged him to the study of the law, and he was admitted advocate. But though he had all the talents necessary for the bar, yet he could not adapt himself to a science which turns upon continual equivocations, and often obliges those who follow it to clothe falsehood in the garb of truth. He therefore determined to study theology; but he could not long endure the thorns of school divinity. He imagined, that, to allure him more cunningly, chicanery, which he thought to avoid, had only changed her habit; and so he renounced the Sorbonne, betook himself entirely to the belles lettres, and took possession of one of the foremost places in Parnassus. The public gave his works the encomium they deserved; and Louis XIV. who always loved to encourage the sciences and polite literature, was not only pleased to have M. Boileau's works read to him constantly as he composed them, but settled a yearly pension of 2000 livres upon him, and gave him the privilege of printing all his works. He was afterwards chosen a member of the French academy, and also of the academy of medals and inscriptions. This great man, who was as remarkable for his integrity, his innocence, and diffusive benevolence, as for the keenness of his satires, died of a dropsy on the 2d of March 1711, in the 75th year of his age. The Lutrin of Boileau, still considered by some French critics of the present time as the best poem to which France has given birth, was first published in 1674. It is with great reason and justice that Voltaire confesses the Lutrin inferior to the Rape of the Lock. Few poets can so properly be compared as Pope and Boileau; and, wherever their writings will admit of comparison, we may, without any national partiality, adjudge the superiority to the English bard. These two great authors resembled each other as much in the integrity of their lives, as in the subjects and execution of their several compositions. There are two actions recorded of Boileau, which sufficiently prove that the inexorable satirist had a most generous and friendly heart. When Patru, the celebrated advocate, who was ruined by his passion for literature, found himself under the painful necessity of selling his extensive library, and had almost agreed to part with it for a moderate sum, Boileau gave him a much superior price; and, after paying the money, added this condition to the purchase, that Patru should retain, during his life, the possession of the books. The succeeding instance of the poet's generosity is yet nobler:—when it was rumoured at court that the king intended to retrench the pension of Corneille, Boileau hastened to Madame de Montespan,

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Montespan, and said, that his sovereign, equitable as he was, could not, without injustice, grant a pension to an author like himself, just ascending Parnassus, and take it from Corneille, who had so long been seated on the summit; that he entreated her, for the honour of the king, to prevail on his majesty rather to strike off *his* pension, than to withdraw that reward from a man whose title to it was incomparably greater; and that he should more easily console himself under the loss of that distinction, than under the affliction of seeing it taken away from such a poet as Corneille. This magnanimous application had the success which it deserved, and it appears the more noble, when we recollect that the rival of Corneille was the intimate friend of Boileau. The long unreserved intercourse which subsisted between our poet and Racine was highly beneficial and honourable to both. The dying farewell of the latter is the most expressive eulogy on the private character of Boileau: "*Je regarde comme un bonheur pour moi de mourir avant vous*," said the tender Racine, in taking a final leave of his faithful and generous friend.

BOILING, or EBULLITION, the bubbling up of any fluid. The term is most commonly applied to that bubbling which happens by the application of fire, though that which ensues on the mixture of an acid and alkali is sometimes also distinguished by the same name. Boiling, in general, is occasioned by the discharge of an elastic fluid through that which is said to boil; and the appearance is the same, whether it is common air, fixed air, or steam, that makes its way through the fluid. The boiling of water is proved by Dr Hamilton of Dublin, in his essay on the ascent of vapour, to be occasioned by the lowermost particles of the water being heated and rarefied into vapour by reason of the vicinity of the bottom of the containing vessel; in consequence of which, being greatly inferior in specific gravity to the surrounding fluid, they ascend with great velocity, and lacerating and pushing up the body of water in their ascent, give it the tumultuous motion called *boiling*. That this is occasioned by steam, and not by particles of air or fire, as some have imagined, may be very easily proved in the following manner: Let a common drinking glass be filled with hot water, and then inverted into a vessel of the same: as soon as the water in the vessel begins to boil, large bubbles will be observed to ascend in the glass, which will displace the water in it, and in a short time there will be a continual bubbling from under its edge; but if the glass is then drawn up, so that its mouth may only touch the water, and a cloth dipt in cold water be applied to the outside, the steam within it will be instantly condensed, and the water will ascend so as to fill it entirely, or very nearly so. See the article EVAPORATION.

BOILING, in trade and manufactures, is a preparation given to divers sorts of bodies by making them pass over the fire, chiefly in water, though sometimes in other liquors. In this sense we speak of the boiling of salt, boiling of sugar, copperas, &c.

BOILING of Silk with Soap is the first preparation in order to dyeing it. Thread is also boiled in a strong lixivium of ashes to prepare it for dyeing.

BOILING, in the culinary art, is a method of dressing meats by coction in hot water, intended to soften them, and dispose them for easier digestion. The effects of boiling are different according to the kinds and qualities of the water. Pulse boiled in sea-water grow harder: mutton boiled in the same becomes softer and tenderer than in fresh water, but tastes saltish and bitter.

BOILING to Death (*caldariis decoquere*), in the middle age; a kind of punishment inflicted on thieves, false coiners, and some other criminals.

BOILING is also a method of trying or essaying the goodness or falseness of a colour or dye. The stuff is to be boiled in water with certain drugs, different according to the kind or quality of the colour, to try whether or no it will discharge, and give a tincture to the water. With this view crimson silks are boiled with alum, and scarlets with soap, in quantity equal to the weight of the silk.

BOILING-Wells, in *Natural History*. See *BURNING-Springs*, and ICELAND.

BOINITZ, a town of Upper Hungary, in the county of Zell, remarkable for its baths and the quantity of saffron that grows about it. E. Long. 19. 10. N. Lat. 48. 42.

BOIOBI, in *Zoology*, the name of a species of serpent found in America, and called by the Portuguese *cobra de verd*. It is about an ell in length, of the thickness of a man's thumb, and is all over of a very beautiful and shining green. Its mouth is very large, and its tongue black. It loves to be about houses, and never injures any creature unless provoked or hurt; but it will then bite, and its poison is very fatal. The natives take as a remedy against its poison, the root *caa apia* bruised and mixed with water. See *CAA-Apia*.

BOIORUM DESERTA, in *Ancient Geography*, a district of Pannonia, so called from the excision of the Boii by the Getæ. Now the Weinerwald, of Lower Austria, towards Stiria, to the east of Mount Cetius, or the Hahlenberg, and south of Vindobona or Vienna.

BOIQUIRA, the American name for the rattlesnake.

BOIS-LE-DUC, called by the Dutch *Hertogen-bosch*, a large, strong, and handsome town of the Netherlands, in Dutch Brabant, seated between the rivers Dommel and Aa, among morasses, in E. Long. 6. 16. N. Lat. 51. 45.

Bois de Soignies, the forest of Soignies in the Austrian Netherlands and province of Brabant, about three miles south-east of Brussels.

Bois de Coissi, the name given to a South American tree growing about Surinam, held in the highest estimation by the Indians in that part of the world, and now recommended to the physicians of Europe by Dr Fernin in a treatise lately published at Amsterdam. The root is esteemed an excellent stomachic, restoring the appetite and assisting digestion; but it is chiefly celebrated as an infallible remedy against even the most inveterate intermittents. It is said also to be used with great safety and advantage in every species of remittent and continued fever, with patients of all ages, sexes, and conditions, even during pregnancy, and in the puerperal state. Before employing it, however, it is absolutely necessary to administer either a purgative or emetic. The best method of exhibiting it is in decoction: half an ounce of the bark of the root must be boiled in a close vessel with six pints of water till one half

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half be consumed; the decoction is then strained off, and a cupful taken every two hours till the fever is entirely extinguished. Six or seven days after a cure is thus performed, it is generally necessary to repeat the purgative.

BOISSARD, John James, a famous antiquarian, born at Besançon the capital of Franche Compte in France. He published several collections which are of great use to such as are desirous to understand the Roman antiquities. He had a great passion for this study; and drew with his own hand plans of all the ancient monuments of Italy. He died at Metz, October 30th, 1602. His principal works are, 1. Four volumes in folio of Roman antiquities, adorned with plates engraved by Theodore de Bey and his two sons. 2. *Theatrum Vitæ Humanæ;* which contains the lives of 198 famous persons, with their portraits. 3. A treatise *De Divinatione et Magicis Præstigiis.* These works are scarce, and esteemed by the antiquarians.

BOIT, an excellent painter in enamel. He was born in Stockholm, and bred a jeweller; which profession he intended to follow in England; but changed his design, and went into the country, where he taught children to draw. He there engaged a gentleman's daughter, who was one of his scholars, to promise him marriage; but the affair being discovered, he was thrown into prison. In that confinement, which lasted two years, he studied enamelling; an art to which he fixed, on his return to London, and practised with the greatest success. The prices he is said to have obtained for his work are almost incredible: but being engaged in a very large design for the court, and Queen Anne dying before it was completed, he ran in debt, his goods were seized by execution, and he fled to France; where he changed his religion, was countenanced by the regent, and obtained a pension of 250l. per annum, but died suddenly at Paris in 1726. There is a large piece done by him at Kensington, representing Queen Anne sitting, and Prince George standing by her; and at Bedford-house is another very large plate of the duke's father and mother.

BOITJAPO, in *Zoology*, the name of a species of serpent found in *America;* and called by the Portuguese there, *cobra di apo.* It grows to seven or eight feet long, is about the thickness of a man's arm, and very small and taper towards the tail. Its back is of an olive colour; its belly yellow, and covered with very regular and elegant triangular scales. It feeds on frogs, &c. but is very poisonous, and its bite extremely fatal.

BOKHARA, a city of Tartary, in Asia, and capital of Great Bukharia, situated one day's journey to the north of the river Jehun, or Amu; in E. Long. 62. 45. N. Lat. 39. 15. In 1219 it was besieged by Jenghiz Khan, as being part of Sultan Mohammed's dominions, a descendant of the famous Mahmud Gazni. At that time, besides the city-walls, which were very strong, Bokhara had an outward enclosure 12 leagues in compass; which shut in not only the suburbs, but also many pleasant seats and farms watered by the river Soghd, from whence the ancient Sogdiana took its name. The Mogul army arrived before the place in July, and continued the siege during the following winter. In March 1220, they forced the outer wall, and began to besiege the city in form. Sultan Mohammed had left in the city a very numerous garrison under the command of three generals, who made a sally at the head of 20,000 men: but being repulsed with great loss, their courage failed them; and, instead of staying to defend the inhabitants, as soon as they had got into the city by one gate, passed out by another with their families, and almost all their soldiers, hoping to escape by the darkness of the night; but their design being discovered, they were pursued by a detachment of 30,000 Moguls; and being overtaken at the river Amu, they were, after a bloody dispute, almost all cut to pieces. Mean time, Jenghiz Khan, being informed of the confusion into which the city had been thrown by the desertion of the garrison, ordered an attack to be made on all sides at once; but while he was preparing for this, the magistrates and clergy went out and presented him with the keys of the city. Jenghiz Khan granted them their lives, on condition that they gave no shelter to any of the sultan's soldiers, and put out all who should be suspected of being in that prince's interest; which they promised to do upon oath. All the young people, however, who were displeased with the surrender, retired with the governor to the castle, which was very strong, and resolved to defend themselves to the last extremity. Jenghiz Khan having taken possession of Bokhara, entered on horseback into the great mosque, and asked merrily if that was the sultan's palace? On being answered that it was the house of God, he alighted; and giving the principal magistrate his horse to hold, mounted the gallery where the ecclesiastics usually sat, and then taking up the Koran, threw it under the feet of his horses. Having staid there for some time, he retired to his camp; where, some days after, having assembled the principal people of Bokhara, and ascended a pulpit erected for that purpose in the midst of them, he began his speech by praising God, and recounted all the favours he had received from the Almighty: he then mentioned the perfidious behaviour of their sultan towards himself, telling them that God had sent him, to rid the world of such wicked men. As to them, he testified his satisfaction for their having freely furnished his army with necessaries; and promised that his soldiers should not meddle with any goods which they made use of in their houses; but commanded them to deliver up what they had hidden, under pain of being tortured. This speech had such an effect, that the poor inhabitants delivered up every thing, as well what they had concealed as what they had present use for; notwithstanding which, the tyrant soon after caused the city to be burnt, on pretence that some of the sultan's soldiers were concealed in it. As all the houses were made of wood, except the sultan's palace which was built of stone, and some few private houses of brick, the whole was utterly consumed; and Jenghiz Khan having found some few soldiers that had actually concealed themselves, put them all to death without mercy. The castle surrendered at discretion soon after; and though it was demolished, the governor and garrison, out of a very extraordinary piece of clemency from so bloody a tyrant, had their lives spared. Bokhara continued in ruins for some years, but at length Jenghiz Khan ordered it to be rebuilt. It is now large and populous; and is the residence of a khan who is altogether despotic, though his power reaches but a little

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little way without the city. The town is seated on a rising ground, with a slender wall of earth and a dry ditch. The houses are low, built mostly of mud: but the caravanseras and mosques, which are numerous, are all of brick. The bazars or market-places, which have been stately buildings, are now mostly in ruins. The inhabitants are said to amount to 100,000, and are more civilized and polite than some of their neighbours. Great numbers of Jews and Arabians frequent this place. A plan was proposed so far back as 1557, and revived in 1741, for supplying the town with English goods; but it was found that the price brought was not sufficient to indemnify the hazard of the conveyance.

BOL, Hans or John, a painter, born at Mechlin in 1534. He received his first instructions from a master of no great repute, whom he soon left; and going to Heidelberg, employed himself in copying several pictures of the eminent artists. His subjects are chiefly landscapes with animals; but he also sometimes painted history, with no small success. We have by him a set of landscapes, views in Holland, slightly etched, but in a style that indicates the hand of the master. He died in 1593.

Bol, *Ferdinand*, a celebrated painter both of history and portraits, was born at Dort in 1611, and educated at Amsterdam. In the school of the celebrated Rembrandt Gerretz, he received his instructions as a painter; and imitated the style of his master with no little success, not only in his pictures but in his engravings. Bol's etchings are bold and free. The lights and shadows in them are broad and powerful, which renders the effect very striking: but they want that lightness of touch and admirable taste which those of Rembrandt possess in so great a degree. Bol died at Dort, the place of his birth, in 1681, aged 70.

BOKHARIA. See Bukharia.

BOLANDUS, John, a famous Jesuit, born at Tillemont in the Netherlands, in 1696. He distinguished himself by writing the lives of the saints, under the title of *Acta Sanctorum*, of which he published five volumes in folio; but died while he was labouring at the sixth, in the 70th year of his age. The continuators of that work are called *Bolandists*.

BOLBITINUM, in *Ancient Geography*, the second mouth of the Nile reckoning from west to east; now very small, choked up with sand, and called *le Bras de Beltin*.

BOLENTIUM, in *Ancient Geography*, a town of Pannonia Superior; now *Rackersburg* in Stiria. See Rackersburg.

BOLES, are viscid earths, less coherent and more friable than clay; more readily uniting with water, and more freely subsiding from it. They are soft and unctuous to the touch; adhere to the tongue: and by degrees melt in the mouth, impressing a light sense of astringency. There is a great variety of these earths; the principal of which are the following.

1. Armenian bole, when pure, is of a bright red colour with a tinge of yellow: It is one of the hardest and most compact bodies of this class, and not smooth and glossy like the others, but generally of a rough and dusty surface. It does not effervesce with acids, though some part of it is dissolved by all of them. Neuman observes, that four ounces of Armenian bole distilled in a glass retort in an open fire, yielded three drachms of a saline phlegm, which smelt a little urinous, and changed syrup of violets green. In the neck of the retort was found a little powdery saline matter which had an ammoniacal taste, but it was in too small quantity to be collected or further examined. Like most other coloured earths, this kind of bole contains a portion of ferruginous matter, to which the colour is owing; and which may be separated by the magnet, after the bole has been calcined with oil or other inflammable matters. It is likewise impregnated with vitriolic acid; and hence, when mixed with nitre or sea salt, it extricates the acids of these salts in the fire.

2. French bole is of a pale red colour, variegated with irregular specks of white and yellow. It is much softer than the Armenian, and slightly effervesces with acids.

3. Bole of Blois is yellow, remarkably lighter than most of the other yellow earths, and effervesces strongly with acids.

4. Bohemian bole is of a yellow colour, with a cast of red, and generally of a flaky texture. It is not acted on by acids.

5. Lemnian earth is of a pale red colour, and slightly effervesces with acids.

6. Silesian bole is of a pale yellow colour, and acids have no sensible effect upon it.

These and other earths, made into little masses, and stamped with certain impressions, are called *terræ sigillatæ*. They have been recommended as astringent, sudorific, and alexipharmic; but these and many other virtues that have been ascribed to them appear to have no foundation. They are still, however, prescribed in fluxes and complaints of the primæ viæ.

BOLESLAFF, or Buntzlau, a town of Silesia, seated on the river Bobar, in E. Long. 16. 0. N. Lat. 51. 12.

BOLESLAUS I. and II. kings of Poland. See Poland.

BOLETUS, Spunk. See Botany *Index*.

BOLEYN, Ann, queen of Henry VIII. of England; memorable in the English history, as the first cause of the reformation, as the mother of Queen Elizabeth under whom it was completely established, and also on account of her own sufferings. She was the daughter of Sir Thomas Boleyn, and born in 1507. She was carried into France at seven years of age by Henry VIII.'s sister, who was wife of Louis XII.: nor did she return into England when that queen retired thither after the death of her husband; but staid in the service of Queen Claudia the wife of Francis I. and after the death of that princess went to the duchess of Alençon. The year of her return is not well known: some will have it to have been in 1527, others in 1525. This much is certain, that she was maid of honour to Queen Catharine of Spain, Henry VIII.'s first wife; and that the king fell extremely in love with her. She behaved herself with so much art and address, that by refusing to satisfy his passion, she brought him to think of marrying her: and the king, deceived by her into a persuasion that he should never enjoy her unless he made her his wife, was induced to set on foot the affair of his divorce with Catharine, which at last was executed

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Boleyn.

with great solemnity and form. A celebrated author observes, that "That which would have been very praise-worthy on another occasion, was Anne Boleyn's chief crime: since her refusing to comply with an amorous king, unless he would divorce his wife, was a much more enormous crime than to have been his concubine. A concubine (says he) would not have dethroned a queen, nor taken her crown or her husband from her; whereas the crafty Anne Boleyn, by pretending to be chaste and scrupulous, aimed only at the usurpation of the throne, and the exclusion of Catharine of Arragon and her daughters from all the honours due to them." In the mean time, Henry could not procure a divorce from the Pope; which, we know, made him resolve at length to throw off his authority, and to fling off his yoke. Nevertheless he married Anne Boleyn privately upon the 14th of November 1532, without waiting any longer for a release from Rome; and as soon as he perceived that his new wife was with child, he made his marriage public. He caused Anne Boleyn to be declared queen of England on Easter-eve 1533, and to be crowned the first of June following. She was brought to bed upon the 7th of September of a daughter, who was afterwards Queen Elizabeth; and continued to be much beloved by the king, till the charms of Jane Seymour had fired that prince's heart in 1536. Then his love for his wife was changed into violent hatred: he believed her to be unchaste, and caused her to be imprisoned and tried. "She was indicted of high treason, for that she had procured her brother and other four to lie with her, which they had done often: that she had said to them, that the king never had her heart; and had said to every one of them by themselves, that she loved him better than any person whatever; which was to the slander of the issue that was begotten between the king and her. And this was treason according to the statute made in the 26th year of this reign; so that the law which was made for her and the issue of her marriage, is now made use of to destroy her." She was condemned to be either burnt or beheaded; and she underwent the latter on the 19th of May 1536. The right reverend author of the *History of the Reformation*, relates some very remarkable things of her behaviour during the time of her imprisonment, and a little before her execution. When she was imprisoned, she is said to have acted very different parts; sometimes seeming devout and shedding abundance of tears, then all of a sudden breaking out into a loud laughter. A few hours before her death, she said, that the executioner was very handy; and besides, that she had a very small neck; at the same time feeling it with her hands, and laughing heartily. However, it is agreed that she died with great resolution; taking care to spread her gown about her feet, that she might fall with decency; as the poets have related of Polyxena, and the historians of Julius Cæsar. Roman Catholic writers have taken all occasions to rail at this unhappy woman, as well through vexation at the schism which she occasioned, as for the sake of defaming and dishonouring Queen Elizabeth by this means; and they have triumphed vehemently, that in the long reign of that queen, no endeavours were used to justify her mother. But either Queen Elizabeth or her ministers are greatly to be admired for prudence in this respect; since it is certain, that Anne Boleyn's justification could never have been carried on without discovering many things which must have been extremely prejudicial to the queen, and have weakened her right instead of establishing it. For though the representations of the papists are in nowise to be regarded, yet many things might have been said to the disadvantage of her mother, without transgressing the laws of true history; as that she was a woman gay even to immodesty, indiscreet in the liberties she took, and of an irregular and licentious behaviour.

Boleyn, Boling-broke.

BOLINGBROKE, or BULLINGBROKE, a town of Lincolnshire in England, and of great antiquity, but now in a mean condition. It gives title of viscount to the St Johns of Battersea. Population 361 in 1811. E. Long. 0. 40. N. Lat. 53. 15.

BOLINGBROKE, *Henry St John*, lord visount, a great statesman and philosopher, descended from an ancient and noble family, was born about the year 1672. He had a regular and liberal education; and by the time he left the university, was considered as a person of uncommon qualifications: but with great parts, he had, as it usually happens, great passions, and these hurried him into many indiscretions and follies. Contrary to the inclinations of his family, he cultivated Tory connections; and gained such an influence in the house of commons, that in 1704 he was appointed secretary of war and of the marines. He was closely united in all political measures with Mr Harley: when, therefore, that gentleman was removed from the seals in 1707, Mr St John resigned his employment; and in 1710, when Mr Harley was made chancellor of the exchequer, the post of secretary of state was given to Mr St John. In 1712 he was created Baron St John of Lediard-Tregoze in Wiltshire, and Viscount Bolingbroke. But being overlooked in the bestowal of vacant ribbons of the order of the Garter, he resented the affront, renounced the friendship of Harley then earl of Oxford, and made his court to the Whigs. Nevertheless on the accession of George I. the seals were taken from him; and being informed that a resolution was taken to pursue him to the scaffold, for his conduct regarding the treaty of Utrecht, he withdrew to France. Here he accepted an invitation to enter into the Pretender's service, and accepted the seals as his secretary; but he was as unfortunate in his new connections as in those he had renounced; for the year 1715 was scarcely expired, when at the same time that he was attainted of high treason at home, the seals and papers of his foreign secretary's office were taken from him; followed by an accusation from the Pretender and his party, of neglect, incapacity, and treachery. Such a complication of distressful events threw him into a state of reflection, that produced by way of relief a *consolatio philosophica*, which he wrote the same year under the title of *Reflections upon exile*; and the following year he drew up a vindication of his conduct with respect to the Tories, in the form of *A Letter to Sir William Wyndham*. His first lady being dead, he about this time espoused a niece of the famous Madame Maintenon, and widow of the Marquis de Vilette, with whom he had a very large fortune. In 1723 the king was prevailed on to grant him a free pardon, and he returned in consequence to England; but was by no means satisfied within, while he was yet no more than a mere titular lord, and remained excluded from the

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house of peers. This stigma operated to fix him in enmity to Sir Robert Walpole, to whose secret enmity he attributed his not receiving the full extent of the king's clemency: hence he distinguished himself by a multitude of political writings, till the year 1735; when being thoroughly convinced that the door was finally shut against him, he returned once more to France. In this foreign retreat he began his course of Letters on the study and use of History, for the use of Lord Cornbury, to whom they are addressed. Upon the death of his father, who lived to be extremely old, he settled at Battersea, the ancient seat of his family, where he passed the remainder of his life in philosophical dignity. Pope and Swift, one the greatest poet, the other the greatest wit of the time, perfectly adored him; and it is well known that the former received from him the materials for his incomparable poem the "Essay on Man."—He died in 1751, and left the care and benefit of his MSS. to Mr Mallet, who published them together with his former printed work, in 5 vols. 4to; they are also printed in 8vo.

BOLISAW, a town of the kingdom of Bohemia in Germany, situated in E. Long. 14. 35. N. Lat. 20. 25.

BOLKOWITZ, a town of Silesia in the duchy of Glogaw. E. Long. 15. 20. N. Lat. 51. 27.

BOLLARDS, large posts set into the ground on each side of a dock. On docking or undocking ships, large blocks are lashed to them; and through these blocks are reeved the transporting hawsers to be brought to the capstans.

BOLLITO, a name by which the Italians call a *sea-green colour* in artificial crystal. To prepare this colour, you must have in the furnace a pot filled with 40 lb. of good crystal, first carefully skimmed, boiled, and purified, without any manganese: then you must have twelve ounces of the powder of small leaves of copper thrice calcined, and half an ounce of zaffre in powder: mix them together; and put them at four times into the pot, that they may the better mix with the glass; stirring them well each time of putting in the powder, lest the mixture should swell and run over.

BOLOGNA, an ancient, large, and very handsome town of Italy, in the territory of the church, and capital of the Bolognese; an archbishop's see, and an university. The public buildings are magnificent, as well with regard to the architecture as the ornaments, especially the paintings, which are done by the greatest masters. There is a vast number of palaces, in one of which the pope's nuncio resides; the private houses are also well built. Here are 169 churches, and in 1806 the town contained 63,420 inhabitants. It is a place of great trade, which is in some measure owing to a canal that runs from the city to the river Po. The Reno, which runs near Bologna, turns 400 mills that are employed in the silk-works; besides, they deal in wax, soap, hams, sausages, and even lap-dogs, which are greatly esteemed. This city fell into the hands of the French in 1796, was retaken by the Austrians in 1799, but lost again after the battle of Marengo. It was restored to the pope in 1815. It is seated at the foot of the Apennine mountains. E. Long. 11. 30. N. Lat. 44. 27.

BOLOGNE, by the English commonly called *Bullen*, a city of France, in the department of the Straits of Calais, and capital of the Bolonnois, seated near the sea. It is divided into two towns, the Upper and Lower. The port is at the mouth of the river Lianne, but the water is so shallow that no ships of burden can enter it. It is defended on the side of the river by a mole, which shelters it from the winds, and at the same time prevents the river from filling it with filth. It contained 10,140 inhabitants in 1815. E. Long. 1. 40. N. Lat. 50. 42.

BOLOGNESE, a small province of Italy, in the territory of the church, bounded on the north by the Ferrarese, on the west by the duchy of Modena, on the south by Tuscany, and on the east by Romagna. It is watered by a great number of small rivers, which render its soil the most fertile of any in Italy. Bologna is the capital, and from the great produce of the land about it is called *Bologna the fat*. It produces abundance of all sorts of grain and fruits; particularly muscadine grapes, which are in high esteem. Here are mines of alum and iron; and the inhabitants fabricate large quantities of linen, silk stockings, and cloth. This territory was overrun by the French in 1796, but was restored to the pope in 1815.

BOLOGNESE. See GRIMALDI.

BOLOGNIAN or BONONIAN STONE, a phosphoric substance first discovered near Bologna in Italy, whence it received its name. It has been supposed to contain some metallic matter, on account of its great specific gravity; but it is now found to be only a compound of ponderous earth and sulphuric acid. See BARYTES, MINERALOGY *Index*.

BOLSANE, a town of Germany, in the territory of Tyrol, and circle of Austria. It is very agreeably situated in the midst of a fine large valley, full of villages, and abounding in vineyards. The wines in this valley are the best in all Tyrol; but they must be drank the year after that of their growth, otherwise they become unfit for use. E. Long. 11. 11. N. Lat. 46. 42.

BOLSENNA, a town of Italy, in the territories of the pope, seated on a lake of the same name. E. Long. 11. 3. N. Lat. 42. 37.

BOLSTER, among surgeons, a soft yielding substance, either laid under the head or a broken limb. In this sense, bolsters are contrived for crooked, bunched, and otherwise distorted backs, shoulders, &c.

By a constitution made under Archbishop Burchier, the clergy are forbidden to wear bolsters about their shoulders, in their gowns, coats, or doublets. The occasion of the prohibition is variously construed. Some say that bolsters came in fashion in the reign of King Richard III. who being necessitated, by his natural deformity, to pad, the courtiers, and even the clergy, did the same, out of complaisance to their prince; so that every body who had the misfortune to be born straight, was obliged to wear a bolster on his shoulders to be in the fashion. Others, however, controvert this; alleging that the constitution above mentioned was made 20 years before the usurpation of Richard.

BOLSTERS of a Saddle, those parts of a great saddle, which are raised upon the bows, both before and behind, to hold the rider's thigh, and keep him in a right posture.

BOLSWAERT, a town of the United Provinces, in West Friesland, and in the county of Westergoe. E. Long. 5. 35. N. Lat. 53. 6.

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Bolswert. BOLSWERT, or BOLSUERD, *Boetius Adam à*, an engraver and printseller established at Antwerp, was the descendant of a family who resided at the city of Bolswert in Friesland, from whence he derived his name. He flourished about 1620; but by what master he was instructed in the art of engraving, does not appear. He worked with the graver only; the free open style of the Bloemarts he imitated with great success; and perhaps perfected himself in their school. When he worked from Rubens, he altered that style; and his plates are neater, fuller of colour, and more highly finished. The two following from this master may be here mentioned. 1. The resurrection of Lazarus, a large upright plate. 2. The Last Supper, its companion. Basan, speaking of this print, says, that it proves by its beauty, and the knowledge with which it is engraved, that Boetius could sometimes equal his brother Scheltius.

BOLSWERT, or *Bolsuerd*, *Scheltius à*, an admirable engraver, was the brother of Boetius Adam à Bolswert mentioned in the preceding article. We have no other account of his family than what is there given; nor unfortunately any of himself of the least consequence. The time of his birth and of his death, and the name of the master he studied under, are equally unknown. Bolswert worked entirely with the graver, and never called in the assistance of the point. His general character as an artist is well drawn by Basan, in the following words: "We have a large number of prints, which are held in great esteem, by this artist, from various masters; but especially from Rubens, whose pictures he has copied with all possible knowledge, taste, and great effect. The freedom with which this excellent artist handled the graver, the picturesque roughness of etching, which he could imitate without any other assisting instrument, and the ability he possessed of distinguishing the different masses of colours, have always been admired by the connoisseurs, and give him a place in the number of those celebrated engravers, whose prints ought to be considered as models by all historical engravers, who are desirous of rendering their works as useful as they are agreeable, and of acquiring a reputation as lasting as it is justly merited." He drew excellently, and without any manner of his own; for his prints are the exact transcripts of the pictures he engraved from. His best works, though not always equally neat or finished, are always beautiful, and manifest the hand of the master. Sometimes we find his engravings are in a bold, free, open style; as the Brazen Serpent, the Marriage of the Virgin, &c. from Rubens. At other times they are very neat and sweetly finished: as, the Crowning with Thorns, and the Crucifixion, &c. from Vandyck. Mr Strutt observes, that his boldest engravings are from Rubens, and his neatest from Vandyck and Jordaens.—How greatly Bolswert varied his manner of engraving appears from some prints, which, like the greater part of those of his brother Boetius, bear great resemblance to the free engravings of the Bloemarts, and to those of Frederic Bloemart especially; and form a part of the plates for a large folio volume, entitled *Academie de l'Espee*, by Girard Thibault of Antwerp, where it was published, A. D. 1628; and to these he signs his name, "Scheltius," and sometimes "Shelderic Bolswert," adding the word Bruxelle. His name is usually affixed to his plates in this manner, "S. A. Bolswert." It is very necessary to caution the collectors of this master's works (those especially who are not very conversant with them), that many of them have been copied in a very careful manner, so as easily to deceive the unskilful. Some of these copies, as the Marriage of the Virgin, from Rubens, &c. are by Lauwers. But those which are most likely to mislead, are by Ragot, a French engraver, employed by Mariette the printseller, who frequently meeting with the reverses or counterproofs from the prints of Bolswert, gave them to the engraver; and he imitated them with the utmost precision. By this means the impressions from the plate copied come upon the paper the same way with the original. It is true his name is usually affixed at the bottom; but it is often cut off, and then the copy is not easily distinguished from the original. Among other prints thus imitated by Ragot from Bolswert, is Christ crucified between the two Thieves, where the soldier is represented piercing his side, from Rubens.

Among the variety of estimable engravings by this great artist, the few following may be here mentioned: 1. The Brazen Serpent, a large plate, lengthwise, from Rubens. Those impressions are the most estimable which have only the word *Antuerpiæ* at the right-hand corner, without the name of Giles Hendrix, which was afterwards inserted above it, and part of the small circle over the arms is left white. 2. Abraham offering his son Isaac, a large plate nearly square, from Theodore Rombout. 3. The education of the Virgin by Saint Anne, a middling-sized upright plate, from Rubens. Those impressions without the name of Hendrix are the most esteemed. 4. The marriage of the Virgin, a middling-sized upright plate, from the same painter. Those impressions are best in which the word *Antuerpiæ* is not added to the name of Hendrix. 5. The adoration of the wise men, a middling-sized upright plate, from the same. The good impressions of this plate have the name of Vanden Enden. 6. The feast of Herod, in which is represented the daughter of Herodias, presenting the head of John the Baptist to her mother; a large plate, lengthwise, from the same. 7. The miraculous draught of fishes; a large print lengthwise, on three plates, from the same. 8. Christ crowned with thorns; a large upright plate from Vandyck: An admirable print; with the name of Vanden Enden. 9. A crucifixion, where a figure appears presenting the sponge to Christ, St John and the Virgin are standing at the foot of the cross, and Mary Magdalene is reclining towards it; a large upright plate, from Vandyck. Of this admirable engraving there appear to have been four different impressions; though Basan mentions only three, and says that in the first the left hand of St John is hid. The chief marks of those impressions are: In the 1st, St John's left hand appears on the shoulder of the Virgin (A). In

(A) Prints of this impression are very rare, and at sales have been known to fetch from 25l. to 30l.

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In the 2d impression, the hand is erased: This Basan calls the first impression; and it sells at a very high price. In the 3d impression, the hand is restored: In the 4th, it is again erased: And in both, the short strokes upon the ground near the great toe of the figure who holds the sponge are crossed with second strokes; which cross-hatchings are not in the two first impressions. There are several other crucifixions by the same master after different designs. 10. The god Pan playing upon his flute, from Jordaens. 11. Mercury and Argus, a large plate lengthwise, from the same. 12. A drunken Silenus, supported by a satyr, and another figure; a middling-sized upright plate, from Rubens. Of these three last, the impressions without the address of Bloteling are the best. 13. A chase of lions: a large plate lengthwise, from the same. 14. A variety of landscapes.

BOLT, among builders, an iron fastening fixed to doors and windows. They are generally distinguished into three kinds, viz. plate, round and spring bolts.

Bolts, in *Gunnery*, are of several sorts; as, 1. Transum-bolts, that go between the cheeks of a gun-carriage, to strengthen the transums. 2. Prise bolts; the large knobs of iron on the cheeks of a carriage, which keep the handspike from sliding, when it is poizing up the breech of a piece. 3. Traverse bolts; the two short bolts, that, being put one in each end of a mortar carriage, serve to traverse her. 4. Bracket-bolts; the bolts that go through the cheeks of a mortar, and by the help of quoins keep her fixed at the given elevation. And, 5. Bed bolts; the four bolts that fasten the brackets of a mortar to the bed.

Bolts, in a ship, are iron pins, of which there are several sorts, according to their different makes and uses. Such are drive-bolts, used to drive out others. Ray-bolts, with jags or barbs on each side, to keep them from flying out of their holes. Clench-bolts, which are clenched with rivetting hammers. Forelock-bolts, which have at the end a forelock of iron driven in to keep them from starting back. Set-bolts used for forcing the planks, and bringing them close together. Fend or fender bolts, made with long and thick heads, and struck into the uttermost bends of the ship, to save her sides from bruises. And ring-bolts, used for bringing to of the planks, and those parts whereto are fastened the breeches and tackling of the guns.

Bolt of Canvas, in commerce, the quantity of 28 ells.

Bolt-Rope, in naval affairs, a rope passing round the sail, to which the edges of it are sewed, to prevent the sail from tearing: the bottom part of it is called the *foot-rope;* the side *leeches;* and if the sail be oblong or square, the upper part is called the *head-rope*.

BOLTED flour, that which has passed through the bolters. See the following article.

BOLTER, or Boulter, a kind of sieves for meal, having the bottoms made of woollen, hair, or even wire. The bakers use bolters which are worked by the hand; millers have a larger sort, wrought by the motion of the mill.

BOLTING, a term of art used in our inns of court, whereby is intended a private arguing of cases. The manner of it at Gray's inn is thus: An ancient and two barristers sit as judges; three students bring each a case, out of which the judges choose one to be argued; which done, the students first argue it, and after them the barristers. It is inferior to *mooting:* and may be derived from the Saxon word *bolt*, "a house," because done privately in the house for instruction. In Lincoln's inn, Mondays and Wednesdays are the bolting days in vacation time; and Tuesdays and Thursdays the moot days.

Bolting, or *Boulting*, the act of separating the flour from the bran by means of a sieve or bolter. See Bolter.

Bolting-Cloth, or *Bolster-cloth*, sometimes also called *Boulting-cloth*, denotes a linen or hair-cloth for sifting meal or flour.

Bolting-Mill, a versatile engine for sifting with more ease and expedition. The cloth round this is called the *bolter*.

Bolting, or *Boulting*, among sportsmen, signifies rousing or dislodging a coney from its resting place. They say, to *bolt* a coney, *start* a hare, *rouse* a buck, &c.

BOLTON, or Boulton, *Edmund*, an ingenious English antiquarian, who lived in the beginning of the 17th century. His most considerable work is that entitled *Nero Cæsar*, or *Monarchie depraved*, dedicated to the duke of Buckingham, lord-admiral, printed at London 1624, folio, and adorned with several curious and valuable medals. It is divided into 55 chapters, in some of which are introduced curious remarks and observations. In the 24th and 25th chapters he gives an account of the revolt in Britain, against the Romans, under the conduct of Boadicea, which he introduces with a recapitulation of the affairs in Britain from the first entrance of the Romans into this island under Julius Cæsar, till the revolt in the reign of Nero. In chapter 36th he treats of the East India trade in Nero's time, which was then carried on by the river Nile, and from thence by caravans over land to the Red sea, and thence to the Indian ocean; the ready coin carried yearly from Rome upon this account amounting, according to Pliny's computation, to above 300,000l. sterling; and the usual returns in December and January yielding in clear gain a hundred for one. Besides this he wrote, 1. An English translation of Lucius Florus's Roman History. 2. Hypercritica, or a rule of judgment for reading or writing our histories. 3. The elements of armories, &c.; and some other works.

Bolton, a town of Lancashire in England, seated on the river Croell. It has a manufacture of fustians, and the market is considerable for cloth and provisions. Great and Little Bolton together contained 24,149 inhabitants in 1811. W. Long. 2. 15. N. Lat. 53. 55.

BOLUS, in *Pharmacy*, an extemporaneous form of a medicine, soft, coherent, a little thicker than honey, and the quantity of which is a little morsel or mouthful; for which reason it is by some called *buccella*.

BOMAL, a town of Luxemburg in the Netherlands, situated on the river Ourt, in E. Long. 5. 30. N. Lat. 50. 20.

BOMB, in military affairs, a large shell of cast iron, having a great vent to receive the fusee, which is made of wood. The shell being filled with gunpowder, the fusee

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fusee is driven into the vent or aperture, within an inch of the head, and fastened with a cement made of quicklime, ashes, brick-dust, and steel filings, worked together in a glutinous water; or of four parts of pitch, two of colophony, one of turpentine, and one of wax. This tube is filled with a combustible matter, made of two ounces of nitre, one of sulphur, and three of gunpowder-dust, well rammed. To preserve the fusee, they pitch it over, but uncase it when they put the bomb into the mortar, and cover it with gunpowder-dust; which having taken fire by the flash of the powder in the chamber of the mortar, burns all the time the bomb is in the air; and the composition in the fusee being spent, it fires the powder in the bomb, which bursts with great force, blowing up whatever is about it. The great height a bomb goes in the air, and the force with which it falls, makes it go deep into the earth.

Bombs may be used without mortar-pieces, as was done by the Venetians at Candia, when the Turks had possessed themselves of the ditch, rolling down bombs upon them along a plank set sloping towards their works, with ledges on the sides, to keep the bomb right forward. They are sometimes also buried under ground to blow up. See CAISSON.—Bombs came not into common use before the year 1634, and then only in the Dutch and Spanish armies. One Malthus an English engineer is said to have first carried them into France, where they were put in use at the siege of Colliouse. The French have lately invented a new sort of bombs of vast weight, called *Comminges*.—The art of throwing bombs makes a branch of gunnery, founded on the theory of projectiles, and the laws and qualities of gunpowder. See GUNNERY, PROJECTILES, GUNPOWDER, &c.

BOMB-Chest, is a kind of chest filled usually with bombs, sometimes only with gunpowder, placed under ground, to tear and blow it up in the air with those who stand on it. Bomb-chests were formerly much used to drive enemies from a post they had seized or were about to take possession of: they were set on fire by means of a saucissee fastened at one end, but they are now much disused.

BOMB-Vessels, which are small ships formed for throwing bombs into a fortress, are said to be the invention of M. Reyneau, and to have been first used at the bombardment of Algiers. Till then it had been judged impracticable to bombard a place from the sea. See KETCH.

BOMBARD, a piece of ordnance anciently in use, exceedingly short and thick, and with a very large mouth. There have been bombards which have thrown a ball of 300 pounds weight. They made use of cranes to load them. The bombard is by some called *basilisk*, and by the Dutch *donberbass*.

BOMBARDIER, a person employed about a mortar. His business is to drive the fusee, fix the shell, and load and fire the mortar.

BOMBARDIER. See CARABUS, ENTOMOLOGY *Index*.

BOMBARDMENT, the havock committed in throwing bombs into a town or fortress.

BOMBARDO, a musical instrument of the wind kind, much the same as the bassoon, and used as a bass to the hautboy.

BOMBASINE, a name given to two sorts of stuffs, the one of silk, and the other crossed of cotton.

BOMBAST, in composition, is a serious endeavour, by strained description, to raise a low or familiar subject beyond its rank; which, instead of being sublime, never fails to be ridiculous. The mind in some animating passions is indeed apt to magnify its objects beyond natural bounds; but such hyperbolical description has its limits; and when carried beyond these, it degenerates into burlesque, as in the following example.

Sejanus. ——————Great and high,
The world knows only two, that's Rome and I.
My roof receives me not; 'tis air I tread,
And at each step I feel my advanc'd head
Knock out a star in heaven.

SEJAN. of *Ben Johnson*, Act v.

A writer who has not natural elevation of genius is extremely apt to deviate into bombast. He strains above his genius, and the violent effort he makes carries him generally beyond the bounds of propriety.

BOMBAX, or SILK COTTON TREE. See BOTANY *Index*.

BOMBAX, in *Zoology*, a synonyme of a species of CONUS. *Bombax* is also used sometimes for silk or cotton; but the true botanic name of cotton is GOSSYPIUM. It is likewise applied by Linnæus to signify such insects as have incumbent wings, and feelers resembling a comb.

BOMBAY, an island in the East Indies near the coast of Decan, situated in N. Lat. 19. 0. and E. Long. 73. 0. It has its present name from the Portuguese *Buon-bahia*, on account of the excellent bay formed by it, together with the winding of other islands adjacent. The harbour is spacious enough to contain any number of ships, and has likewise excellent anchoring ground, affording also, by its land-locked situation, a shelter from any winds to which the mouth may be exposed.

1 This island more healthy now than formerly, and why.

This island was formerly reckoned exceedingly unhealthy, insomuch that it had the name of the burying ground of the English, though it is now so far improved in this respect as to be no worse than any other place in the East Indies under the same parallel of latitude. The reasons of this unhealthiness and the subsequent improvements are enumerated by Mr Grose. 1. The nature of the climate, and the precautions required by it, being less understood than they are at present. 2. Formerly there obtained a very pernicious practice of employing a small fry of fish as manure for the cocoa-trees which grow in plenty on the island; though this has been denied by others, and perhaps with justice, as the putrid effluvia of animal bodies seems to be very effectually absorbed by the earth, when buried in it. All agree, however, that the habitations in the woods or cocoa-nut groves are unwholesome, by reason of the moisture, and want of a free circulation of air. 3. Another cause has been assigned for the superior healthiness of this island, viz. the lessening of the waters by the banking of a breach of the sea, though this does not appear satisfactory to our author. There is still, says he, a great body of salt water on the inside of the breach, the communication of which with the ocean being less free than before the breach was built,

Bombay.

built, must be proportionably more apt to stagnate, and to produce noxious vapours.

Whatever may be the cause, however, it is certain, that the island of Bombay no longer deserves its former character, provided a due degree of temperance be observed; without which health cannot be expected in any warm climate.

2 Climate, &c.

The climate of Bombay seems to be drier than many other parts under the same parallel. The rains last only four months of the year, but with short intermissions. The setting-in of the rains is commonly ushered in by a violent thunder-storm, called there the *Elephanta* from its extraordinary violence. The air, however, is then agreeably cooled, and the excessive heat, then nearly at its height, much moderated. The rains begin about the end of May, and go off in the beginning of September; after which there never falls any, except a short transient shower, and that but very rarely.

3 Fish in all the stagnant pools formed by the rains.

A very extraordinary circumstance is related by Mr Ives concerning the island of Bombay during the rainy season, viz. that, ten days after the rains set in, every pool and puddle swarms with a species of fish about six inches long, and somewhat resembling a mullet. Such a phenomenon has occasioned various speculations. Some have imagined that the exhaling power of the sun is so strong in the dry season as to be able to raise the spawn of these fishes into the atmosphere, and there suspend and nourish it till the rains come on, when it drops down again in the state of living and perfectly formed fish. A less extravagant supposition is, that after the ponds become dry, the spawn may possibly fall into deep fissures below the apparent bottom, remaining there during the dry season, and being supplied with a sufficient quantity of moisture to prevent it from corruption.

4 Account of the quantity of rain that falls during the rainy season.

The quantity of rain that falls at Bombay in one season has been accurately measured by Mr Thomas, Mr Ives's predecessor as hospital surgeon. His apparatus consisted of a lead cylinder about nine inches diameter, and as many deep, marked on the inside with inches and tenths. To prevent the water from splashing over, he cut a hole two inches from the bottom, and placed the cylinder in a glazed earthen vessel; after which a wax-cloth was securely tied round it, so as to cover the vessel, and prevent any water from getting in, excepting what passed through the cylinder. When more than two inches fell, the hole in the side was stopped with wax, and the water poured from the vessel into the cylinder to ascertain its quantity. It was kept in an open place free from houses, and measured at six in the morning, noon, and six in the evening. The following table shows the quantity of rain that fell from the 25th of May, when it first began, though the sky looked cloudy over land from the beginning of the month.

May 1795.

Days of the month.	*Quantity of rain in* In.	Tenths.
25	0	3
31	0	7

June.

Days of the month.	*Quantity of rain in* In.	Tenths.
3	0	1
4	0	1
5	0	6
6	0	8
7	0	9
8	1	0
9	0	3
11	3	0
12	0	3
13	0	5
14	4	5
15	1	3
16	2	5
17	5	6
18	0	8
19	0	2
20	0	4
21	0	3
22	1	2
23	0	3
24	0	7
25	0	7
26	0	8
27	4	0
28	6	7
29	5	3
30	1	8

July.

Days of the month.	*Quantity of rain in* In.	Tenths.
1	1	3
2	2	0
3	0	9
4	1	9
5	0	5
6	0	2
7	0	4
8	0	9
9	1	3
10	3	1
11	3	7
12	0	7
13	5	5
14	4	9
15	2	2
16	0	1
18	0	5
19	1	1
20	0	5
21	0	7
22	0	2
23	0	2
25	0	1
26	0	3
27	0	3
28	0	8
29	0	6

August.

Days of the month.	*Quantity of rain in* In.	Tenths.
3	0	4
5	1	4
6	7	0
7	0	8
8	0	6
9	1	3
10	0	4
11	0	1
12	0	2
13	1	1
14	0	8
15	0	3
16	0	2
17	0	2
18	0	2
19	0	2
20	0	2
21	0	1
22	0	4
25	0	4
26	0	7
27	0	5
28	0	2
30	0	1
31	0	2

September.

Days of the month.	*Quantity of rain in* In.	Tenths.
1	0	2
3	0	3
8	0	1
9	0	4
10	0	5
11	0	9
12	0	2
13	0	5
16	0	4
17	0	4
18	0	5
19	0	6
20	3	2
21	0	4
22	0	6
23	0	3
24	0	3
25	0	2
26	0	2
27—30	1	0

October.

Days of the month.	*Quantity of rain in* In.	Tenths.
2—7	2	1
9	2	0
15	0	3
16,17	0	1

22 The air fine and clear, without a cloud, the land and sea-breezes regular.

Whole quantity of rain in

	In.	Tenths.
May	1	0
June	44	7
July	29	9
August	19	0
September	11	2
October	4	5
Total	110	3

In this journal our author makes no mention of the elephanta above mentioned from Mr Grose as the forerunner of the rainy season, though he mentions a storm under

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under that name on the 9th of October. It was an excessive hard gale, with violent thunder, lightning, and rain; of which last there fell two inches in no more than four hours. Neither is the quantity of thunder and lightning at all comparable to what people unacquainted with hot climates might be apt to expect. The only thunder-storms mentioned in the journal were on May 31st, June 3d, 5th, 12th, 14th, September 7th, October 9th, an elephanta; and some thunder on the 15th of the same month.

5 Vegetable productions of Bombay.

The vegetable productions of Bombay are very insignificant. Mr Ives says, that its "soil is so barren as not to produce any one thing worth mentioning;" but afterwards informs us, that its "natural produce is the cocoa-nut tree, from which they extract a liquor called *toddy*. This is soft and mild when drunk immediately: but if it stands long, it gathers strength, and becomes very intoxicating; whence probably arose the term *toddy-headed*. For each tree a tax of 20s. a-year is paid to the company, which is appropriated towards maintaining the garrison and ships of war."

Mr Grose gives an account somewhat different.—"The *oarts*, or cocoa-nut groves, make the most considerable part of the landed property, being planted wherever the situation and soil is favourable to them. When a number of these groves lie contiguous to each other, they form what is called the *woods;* through which there is a due space left for roads and path-ways, where one is pleasantly defended from the sun at all hours in the day. They are also thick set with houses belonging to the respective proprietors, as well as with the huts of the poorer sort of people; but are very unwholesome, for the reasons already given. As to the cocoa-nut tree itself, not all the minute descriptions I have met with in many authors seem to me to come up to the reality of its wonderful properties and use. The cultivation of it is extremely easy, by means of channels conveying water to the roots, and by the manure already mentioned laid round them. An owner of 200 cocoa-nut trees is supposed to have a competency to live on.

"As to the rice fields, they differ in value, according to the fineness and quantity of rice they produce. The growth of this grain has a particularity not unworthy of notice, viz. that as it loves a watery soil, so to whatever height the water rises wherever it is planted, the growth of the rice keeps measure with it, even to that of 12 and 14 feet; the summit always appearing above the surface of the water. It is also remarked, that the eating of new rice affects the eyes. The fact is certain, though the physical reason of it is unknown.

"Here and there are interspersed some few *brab trees*, or rather wild palm trees (the word *brab* being derived from *brabo*, which in the Portuguese signifies *wild*). They bear an insipid kind of fruit, about the bigness of a common pear; but the chief profit from them is the toddy, or liquor drawn from them by incisions at the top, of which the arrack is reckoned better than that produced by the cocoa-nut trees. They are generally near the sea-side, as they delight most in a sandy soil. It is on this tree that the *toddy birds*, so called from their attachment to it, make their exquisitely curious nests, wrought out of the thinnest reeds and filaments of branches, with an inimitable mechanism. The birds themselves are about the size of a partridge, but are of no value either for plumage, song, or the table.

"This island is a strong instance of the benefits of a good government, and a numerous population; for not a spot of it remains uncultivated; so that though it is far from producing sufficient for the consumption of its inhabitants, and notwithstanding its many disadvantages of situation and soil, it yields incomparably more than the adjacent island of Salsette."

6 Curiosities in this island.

Among the curiosities of Bombay Mr Ives mentions a large *terapin* or land tortoise kept at the governor's house, the age of which was upwards of 200 years. Frogs, which abound everywhere through the East Indies, are very large at Bombay. Our author saw one that measured 22 inches from the extremities of the fore and hind feet when extended; and he supposes that its weight would not have been less than four or five pounds. On the sea-shore round the island are a great variety of beautiful shells, particularly the sort called *ventle-traps* or *wendle-traps*, held in great esteem among the ladies some time ago. Several pounds sterling are said to have been given by a *virtuoso* for one of these shells when Commodore Leslie's collection of shells was sold by auction.

7 Different kinds of serpents found here.

Mr Ives enumerates the following kinds of snakes found on this island and other parts of the British empire in the East Indies. 1. The *cobra de capella*, growing from four to eight or nine feet long. They kill by their bite in 15 minutes. 2. The *cobra manila* is a small bluish snake, of the size of a man's little finger, and about a foot long, frequently seen about old walls. A species of these found at Bombay kill much sooner than even the former. 3. The *palmira*, a very thin beautiful snake, of different colours: its head is like that of the common viper, but much thicker than the body. Our author saw one that was four feet long, and the body not much thicker than a swan's quill. 4. The green snake is of a very bright green colour, with a sharp head: towards the tail it is smaller than in the middle. The largest part of it is no bigger than a tobacco-pipe. 5. The sand snake is small and short, but not less deadly than the others. 6. The *cobra de aurelia* resembles an earth-worm, is about six inches long, and no bigger than a small crow-quill. It kills by getting into the ear, causing madness, &c. 7. The *manila bomba* is a very beautiful snake, of almost the same size throughout the whole length, except at the two ends, where it comes to a point. It is white on the belly, but finely variegated on the back. It lives in the sand, and is said to sting with its tail, which occasions contractions in the joints.

Bombay is the most considerable English settlement on the Malabar coast; and by reason of its situation, may be styled the grand storehouse of all the Arabian and Persian commerce. It is also the most convenient place in all the East Indies for careening or heaving down large ships; and for small ones they have a very good dock. They have also a very good rope-yard; and indeed, says Mr Ives, "this is the only place, in this distant part of the world, for shattered ships to refit at, having always a good quantity of naval stores, and its very name conveying an idea of a safe retreat in foul weather."

8 Different forts, &c.

On this island are many little forts and batteries, which

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which carry some guns; but the principal fort, which defends the place, has above an hundred. Mr Grose finds fault with the situation of this last fort, which, he says, not only does not command the harbour sufficiently, but is itself overlooked by an eminence called Dungharee point. The castle itself is a regular quadrangle, well built of strong hard stone. In one of the bastions facing Dungharee point is a large tank or cistern which contains a great quantity of water constantly replenished by the stationary rains. There is also a well within the fort, but the water is not very good, and liable to be dried up by the heats. The water of Bombay in general indeed is not good, which has been given as a reason why the Gentoo merchants were not fond of settling upon it; for as they drink no wine nor spirituous liquors, they are very nice judges of the taste and qualities of waters.

When the town of Bombay began to increase considerably, it was judged proper to add the security of a wall round it to the strength of the fort it had before. Even then, however, it was neglected to take in the dangerous post of Dungharee, which now evidently commands both the town and fort. There has since that time been added, at a great expence, a ditch that encompasses the wall, and can be flooded at pleasure, by letting in the sea, which terminates the ditch on two sides, so that the town is now entirely surrounded with water, and is one of the strongest places in India.

Next to Bombay, the most considerable fort on the island is that of *Mahim*. It is situated at the opposite extremity of the island, and commands the pass of Bandurah, a fort directly opposite to it on the coast of Salsette. From this island Bombay is separated by an arm of the sea, capable of receiving only small craft. The other forts are capable of making but a slight defence.

About two miles out of town, towards the middle of the island, the sea had gained so far as almost to divide it in two, and rendered the roads impassable. A great quantity of this water, however, was drained off at a very considerable expence, and a causeway raised which kept it from overflowing again. This causeway is above a quarter of a mile in length, and considerably broad; "but (says Mr Grose), there is one gross fault remarked in it; that, being bending near the middle, the architect has opposed to the sea a re-entering angle instead of a salient one." Within the beach, however, there is still a considerable body of water, that has a free communication with the sea, as appears by its ebbing and flowing; so that it is probable the causeway itself, erected at the expence of at least 100,000l. may in no long time be totally undermined and thrown down.

9
Division, &c.

When the island of Bombay was ceded to the English by the Portuguese, it was divided and still continues to be so, into three Roman Catholic parishes, Bombay, Mahim, and Salvacam. The churches of these are governed by priests of that religion, and of any nation excepting Portugal, who were expressly objected to at the time of cession. The bulk of the land-proprietors at that time were Mestizos and Canarins. The former are a mixed breed of the natives and Portuguese; the latter purely aborigines of the country converted to the Popish religion. The other land-owners were Moors, Gentoos, and Parsees; but these last are of more modern date, having purchased estates on the island. The company has also a very considerable landed estate either by purchases, confiscations for crimes, or seizures for debt. The land is laid out in cocoa-nut groves, rice fields, and onion grounds, which last are reckoned of an excellent quality.

There is only one English church at Bombay, a very neat commodious building, seated in a spacious area called the Green; which continues from the church to the fort, and is pleasantly laid out in walks planted with trees, round which the houses of the English inhabitants are mostly situated. These are generally only ground-floored, with a court-yard before and behind, in which are the offices and out-houses. They are substantially built of stone and lime, and smooth plastered on the outside. They are often kept white-washed, which, however neat, is in some respects very disagreeable, by reason of the excessive glare it occasions in reflecting the light of the sun. Few of them have glass windows to any apartment; the sashes being generally paned with a kind of transparent oyster-shells, square cut; which have the singular property of transmitting sufficient light, at the same time that they exclude the violent glare of the sun, and have beside a cool look. The flooring is generally composed of a kind of loam or stucco called *chunam*, being a lime made of burnt shells, which if well tempered in a peculiar manner known to the natives, is extremely hard and lasting, and takes such a smooth polish, that one may see his own face in it. But where terraces are made of this substance, unless it be duly prepared, and which is very expensive, it is apt to crack by the sun's heat. Some attempts have been made to paint the stucco walls in apartments; but these have proved abortive through the ignorance of the artists, who have not chosen colours capable of resisting the alkaline power of the lime *. Our author remarks, that in the gardens of Surat he saw this kind of stucco made use of intead of gravel for the walks. They were a little raised above the garden beds, so that they must be instantly dry after the most violent rain; though their whiteness and polish must not only produce a disagreeable reflection in sunshine, but be extremely slippery to walk on. The houses of the black merchants are for the most part extremely ill built and inconvenient; the window lights small, and the apartments ill distributed. Some, however, make a better appearance if only one story high; but even the best of them have a certain meanness in the manner, and clumsiness in their execution, which renders the architecture contemptible in comparison of the European. There is one convenience, however, in all the houses of Bombay, viz. small ranges of pillars that support a penthouse or shed, forming what are called in the Portuguese language *verandas*, either all round the house, or on particular sides of it, which afford a pleasing shelter from the sun, and keep the inner apartments cool and refreshed by the draught of air under them. The pagodas, or temples of the Gentoos, are low mean buildings, having usually no light but what is admitted by the door; facing which is the principal idol. They imagine that a dark gloomy place inspires a kind of religious horror and reverence; and are very fond of

* See *Colour Making*.

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of having these pagodas among trees, and near the side of a tank or pond, for the sake of their frequent ablutions. These tanks are often very expensive; being generally square and surrounded with stone steps that are very convenient for the bathers.

10 Inhabitants, manners, &c.

The natives of Bombay, though composed of almost every Asiatic nation, are shorter of stature and stronger than the inhabitants of the Coromandel coast. Here a palanquin, which requires six men to carry it at Madras, or Fort St David, is carried by four. Here are some Parsees, who like their forefathers the ancient Persians, are followers of Zoroaster, who is said to have reduced into order the religion of the Persian magi; the fundamental maxim of which was the worshipping of one God under the symbol of light. They adore the sun, particularly when rising, with the most profound reverence and veneration; and likewise pay a kind of adoration to common fire. Mr Ives had once the opportunity of observing the manner in which they perform this devotion. A large brass pan was placed in the middle of the house with fire in it: before this fire, or rather on each side of it, two men were kneeling at their devotions, pronouncing their prayers with great rapidity. He was afterwards informed, that one of them was a priest, at that time on a visit to another priest in a fit of sickness. He was likewise informed, that the Parsees have such a veneration for the fire, that they never put it out, or even breathe upon it; and he observed, that while the two priests were at their prayers over the pan of coals, they had a little white bib over their mouths, as he supposed to prevent their breath from approaching their favourite element. The prayers, however, from the similarity of the sounds, appeared to him only to be a repetition of the same set of words. The visiting priest used many gestures with his hands over the fire, and afterwards stroaked down the face of the sick priest, which our author looked upon to be the final benediction, as the ceremony ended immediately.

As the Gentoos burn their dead, one would imagine that the Parsees, who have such a veneration for fire, would be desirous of having their bodies consumed by that element; but instead of this, they expose their dead bodies to be devoured by birds of prey; because, say they, a living man is composed of all the elements; so that it is but reasonable, after he is dead, that every particular element should receive its own again. On the top of Malabar hill, about two miles from the town of Bombay, there are two round buildings for receiving the dead bodies of the Parsees, which remain there till the bones are clean picked by the birds. This is certainly an abominable custom, and affords very shocking spectacles; however, a guard is always placed at a little distance to prevent people from prying too narrowly into these matters, or, as Mr Ives says, to ensure the vultures of their repast without any disturbance. Mr Grose tells us, that on his going to look into one of these repositories, a Parsee advised him in a friendly manner to let it alone, as no person, who was not a party concerned, would long survive such curiosity. He tells us also, that the person appointed to look after the dead, carefully observes which eye is first picked out by the birds, and from thence judges of the situation of the soul of the deceased; a state of happiness being indicated by the right eye being first picked out. Mr Ives observes, that by reason of the heat of the sun, much less noxious vapour is emitted by these bodies than might be expected; the flesh being soon shrivelled up, and the bones turning quite black.

Bombay | Bona.

At the extreme point of Malabar-hill there is a rock, on the descent to the sea, flat on the top, in which there is a natural crevice, which communicates with a hollow terminating at an exterior opening to the sea. This place is used by the Gentoos as a purifier from their sins. This purification is effected by their going in at the opening, and coming through the crevice, though it seems too small for people of any corpulence to pass.

11 Oxen used here instead of horses.

In Bombay, and indeed in many other places of the East Indies, oxen are generally used instead of horses, not only for drawing carriages but for riding; and, however ridiculous such a practice may seem to us, it appears that they are not in this respect inferior to ordinary horses, being capable of going at the rate of seven or eight miles an hour. They are commonly of a white colour, with large perpendicular horns, and black noses. The only inconvenience that attends them, is, that, by being naturally subject to a lax habit of body, they sometimes incommode the rider with filth thrown upon him by the continual motion of their tails. In other respects they are far preferable to Indian horses, and will trot and gallop as naturally as the horses of this country. Admiral Watson, while at Bombay, was allowed a chaise drawn by two of these oxen by the East India company. At the end of every stage the driver puts the near bullock in the place of the other; he then puts his hand into their mouths, to take out the froth; without this they would be in danger of suffocation. See BOMBAY, SUPPLEMENT.

For the History, Government, &c. of Bombay, see the articles INDOSTAN and *East India* COMPANY.

BOMB-KETCH, a small vessel built and strengthened with large beams for the use of mortars at sea.

BOMBUS, in *Music*, an artificial motion with the hands, imitating in cadence and harmony the buzzing of bees. The word is originally Greek, and signifies the buzz or noise of bees, gnats, and the like. In this sense, bombus made one of the species of applause used by the ancient auditories.

BOMBUS, in *Medicine*, denotes a murmuring noise, as of wind breaking out of a narrow into a larger cavity, frequently heard in the thick intestines. The bombus heard in the ears in acute diseases, is laid down by Hippocrates as a sign of death.

BOMBYLIUS. See ENTOMOLOGY *Index*.

BOMENE, a sea-port town of the United Provinces, in Zealand, seated on the northern shore of the island of Schonen, opposite to the island of Goree, in E. Long. 4. 0. N. Lat. 51. 50.

BOMMEL, a town of Dutch Guelderland, situated on the northern shore of the river Waal, in E. Long. 3. 50. N. Lat. 52. 0.

BOMONICI, in Grecian antiquity, young men of Lacedæmon, who contended at the sacrifices of Diana which of them was able to endure most lashes; being scourged before the altar of this goddess.

BONA, by the Moors called *Balederna*, a sea-port town of the kingdom of Algiers in Africa, situated in E. Long. 7. 57. N. Lat. 36. 5. It was formerly rich, populous,

populous, capital of the province of the same name under the kingdom of Constantina, and is supposed by some to be the ancient Hippo, once the seat of the great St Austin, and a sea-port built by the Romans. The inhabitants, however, deny it to be the ancient Hippo, which had been so often taken, retaken, and destroyed by the wars; and pretend it to be since rebuilt at the distance of two or three miles from the ancient Hippo, out of its ruins, and called *Baleed-el-Ugned*, from a sort of trees of that name that grow in the neighbourhood. It is now a very mean place, poorly built, and thinly inhabited, with scarce any traces of its former grandeur, except the ruins of a cathedral, or, as others guess, of a monastery, built by St Austin, about three miles distant from the city. Near these ruins is a famed spring called by his name, much resorted to by the French and Italian sailors, who come to drink of its waters, and pay their devotions to a maimed statue said also to belong to the saint, but so mutilated that no traces either of face or dress are remaining; and as each of them strives to break off some splinter, or to scrape off some part of it on account of its supposed sanctity, it will probably be soon reduced to a state of non-existence. Bona was taken by the pirate Barbarossa, and joined to his new kingdom of Algiers; but as quickly lost, and recovered by its old masters the Tuniseens, who soon after lost it again. It is commanded by a little fort, in which is a garrison of about 300 Turks, under the command of an aga, who is also governor of the town. The road for the ships is good for nothing before the town, but a little farther west is very deep and safe. Dr Shaw tells us, that the continual discharging of ballast into the road, and the neglect of cleansing the port, is the cause of both becoming so unsafe and incommodious. In 1816, a number of Neapolitans, Genoese, &c. assembled here for the purpose of prosecuting the coral fishery, were attacked and massacred by a body of Turkish troops.

Bona Dea, the good goddess, in Pagan mythology, one of the names of Cybele. Others say, she was a Roman lady, the wife of one Faunus, and was famous for her chastity, and that after her death she was deified. Her sacrifices were performed only by matrons; and in so secret a manner, that it was no less than death for any man to be present at the assembly (see Cybele). Cicero reproaches Clodius with having entered into this temple disguised as a singing woman, and having by his presence polluted the mysteries of the good goddess. What kind of mysteries these were, we may learn from Juvenal, Sat. vi. 313. The poet there mentions the adventure of Clodius.

Atque utinam ritus veteres, et publica saltem
His intacta malis agerentur sacra: sed omnes
Noverunt Mauri, atque Indi, quæ psaltria penem
Majorem, quam sint duo Cæsaris Anticatones,
Illuc testiculi sibi conscius, unde fugit mus,
Intulerit.

I wish at least our sacred rites were free
From those pollutions of obscenity:
But 'tis well known what singer, how disguis'd,
A lewd audacious action enterpris'd:
Into the fane, with women mix'd, he went,
Arm'd with a huge two-handed instrument;
A grateful present to these holy choirs,
Where the mouse, conscious of his sex, retires.
DRYDEN.

Bona Fides, in *Law*. When a person performs any action which he believes at the time to be just and lawful, he is said to have acted *bona fide*.

Bona Mobilia, the same with moveable effects or goods.

Bona Notabilia, are such goods as a person dying has in another diocese than that wherein he dies, amounting to the value of 5l. at least; in which case the will of the deceased must be proved, or administration granted, in the court of the archbishop of the province, unless, by composition or custom, any dioceses are authorised to do it, when rated at a greater sum.

Bona Patria, an assize of countrymen or good neighbours, where 12 or more are chosen out of the country to pass upon an assize, being sworn judicially in the presence of the party.

Bona Peritura, perishable goods. By stat. 13 Ed. I. cap. 4. the cargo of a ship that has been cast away shall be kept for a year and a day, and restored to the rightful owner; and if the goods are such as will not endure so long, they are *bona peritura*, which the sheriff is allowed to sell, and to account in money for the value.

Bona Vacantia, goods, such as royal-fish, shipwrecks, treasure-trove, waifs, and estrays, in which no one can claim a property. These goods by the law of nature, and by the imperial law, belonged to the first occupant or finder; but in the modern constitutions of European governments, they are annexed to the supreme power by the positive laws of the state.

BONAIRE, an island of South America, near the north coast of Terra Firma. It lies about 30 miles east of Curaçoa, and abounds in kabritoes and salt. W. Long. 68. 18. N. Lat. 12. 30.

BONAIS, very high mountains in Italy, in the duchy of Savoy, not far from Lassoreburg: in some seasons they cannot be ascended without great danger.

BONARELLI, Count Guid' Ubaldo, an Italian poet, was the son of Count Pietro Bonarelli, minister of the duke of Urbino. He was intrusted with several important negociations, and was esteemed an able politician and learned philosopher. He was the author of a fine Italian pastoral entitled *Filli di Sciro*. He died at Fano, in 1608, aged 45.

BONAVENTURA, The Bay of, in America on the coast next the South sea, in the Popayan. It has a port and harbour for ships; but the air is very unwholesome. W. Long. 78. N. Lat. 3. 20.

BONAVENTURE, a celebrated cardinal, called, from his works, the *seraphic doctor*. He was born at Bagnarea, a small town of Tuscany, in 1221; and his original name was *John Fidanza*. He took the habit of a monk of the order of St Francis in 1243, became doctor of Paris in 1255, and the next year general of his order. After the death of Clement IV. the cardinals disagreeing about the election of a new pope, engaged themselves by a solemn promise to elect him who should be named by Bonaventure, even though it should be himself; but he chose Theobald archdeacon of of Liege, who was then in the Holy Land, and took the name of *Gregory* X. This pope, in return, in 1272, made him cardinal and bishop of Alba, and ordered him to assist at the second general council of Lyons, where he died in 1274. His works were printed at Rome in 8 vols folio.

BONAVISTA, an island in the Atlantic ocean, the most easterly and first discovered of the Cape de Verd islands. It is 20 miles long, and 13 broad; has plenty of goats and cotton, and some indigo. The inhabitants are remarkable for slothfulness; they have a town, and two roads where ships come to an anchor. W. Long. 23. 6. N. Lat. 16. 5.

BOND, John, a commentator on Horace and Persius, was born in Somersetshire in the year 1550, and educated at Winchester school. In 1569 he was entered a student of the university of Oxford, probably in the New college, of which he became either one of the clerks or one of the chaplains. He took his bachelor of arts degree in 1573, and that of master in 1579; soon after which he was appointed by his college, master of the free school at Taunton in Somersetshire. In this employment he continued many years with great reputation: but being at length weary of his laborious employment, he commenced physician, and we are told became eminent in that capacity. He died in the year 1612, possessed of several lands and tenements in his neighbourhood; but whether acquired by the practice of physic, does not appear. He wrote, 1. *Commentarii in poemata Q. Horatii*, 8vo. 2. *Commentarii in sex satyras Persii*, Lond. 1614, 8vo.

Bond, in *Law*, is a deed whereby the obligor obliges himself, his heirs, executors, and administrators, to pay a certain sum of money to another at a day appointed. If this be all, the bond is called a simple one, *simplex obligatio*. But there is generally a condition added, that if the obligor does some particular act, the obligation shall be void, or else shall remain in full force: as payment of rent; performance of covenants in a deed; or repayment of a principal sum of money borrowed of the obligee, with interest; which principal sum is usually one half the penal sum specified in the bond. In case this condition is not performed, the bond becomes forfeited, or absolute at law, and charges the obligor while living; and after his death the obligation descends upon his heir, who (on defect of personal assets) is bound to discharge it, provided he has real assets by descent as a recompense.

If the condition of a bond be impossible at the time of making it, or be to do a thing contrary to some rule of law that is merely positive, or be uncertain, or insensible, the condition alone is void, and the bond shall stand single and unconditional: for it is the folly of the obligor to enter into such an obligation from which he can never be released. If it be to do a thing that is *malum in se*, the obligation itself is void: for the whole is an unlawful contract, and the obligee shall take no advantage from such a transaction. And if the condition be possible at the time of making it, and afterwards becomes impossible by the act of God, the act of law, or the act of the obligee himself, there the penalty of the obligation is saved: for no prudence or foresight of the obligor could guard against such a contingency. On the forfeiture of a bond, or its becoming single, the whole penalty was recoverable at law; but here the courts of equity interposed, and would not permit a man to take more in conscience than he ought, viz. his principal, interest, and expences, in case the forfeiture accrued by non-payment of money borrowed: the damages sustained upon non-performance of covenants; and the like. And the statute 4 and 5 Ann. c. 16. hath also enacted, in the same spirit of equity, that in case of a bond, conditioned for the payment of money, the payment or tender of the principal sum due, with interest and costs, even though the bond be forfeited and a suit commenced thereon, shall be a full satisfaction and discharge.

Bond, in masonry and brick-laying, is when bricks or stones are as it were knit and interwoven; and when they say, make *good bond*, they mean that the joints are not made over or upon other joints; but reach at least six inches, both within the wall and on the surface, as the art of building requires.

BONDAGE, properly signifies the same with slavery, but in old law books is used for villenage (see Villenage). Tenants in bondage paid kenots, and did fealty; they were not to fell trees in their own garden, without license of the lord. The widow of a tenant in bondage held her husband's estate *quam diu vixerit sine marito*, "as long as she lived single."

Bondage by the Forelock, or *Bondagium per anteriores crines capitis*, was when a freeman renounced his liberty, and became a slave to some great man; which was done by the ceremony of cutting off a lock of hair from the forehead, and delivering it to his lord; denoting that he was to be maintained by him for the future. Such a bondman, if he reclaimed his liberty, or were fugitive from his master, might be drawn again to his servitude by the nose, whence the origin of the popular menace to pull a man by the nose.

BONDMAN, in the English law, is used for a villain, or tenant in the villenage *.—The Romans had two kinds of bondmen; one called *servi*, who were those either bought for money, taken in war, left by succession, or purchased by some other lawful acquisition; or else born of their *bondwomen*, and called *vernæ*. We may add a third kind of bondmen mentioned by Justinian, called *adscriptitii glebæ*, or *agricensiti*; who were not bound to the person, but to the ground or place, and followed him who had the land. These in our law are called *villains regardants*, as belonging to the manor or place.

* See *Villain* and *Villenage*.

BONE-ace, a game at cards played thus: The dealer deals out two cards to the first hand, and turns up the third, and so on through all the players, who may be seven, eight, or as many as the cards will permit: he that has the highest card turned up to him carries the bone; that is, one half of the stake; the other half remaining to be played for. Again, if there be three kings, three queens, three tens, &c. turned up, the eldest hand wins the bone. But it is to be observed, that the ace of diamonds is bone-ace, and wins all other cards whatever. Thus much for the bone: and as for the other half of the stake, the nearest to 31 wins it; and he that turns up or draws 31 wins it immediately.

BONES, their origin, formation, composition, texture, variety, offices, &c. See Anatomy.

Bones Whitened for Skeletons. Two processes are described in the *Acta Hoffniensia* for whitening bones.

Professor

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Professor Rau had a method of giving them a great degree of whiteness. By bare exposure to the air, sun, and rain, for a length of time, they become notably white; but the whitest bones, kept in a room tainted with smoke or fuliginous vapours, grow in a little time yellowish, brownish, and unsightly. It is customary for the purification of bones, to boil them in alkaline liquors; which, by dissolving and extracting the superfluous fat, improves their whiteness.

Bones Hardened and Softened. Boerhaave observes, that alkaline salts render bones harder and firmer, and that acids make them softer and more flexible. These effects succeed in certain circumstances, but not universally; for bones may be hardened and softened both by acids and alkalies, according to the quantity of saline matter employed, and the manner in which it is applied. Newman made bones harder and more compact by treating them with the strongest of the mineral acids; though, when the acid is in sufficient proportion, it destroys or dissolves them. In Papin's digester (a strong close vessel in which the steam of boiling liquors is confined, and the fluid by this means made to undergo a greater degree of heat than it could otherwise sustain), the hardest bones are reduced in a short time, by the action of simple water into a soft pap or jelly; and alkaline liquors produce this effect still sooner.

In the history of the French Academy for the years 1742 and 1743, there is an account that Mr Geoffroy produced before the academy a small ivory spoon, which by long lying in mustard, was become flexible and transparent like horn: that Mr Fouchy saw an ivory spoon, which, by lying for a considerable time in milk, was become supple like leather; and that Mr Hunauld produced bones, which had been softened by steeping in vinegar, afterwards hardened to their natural state by steeping in water, and softened a second time by steeping in vinegar. Dr Lewis observed that the nitrous and marine acids diluted, and the acetous acid, make bones flexible and tough like leather; but that the diluted vitriolic acid, though it renders them notably soft, makes them at the same time brittle. It seems as if a great part of the earthy matter, which is the basis of the bone, and on which its hardness depends, was dissolved and extracted by the three first; whilst the latter, incapable of dissolving this kind of earth into a liquid form, only corrodes it into a kind of selenitic concrete, which remains intermixed in minute particles among the gelatinous matter. Dr Lewis did not find that the softened bones, whatever acid they were softened by, recovered their hardness by steeping in water. Slips of softened ivory, after lying above a month in water, continued nearly as soft as when they were taken out of the acid liquor.

There is a singular induration of bones produced by fire; the effects of which agent are here remarkably different according to its degree and the circumstances of its application. Bones exposed to a moderate fire, either in open vessels, or in contact with the burning fuel, become opaque, white, and friable throughout; and an increase of fire, after they have once suffered this change, renders them only more and more friable. But if they are urged at first with a strong fire, such as that in which copper or iron melts, they become hard, semitransparent, and sonorous, like the hard mineral stones. This curious experiment deserves to be further prosecuted.

Colouring of Bones. Bones may be stained of a variety of colours by the common dyeing infusions and decoctions of animal and vegetable substances. They are stained also, without heat, by metallic solutions; and by means of these may be spotted or variegated at pleasure. Thus, solution of silver in aquafortis gives a brown or black according to its quantity; solution of gold in aqua regia, or in the spirit of salt, a fine purple; solution of copper in the acetous acid, a fine green; and solutions of the same metal in volatile alkalies, a blue, which is at first deep and beautiful, but changes, upon exposure to the air, into a green or bluish-green. If the bone is but touched with the two first solutions, and exposed to the air, it does not fail to acquire the colour in a few hours: In the two latter, it requires to be steeped for a day or longer in order to its imbibing the colour. In these and other cases where immersion for some time is necessary, the bone may be variegated, by covering such parts as are to remain white, with wax or any other matter that the liquor will not dissolve or penetrate.

Oeconomical Uses of Bones. Bones are a very useful article, not only for making different kinds of toys, but likewise in several of the chemical arts; as, for making cast iron malleable, for absorbing the sulphur of sulphureous ores; for forming tests and cupels, or vessels for refining gold and silver with lead (burnt bones composing a mass of a porous texture, which absorbs the vitrified lead and other matters, while the unvitrescible gold and silver remain entire behind); for the preparation of milky glasses and porcelains; for the rectification of volatile salts and empyreumatic oils; and for making glue. The bones of different animals are not equally fit for these uses: even the glue, or gelatinous part of the bones of one animal is notably different both in quantity and cohesiveness from that of another.

The human skull-bone, or cranium, the natural defence of the seat of sensation and perception in the noblest animal, has been recommended medicinally as a cure for epilepsies, deliria, and all disorders of the senses, from the same philosophy which ascribed antiasthmatic virtues to the lungs of the long-winded fox; and expected, because fowls are said to digest even small stones, that the skin of the gizzard, dried and powdered, would produce a similar effect in the human stomach. To such lengths of extravagance have the sons of physic been carried by the blind superstition of former ages!

Bones in the funeral Solemnities of the Ancients.— Divers usages and ceremonies relating to the bones of the dead have obtained in different ages; as gathering them from the funeral pile, washing, anointing, and depositing them in urns, and then into tombs: translating them, which was not to be done without the authority of the pontiffs; not to say worshipping of them, still practised to the bones of the saints in the Romish church. Among the ancients, the bones of travellers and soldiers dying in foreign countries were brought home to be buried; till, by an express S. C. made during the Italic war, it was forbid, and the soldiers bodies ordered to be buried where they died.

The Romans had a peculiar deity under the denomination,

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mination of *Ossilago*, to whom the care of the induration and knitting of the human bones was committed; and who, on that account, was the object of the adoration of all breeding women.

Fossil or *Petrified* BONES, are those found in the earth, frequently at great depths, in all the strata, even in the bodies of stones and rocks; some of them of a huge size, usually supposed to be the bones of giants, but more truly of elephants or hippopotami. It is supposed they were reposited in those strata when all things were in a state of solution; and that they incorporated and petrified with the bodies where they happened to be lodged.

In the museum of the Russian Academy of Sciences, there is a vast collection of fossil bones, teeth, and horns, of the elephant, rhinoceros, and buffalo, which have been found in different parts of this empire, but more particularly in the southern regions of Siberia. Naturalists have been puzzled to account for so great a variety being found in a country where the animals of which they formerly made a part were never known to exist. It was the opinion of Peter, who, though he deserves to be esteemed a great monarch, was certainly no great naturalist, that the teeth found near Voronetz were the remains of elephants belonging to the army of Alexander the Great, who, according to some historians, crossed the Don, and advanced as far as Kostinka. The celebrated Bayer, whose authority carries greater weight in the literary world, conjectures, that the bones and teeth found in Siberia belonged to elephants common in that country during the wars which the Mogul monarchs carried on with the Persians and Indians; and this plausible supposition seems in some measure to be corroborated by the discovery of the entire skeleton of an elephant in one of the Siberian tombs. But this opinion, as Mr Pallas* very justly observes, is sufficiently refuted by the consideration, that the elephants employed in the armies of all India could never have afforded the vast quantities of teeth which have been discovered, not to mention those which it is justly to be presumed may still be buried. They have been already dug up in such plenty as to make a considerable article of trade. The same ingenious naturalist has given an ample description of those fossil bones, and has endeavoured to account for their origin. Upon examining those in the museum, he was led to conclude, that as these bones are equally dispersed in all the northern regions of Europe, the climate probably was in the earlier ages less severe than at present, and then possibly sufficiently warm to be the native countries of the elephant, rhinoceros, and other quadrupeds, now found only in the southern climates. But when he visited, during his travels, the spots where the fossil bodies were dug up, and could form a judgment from his own observations, and not from the accounts of others, he renounced his former hypothesis; and, in conformity with the opinions of many modern philosophers, asserted, that they must have been brought by the waters; and that nothing but a sudden and general inundation, such as the deluge, could have transported them from their native countries in the south, to the regions of the north. In proof of this assertion, he adds, that the bones are generally found separate, as if they had been scattered by the waves, covered with a stratum of mud evidently formed by the waters, and commonly intermixed with the remains of marine plants, and similar substances; instances of which he himself observed during his progress through Siberia, and which sufficiently prove that these regions of Asia were once overwhelmed with the sea.

* *Nov. Com. de Ossibus Siberiæ fossilibus.* p. 440.

We often find in the earth petrified bones, the greatest part of their gelatinous matter being extracted by the moisture, and a stony one introduced in its room. In some parts of France petrified bones are met with which have an impregnation of copper. Hence, on being calcined in an open fire, a volatile salt is produced from the remains of their gelatinous principle, and the bone is tinged throughout of a fine greenish blue colour, copper always striking a blue with volatile alkalies. The French turcoise stones are no other than these bones prepared by calcination: they are very durable, and bear to be worked and polished nearly in the same manner as glass; without the imperfection, inseparable from glassy bodies, of being brittle. See the article TURCOISE.

There have been lately discovered several enormous skeletons, five or six feet beneath the surface, on the banks of the Ohio, not far from the river Miami in America, 700 miles from the sea-coast. Some of the tusks are seven, others ten feet long; one foot six inches in circumference at the base, and one foot near the point; the cavity at the root or base, 19 inches deep. Besides their size, there are several other differences which will not allow the supposition of their having been elephants: the tusks of the true elephant have sometimes a very slight lateral bend; these have a larger twist, or spiral curve, towards the smaller end: but the great and specific difference consists in the shape of the grinding teeth: which, in these newly found, are fashioned like the teeth of a carnivorous animal; not flat and ribbed transversely on their surface like those of the modern elephant, but furnished with a double row of high and conic processes, as if intended to masticate, not to grind, their food. A third difference is in the thigh-bone, which is of great disproportionable thickness to that of the elephant; and has also some other anatomical variations. These fossil bones have been also found in Peru and the Brazils; and when cut and polished by the workers in ivory, appear in every respect similar. It is the opinion of Dr Hunter, that they must have belonged to a larger animal than the elephant; and differing from it in being carnivorous. But as yet this formidable creature has evaded our search; and if indeed, such an animal exists, it is happy for man that it keeps at a distance; since what ravage might not be expected from a creature, endowed with more than the strength of the elephant, and all the rapacity of the tiger? See MAMMOUTH.

Bone-Spavin. See FARRIERY *Index*.

BON ESPERANCE, the same with the Cape of Good Hope. See GOOD HOPE.

BONET, THEOPHILUS, an eminent physician, born at Geneva, March 15th 1620. He took his degree in physic in 1643, after he had gone through most of the famous universities, and was for some time physician to the duke of Longueville. Meanwhile his skill in his profession got him considerable practice; but being seized with deafness, it obliged him to retire from business, which gave him leisure to collect all the observations

tions he had made during a practice of 40 years. He wrote, 1. *Polyalthes, sive Thesaurus Medico-practica*, 3 vols. folio. 2. *Labyrinthi Medici extricati*. 3. *Medicini Septentrionalis Collatitia*; and other works.

BONFADIO, JAMES, one of the most polite writers of the 16th century, was born in Italy, near the lake Garda. He was secretary to the cardinal de Bari, and after his death to the cardinal Ghinucci. He afterwards read public lectures on Aristotle's politics, and on rhetoric; and was made historiographer to the republic of Genoa. He applied himself to compose the annals of that state, in which he wrote too satirically on some families. This creating him enemies who were resolved to ruin him, they accused him of the unnatural sin; and, as witnesses were found to convict him of it, he was condemned to be burnt. Some say that this sentence was executed; and others, that his punishment was changed, and that he was beheaded. This was in the year 1560. Upon the day of his execution he wrote a note to John Baptist Grimaldi, to testify his gratitude to the persons who had endeavoured to serve him; and promised to inform them how he found himself in the other world, if it could be done without frightening them. But it does not appear that he performed his promise, any more than the many who had promised the like before him.—His history of Genoa is esteemed. We have also some letters, some orations, and Latin and Italian poems, of his, which were printed at Bologna in the year 1744, octavo.

BONFINIUS, ANTHONY, flourished in the 15th century. He was a native of Ascoli in Italy, and attached himself to the study of the belles lettres. Matthias Corvin king of Hungary, having heard of his learning, sent for him, retained him, and settled upon him a pension. He wrote, 1. A history of Ascoli; 2. A treatise of virginity and conjugal chastity; 3. An history of Hungary; and other works.

BONFRERIUS, JAMES, a learned Jesuit, born at Dinant, in 1573. He wrote a commentary on the Pentateuch, and learned notes on the Onomasticon of the places and towns mentioned in the Scripture. He died at Tournay in 1643, aged 70.

BONGARS, JAMES, in Latin *Bongarsius*, a native of Orleans, was one of the most learned men of the 16th century. He applied himself to the study of critical learning, and was for near 30 years employed in the most important negociations of Henry IV. whose resident he was several times at the courts of the princes of Germany, and at length his ambassador. He was of the Protestant religion; and, when very young, had the courage to write and post up in Rome a very spirited answer to a bull of Pope Sixtus V. The public is obliged to him for the edition of several authors who have written the History of the expeditions to the Holy Land; he also published, among other works, an edition of Justin, in which he restored several passages that had been corrupted, by consulting valuable muanuscripts, and added notes which explained many dufficulties. He died in 1612, aged 58.

BONIFACE, the name of several eminent men, particularly of nine popes. To the first of these, who was chosen pope in 418, St Augustine dedicated his four books against the two epistles of the Pelagians. The third of that name prevailed upon the emperor Phocas to consent that the title of *Universal Bishop* should be conferred on no other than the bishop of Rome. Boniface IV. obtained from the same emperor, the Pantheon, a famous heathen temple built by Agrippa, and converted it into a church which is now called "Our Lady della Rotunda." Several works are also attributed to him, but they appear to be spurious. Boniface VII. hath the title of *antipope*; because in 974 he caused Benedict VI. to be strangled in prison, and after the election of Benedict VII. removed the treasures of the church to Constantinople. He, however, at length returned after the death of Benedict, and caused his successor John XIV. to be murdered; but died himself soon after, and was dragged naked by the feet about the streets. Boniface VIII. canonized St Lewis in 1297, and in 1300 appointed the jubilee to be solemnized every 100 years after.

BONIFACE is also the name of a saint, who before he took that name was called *Winifred*, and was born at Kirton in Devonshire. He chose to go and preach the gospel among the barbarous nations; and though created archbishop of Mentz, soon after resigned his office, to go and preach in East Friezland, where he was killed by the Pagans on the 5th of June 754. His letters were published by Senarius.

BONIFACIO, a town in the island of Corsica, beyond the mountains, near the strait called *Bocca di Bonifacio*. It is well fortified, and contains 3170 inhabitants. E. Long. 9. 0. N. Lat. 41. 25.

BONIS NON AMOVEDENIS, in *Law*, is a writ directed to the sheriffs of London, &c. charging them that a person against whom judgment is obtained, and prosecuting a writ of error, be not suffered to remove his goods until the error is determined.

BONITO. See SCOMBER, ICHTHYOLOGY *Index*.

BONN, an ancient and strong city of Germany, in the duchy of the Lower Rhine, subject to Prussia. It is of great consequence in the time of war; because it is situated on the Rhine, in a place where it can stop every thing that comes down that river. It is well fortified, and 1801 in contained 8837 inhabitants. The Jews are the principal traders. E. Long. 7. 5. N. Lat. 50. 44.

BONNA, in *Ancient Geography*, one of the 50 citadels built by Drusus on the Rhine; supposed by some to be the same with the *Ara Ubionum*: Now BONN.

BONNEFONS, JOHN, or BONNEFONIUS, a Latin poet, was born at Clermont in Auvergne, in 1554. He became an advocate in the parliament of Paris, and was appointed lieutenant-general of Bar sur Seine, and acquired great reputation by his *Pancharis*, and other poems. He died under the reign of Louis XIII. He ought not to be confounded with John Bonnefons his son, another Latin poet.

BONNER, EDMUND, bishop of London, of infamous memory, was born at Hanley in Worcestershire, and generally supposed to be the natural son of one Savage a priest; and that priest was the natural son of Sir John Savage of Clifton in the same county. Strype, however, says, he was positively assured that Bonner was the legitimate offspring of a poor man, who lived in a cottage known to this day by the name of *Bonner's place*. About the year 1512, he entered student of Broadgate Hall in Oxford. In 1519, he was admitted bachelor of the canon and civil law. About the

same

Bonner, Bonnestable.

same time he took orders, and obtained some preferment in the diocese of Worcester. In 1525, he was created doctor of canon law. Having now acquired the reputation of a shrewd politician and civilian, he was soon distinguished by Cardinal Wolsey, who made him his commissary for the faculties, and heaped upon him a variety of church preferments. He possessed at the same time the livings of Blaydon and Cherry-Burton in Yorkshire, Ripple in Worcestershire, East Dercham in Norfolk, the prebend of St Paul's, and archdeaconry of Leicester. Bonner was with the cardinal at Caw-wood, when he was arrested for high treason. After the death of that minister, he soon found means to insinuate himself into the favour of Henry VIII. who made him one of his chaplains, and employed him in several embassies abroad, particularly to the pope. In 1532, he was sent to Rome, with Sir Edward Kame, to answer for the king, whom his holiness had cited to appear in person or by proxy. In 1533, he was again despatched to Pope Clement VII. at Marseilles, upon the excommunication of King Henry on account of his divorce. On this occasion he threatened the pope with so much resolution, that his holiness talked of burning him alive, or throwing him into a caldron of melted lead; upon which Bonner thought fit to decamp. His infallibility did not foresee that the man whom he thus threatened was predestined to burn heretics in England. In 1538, being then ambassador at the court of France, he was nominated bishop of Hereford; but, before consecration, was translated to the see of London, and enthroned in April 1540. Henry VIII. died in 1547, at which time Bonner was ambassador with the emperor Charles V. During this reign he was constantly zealous in his opposition to the pope; and, in compliance with the king, favoured the reformation. Henry VIII. was not to be trifled with; but on the accession of young Edward, Bonner refused the oath of supremacy, and was committed to the Fleet; however, he soon thought fit to promise obedience to the laws, and was accordingly released. He continued to comply with reformation; but with such manifest neglect and reluctance, that he was twice reprimanded by the privy council, and in 1549, after a long trial, was committed to the Marshalsea, and deprived of his bishopric. The succeeding reign gave him ample opportunity of revenge. Mary was scarce seated on the throne before Bonner was restored to his bishopric; and soon after appointed vicegerent and president of the convocation. From this time he became the chief instrument of papal cruelty: he is said to have condemned no less than 200 Protestants to the flames in the space of three years. Nor was this monster of a priest more remarkable for his cruelty than his impudence. When Queen Elizabeth came to the crown, he had the insolence to meet her, with the rest of the bishops, at Highgate. In the second year of her reign, refusing to take the oath of allegiance and supremacy, he was again deprived, and committed to the Marshalsea; where he died in 1569, after ten years confinement. There cannot be a stronger instance of the comparative lenity of the Protestant church, than its suffering this miscreant to die a natural death. Several pieces were published under his name.

BONNESTABLE, a town of France, in the department of Sarte, which carries on a great trade in corn. E. Long. 0. 30. N. Lat. 48. 11.

Bonnestable, Bonnet.

BONNET, Charles, an eminent naturalist, was born in 1720 at Geneva, of a French family who had been forced on account of religious principles to leave their native country. As he was an only son, his father paid great attention to his education, and finding that he made little progress at the public schools, both from a dislike to the dry study of grammar, and deafness, with which he was very early afflicted, he put him under the care of a domestic tutor, and under him his progress was rapid and successful in general literature. At the early age of 16, his attention was so deeply engaged in the perusal and study of *Le Spectacle de la Nature*, that it seems to have directed the bias and taste of his future studies. The history and the habits of the ant-lion (*formica leo*), particularly attracted his attention, and led him to make his first observations in natural history. He discovered the haunts of this curious insect, watched and studied its manners and habits, and added many observations to those of Poupart and Reaumur. Reaumur's Memoir on insects happening to fall accidentally in his way, he perused it with great eagerness, and this perusal probably decided his taste for natural history. To the observations and experiments of that naturalist, Bonnet added many new facts which he had discovered, the detail of which he communicated to Reaumur, who was not less surprised than pleased to find so much sagacity and acuteness of research exhibited in the investigations of a young man of eighteen.

Young Bonnet had been destined by his father to the profession of the law; but it was with no small reluctance that he entered on the studies necessary to qualify himself for that profession. The bias of his mind leaned too strongly to natural history, to permit him to occupy his attention with other pursuits. The study of some of the elementary books on law was therefore submitted to merely as a task. In the years 1738 and 1739, he sent to Reaumur many interesting observations on different species of caterpillars; and in 1740, he communicated a paper to the Academy of Sciences respecting the propagation or multiplication of *aphides*, or tree-lice, without actual conjunction. This question had been left unsettled by Reaumur. It was now determined by decisive experiments; and his paper on the subject obtained for him the honour of being admitted a correspondent member of the Academy. His experiments on the generation of these insects were conducted with such closeness of attention, and such minuteness of research, as to injure his eyesight to such a degree as he never afterwards recovered. In the year 1741, he instituted a set of experiments, on the effects that follow the division of worms, and he found that many species possessed in some degree the same reproductive power as the polype. In the following year his investigations and experiments were directed to the peculiarities in the mode of respiration of caterpillars and butterflies; and he proved that this function was performed by means of pores to which the name of stigmata has been given. It was about the same time that he made some curious discoveries respecting the *tænia*, or tapeworm. In the year 1743, when he was raised to the rank of doctor of laws, he procured a welcome dispensation

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dispensation from the farther prosecution of studies which had never been agreeable to him, and which being no longer absolutely necessary, he relinquished for ever. In consequence of a memoir on insects which he communicated to the Royal Society of London, the same year, he was admitted a member of that body. Next year he published in one work, his observations on aphides and worms, under the title of *Insectology*. To this work he prefixed a preface, in which he exhibits a philosophical sketch of his ideas concerning the system of the developement of germs, and the scale of organized beings. This work was in general well received by the public. The want of delicacy was objected to in some journals, which, it was alleged, appeared in his descriptions of the mode of propagation of tree-lice.

But the constant labours to which Bonnet had subjected himself in all his inquiries began to produce very serious consequences on his health. His eyes particularly began to be affected with severe pains, and his general health visibly declined. This not only obliged him to lay aside the use of the microscope, but also to forego for a time all reading and writing. Like a true philosopher, he bore his afflictions with patience. But he was not idle: for though he was interdicted from all observation, his mind was fully occupied in reflection. After some time's relaxation from his usual pursuits, he was at last restored to tolerable health and ease, but he never could employ his eyes with the same freedom as formerly. About the year 1746, he undertook a course of experiments on the vegetation of plants in moss and other substances; and in the following year his researches were directed to the functions of the leaves of plants, with the view of ascertaining the different action of the different sides of the leaves. Another question in vegetation offered itself to his consideration. This was the ascent of the sap. And to determine whether it rose by the bark or wood, he employed coloured injections. This investigation, with some observations which he made on vegetable monsters, was the foundation of one of his most interesting and original works, his "Inquiries into the use of the Leaves of Plants." This work was first published in 4to at Leyden in 1754. A supplement was added to it in 1779.

Observation and experiment had been the first passion of Bonnet, yet these now began to give way to speculation; and his inquiries in natural history, in which he had so much studied the nature and generation of the lowest part of the scale of beings, led him to consider the faculties and destination of the highest. Malebranche and Leibnitz laid the foundation of his metaphysical ideas. He engaged deeply in all the discussions connected with the history of the human mind; and the first fruit of his meditations was a kind of abridgement of the materials he had collected, under the title of an "Essay on Physiology," published in London in 1755, but without his name, nor did he acknowledge it till near thirty years afterwards. This work contains in a concise form the fundamental principles of his philosophy. It traces the origin and progress of the human mind, from the first germ of life to the developement of all its faculties, the mutual dependence of which it points out, as deduced from actual observation. It enters into the difficult subject of human liberty, and endeavours to reconcile it with the divine prescience, and the philosophical principle, that every effect must have an adequate cause. From the essential properties of the activity of the soul, and the effects of habit upon it, the whole art of education and government is deduced; and a system of the former is laid down, materially different from the usually established methods. It was the freedom with which he had discussed some of these delicate points, and the fear of being involved in personal controversy, which induced the author to remain so long concealed. It met with a number of critics, yet its success was brilliant.

The next work of Bonnet was a developement of part of the substance of the preceding, viz. the origin and progress of the mental faculties. After a labour of five years on the subject, he produced his "Analytical Essay on the faculties of the soul." This was first printed at Copenhagen in 1760, in 4to, at the expence of the king of Denmark. In this work, like that of the abbé Condillac, he takes the supposition of a statue organized like the human body, which he by degrees animates, and shows how its ideas would arise from impressions on the organs of sense. This work was well received by philosophers, though with some it subjected him to the charge of materialism. To these he made no reply, but contented himself with proceeding in those efforts for the service of religion and morals, to which the best part of his life was devoted. His retired and studious habits, together with his deafness and other bodily infirmities, had ever prevented him from joining in the assemblies of the young and gay; at the same time they rendered domestic comforts more essential to him. In 1756, he married a lady of the respectable family of de la Rive, and with her he passed thirty-seven years of that perfect union which results from mutual tenderness, directed by good sense and virtue. The celebrated Saussure was the nephew of Mad. Bonnet, and it was no small pleasure to her husband to witness the early display of genius and knowledge in this extraordinary young man.

The next work of our author was properly the physical part of his great system. It appeared at Amsterdam in 1762, under the title of "Considerations on organized bodies," 2 vols. 8vo. Its principal objects were, to give in an abridged form all the most interesting and well-ascertained facts respecting the origin, developement, and reproductions of organized bodies; to refute the different systems founded upon *epigenesis*; and to explain and defend the system of germs. This publication, though well received by philosophers in general, was, from some suspicion of its principles, prohibited in France; but a remonstrance from the author to M. des Malesherbes, then licenser of the press, caused the interdict to be removed, after a new examination. His "Contemplation of Nature," which appeared in 1764, Amst. 2 vols. 8vo, was a work rather meant for popular use, in which the principal facts relative to the different orders of created beings are displayed in a manner both instructive and entertaining, and set off by the charms of an eloquent style, with a continual reference to final causes, and the proofs of wisdom and benevolence in the Creator. It has been translated into most of the European languages, and enriched with notes by several hands, as well as by the author himself in a new edition.

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The concluding work of Bonnet was his "Palingenesie Philosophique," printed at Geneva in 1769, 2 vols 8vo. In this he treats on the past and future state of living beings, and supports the idea of the survival of all animals, and the perfecting of their faculties in a future state. Attached to this work is "An Inquiry into the Evidences of the Christian Revelation, and the Doctrines of Christianity," which, with a treatise "On the Existence of God," was published separately at Geneva in 1770. It was likewise translated into German, and dedicated by the translator to a celebrated Jew, with a summons to him to refute it, or acknowledge his conviction. Bonnet, who had an invincible repugnance for controversy, no sooner heard of this step, than he wrote to the Jew, assuring him, that he had no share in it; and the two philosophers mutually agreed to forbear any discussion of a topic in which their opinions were totally different. The temper of Bonnet was, indeed, the direct reverse of that which disposes to contention; and tranquillity was the great object of his life. He readily corrected his own errors; and never but once entered into a defence of himself. This was on occasion of a charge of plagiarism brought against him as having borrowed from Leibnitz his hypothesis on the resurrection. He had, in the earlier part of life, made an anonymous attack in the French Mercury upon Rousseau's discourse on the origin of inequality among men, to which that writer made a reply; but the controversy went no further.

After having in some measure relinquished speculative philosophy, he resumed his attention to natural history, and in 1773, published in Rozier's Journal a memoir on the method of preserving insects and fish in cabinets. In 1774 he communicated to the same journal a memoir on the loves of plants, originating in the discovery of a kind of cleft or mouth in the pistil of a lily. Some experiments on the reproduction of the heads of snails, and of the limbs and organs of the water salamander, furnished matter for other memoirs. He also made observations on the pipa or Surinam toad, on bees, on the blue colour acquired by mushrooms from exposure to the air, and on various other subjects in natural history, which agreeably and usefully occupied his leisure. His reputation was now fully established. There was scarcely an eminent learned society in Europe which did not associate him as a member: and these honours were crowned in 1783 by his election into the small and very select number of foreign associates of the academy of sciences at Paris. His literary correspondents were numerous. Among these were the distinguished names of Reaumur, Du Hamel, De Geer, Haller, Van Swieten, Spallanzani, and Merian. Though attached by inclination to the pursuit of scientific studies in retirement, he did not entirely withdraw from public duties. He entered into the great council of the republic in 1752, and kept his seat in it till 1768, having frequently distinguished himself by the manly eloquence with which he supported wise and moderate measures, and his constant zeal in the cause of morals and religion, on which he thought the prosperity of the state essentially founded. The last twenty-five years of his life he passed entirely in the country, in a simple and uniform mode of living, happy in an easy competence, and in a small circle of friends. It appears that he was, for some time, engaged in the education of youth, an employment for which he was peculiarly fitted, and in which he obtained the warmest attachment of his pupils. The publication of all his works, corrected and revised, in a general collection, occupied near eight years of his life, which greatly injured his health, from the intense application which he bestowed upon it. This appeared at Neufchatel, in 9 vols 4to, and 18 vols 8vo.; and besides the works already mentioned, contains a number of smaller pieces, both in natural history and metaphysics. They are all written in French. It was not till about 1788 that his constitution, feeble as it was, visibly gave way. The symptoms of a dropsy in the chest then began to manifest appearance; and these with some intervals, gradually increased upon him, occasioning a variety of sufferings, which he bore with great patience and serenity. He died on May 20. 1793, at the age of 73. Public honours were rendered to his remains by his fellow-citizens, and his funeral eulogy was pronounced by his learned friend and kinsman, M. de Saussure.

BONNET, in a general sense, denotes a cover for the head, in common use before the introduction of hats. Bonnets are still used in many parts of Scotland.

BONNET, in *Fortification*, a small work consisting of two faces, having only a parapet with two rows of palisadoes, at about 10 or 12 feet distance; it is generally raised before the salient angle of the counterscarp, and has a communication with the covered way, by a trench cut through the glacis, and palisadoes on each side.

BONNET *à Pretre*, or *Priest's Bonnet*, in *Fortification*, is an out-work, having at the head three salient angles, and two inwards. It differs from the double tenaille only in this, that its sides, instead of being parallel, are like the *queue d'aronde*, or swallow's tail, that is, narrowing, or drawing close at the gorge, and opening at the head.

BONNET, in the sea-language, denotes an addition to a sail; thus we say, lace on the bonnet, or shake off the bonnet.

BONNEVAL, CLAUDIUS ALEXANDER, COUNT DE, known in the latter part of his life by the name of *Osman Bashaw*, descended from a family related to the blood-royal of France, entered himself at the age of 16 in the service of that crown, and married the daughter of Marshal de Biron. He made the campaign of Flanders in 1690; but soon after left the French army, and entered into the Imperial service under Prince Eugene, who honoured him with an intimate friendship. The intrigues of the marquis de Prié, his inveterate enemy, ruined his credit, however, at the court of Vienna, and caused him to be banished the empire. He then offered his service to the republic of Venice and to Russia; which being declined, his next tender was to the Grand Signior, who gladly received him. It was stipulated that he should have a body of 30,000 men at his disposal; that a government should be conferred on him, with the rank of bashaw of three tails, and a salary of 10,000 aspers a-day; and that, in case of war, he should be commander in chief. The first expedition he engaged in after his arrival at Constantinople, was to quell an insurrection in

Arabia

Arabia Petræa, which he happily effected; and at his return had large offers made him by Kouli Khan, but he did not choose to accept them. Some time after, he commanded the Turkish army against the emperor, over whose forces he gained a victory on the banks of the Danube. But success does not always protect a person against disgrace, for Bonneval, notwithstanding his service, was first imprisoned, and then banished to the island of Chio. The sultan, however, continued his friend; and the evening before his departure made him bashaw-general of the Archipelago, which, with his former appointment of beglerbeg of Arabia, rendered him one of the most powerful persons in the Ottoman empire. In this island he found a retirement quite agreeable to his wishes; but did not long enjoy it, being sent for back, and made *topigi* or master of the ordnance, a post of great honour and profit. He died in this employment, aged 75, in 1747; and wrote the memoirs of his own life.

BONNEVAL, a town of France, in the department of Eure and Loire, which had before the revolution a fine Benedictine abbey. It is seated on the river Loire, in E. Long. 1. 30. N. Lat. 48. 10.

BONNEVILLE, a town of Savoy, capital of Faucigny, situated on the north side of the river Arve, and subject to the king of Sardinia. It is situated at the foot of a mountain called the *Mole*, and is 20 miles south of Geneva. E. Long. 6. 10. N. Lat. 46. 18.

BONNY, among miners, a bed of ore, differing only from a squat as being round, whereas the squat is flat. See SQUAT.

BONNY, a town of France, in the department of Loiret, seated at the confluence of a river of the same name with the Loire. E. Long. 2. 54. N. Lat. 47. 36.

BONONCINI, GIOVANNI, an eminent composer of music, for some time divided the opinions of the *conoscenti* of this kingdom with respect to the comparative merits of himself and the great Handel, which gave occasion for the following epigram, said to have been written by Dr Swift:

> Some say that Signior Bononcini
> Compar'd to Handel's a mere ninny;
> Others aver, that to him Handel
> Is scarcely fit to hold the candle.
> Strange! that such high disputes should be
> 'Twixt *Tweedle Dum* and *Tweedle Dee*.

There is one opera (Italian) published with his name prefixed to it, entitled *Pharnaces;* but whether the words, or only the music, are his composition, is uncertain; and indeed, in the general, the language of those pieces, written merely for musical representation, is so extremely paltry, and so opposite to every thing that can be deemed poetry, that the greatest compliment that can be paid to the authors of them is, to suffer their names to lie buried in the shades of obscurity.

BONONIA, in *Ancient Geography*, a town of Gallia Belgica, supposed to be the *Portus Iccius* of Cæsar, and the *Gessoriacum* of Mela, and to have had three different names (Cluverius). Peutinger's map expressly calls Gessoriacum *Bononia*. Now *Boulogne*. E. Long. 1. 30. N. Lat. 50. 40.

BONONIA, a town of Italy, in the Gallia Cispadana; a name probably given by the Gauls, there being a *Bononia* in Gallia Belgica. Its ancient name, when in the hands of the Tuscans, who were expelled by the Gauls, was *Fulsina*. In the 563d year of the city the Romans led a colony thither; which, about the beginning of the Actiac war, was increased by Augustus, and is the *Colonia Bononiensis* of Tacitus. Now *Bologna;* which see.

BONONIA, a town of Pannonia Inferior, between Mursa to the north-west, and Taurinum to the east.—Another Bononia, a town of Mœsia Superior, on the Danube; now *Bodon* in Bulgaria. See BODON.

BONONIAN. See BOLONIAN.

BONOSIANI, or BONOSIACI, an ancient branch of *Adoptiani*, in the fourth century, denominated from their leader Bonosus, a bishop of Macedonia. The Bonosiani were prior to the Feliciani, and even to Nestorius; whence some rather consider them as a branch of Arians. They allowed Christ to be no otherwise the Son of God than by adoption.

BONPOURNICKEL, a coarse kind of bread used in Westphalia. See BREAD.

BONS HOMMES, or *Bon-hommes*, a sort of hermits of St Augustin, founded by F. de Paula. They were brought over into England in 1283, by Edmund earl of Cornwall, and settled at Ashorug in Bucks, besides which they had only one house more at Edingdon in Wiltshire. They followed the rule of St Austin, and wore a blue habit. The name is said to have arisen from Louis XI. of France, who used to call F. de Paula, prior of the order, *Le bon homme*. Till then they had been called the *Minimi*, or the order of Grammont. See ALBIGENSES.

BONTIA, WILD OLIVE OF BARBADOES. See BOTANY *Index*.

BONVINCINO, ALESSANDRO, called LE MORETTO, history and portrait painter, was born at Rovate in 1514. He was first the disciple of Titian, under whose direction he studied diligently for some years. But, having accidentally seen the designs of Raphael, he felt an elevation of mind that he never had before experienced. He therefore gave himself up entirely to study those masterpieces of art and genius; and his observations were guided with such judgment, as well as attention, that his improvement was truly surprising, and he became an exceeding good painter. His works were eagerly bought up, as being extremely admired for the tenderness of the pencilling; for the correctness and spirited expression of the figures; for the neatness of the finishing; and for the rich variety of his draperies, which usually consisted of velvets, damasks, or satins, all copied after nature, and being wonderfully imitated. He was also equally excellent in portrait, and by many was placed in competition even with Titian. He died in 1564.

BONUS HENRICUS. See CHENOPODIUM, BOTANY *Index*.

BONZES, Indian priests. The Tonquinese have a pagod or temple in each town; and each pagod has at least two bonzes belonging to it: some have 30 or 40. These bonzes, in order to distinguish themselves from the laity, wear a chaplet about their necks consisting of 100 beads; and carry a staff, at the end of which is a wooden bird. They live upon the alms of the people; yet are very charitably disposed; and maintain several orphans and widows out of their own collections.

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The bonzes of China are the priests of the Fohists or sect of Fohi. It is one of their established tenets that there are rewards allotted for the righteous, and punishments for the wicked, in the next world; and that there are various mansions in which the souls of men will reside, according to their different degrees of merit. But, in order to deserve the favour of heaven, the bonzes instruct the people to treat the priests with respect and reverence, to support and maintain them, and to erect temples and monasteries for them. They tell them, that, unless they comply with these injunctions, they will be cruelly tormented after death, and pass through a disagreeable variety of transmigrations: in short, that they will be changed into mules, asses, rats, and mice.

The Chinese bonzes, according to F. le Compte, are no better than a gang of dissolute idle fellows. All their aim is to incite people to commiserate their abject condition: to which end they have recourse to several tricks and impostures. When the common arts of address fail them, they try what public acts of penance will do. Some of them drag heavy chains 30 feet long after them; some sit in the highway knocking their heads against flint stones; others set particular drugs on fire upon their heads: all these are several ways of drawing the attention and exciting the compassion of the people, and they seldom fail of success.

The bonzes of Japan are generally gentlemen of the highest extraction; for when a gentleman of quality finds his family grow too numerous, nay, when he has only two sons, he very often makes the youngest a bonze, to prevent all domestic broils and confusions. These priests are dressed in various colours; their apartments are very commodious, and situated in the healthiest parts of the country.

F. Navarette tells us, that the bonzes are obliged to chastity; and that, on the 2d of April 1667, a petty king of Canton had condemned 11 of them to be burnt alive for incontinence. He adds, that it was reported of an empress of the last reigning family, who had a particular kindness for the bonzes, that she granted them a dispensation for the use of women during three days. The bonzes of China, according to the same author, are computed at 50,000.

BOOBY. See Pelicanus, Ornithology *Index*.

BOOK, the general name of almost every literary composition; but, in a more limited sense, is applied only to such compositions as are large enough to make a volume. As to the origin of books or writing, those of Moses are undoubtedly the most ancient that are extant: But Moses himself cites many books which it behoved to be written before his time.

Of profane books, the oldest extant are Homer's poems, which were so even in the time of Sextus Empiricus; though we find mention in Greek writers of several others prior to Homer; as Hermes, Orpheus, Daphne, Horus, Linus, Musæus, Palamedes, Zoroaster, &c.: but of the greater part of these there is not the least fragment remaining; and of others, the pieces which go under their names are generally held, by the learned, to be supposititious.

Several sorts of materials were used formerly in making books: Plates of lead and copper, the bark of trees, bricks, stone, and wood, were the first materials employed to engrave such things upon as men were willing to have transmitted to posterity. Josephus speaks of two columns, the one of stone, the other of brick, on which the children of Seth wrote their inventions and astronomical discoveries: Porphyry makes mention of some pillars, preserved in Crete, on which the ceremonies observed by the Corybantes in their sacrifices were recorded. Hesiod's works were originally written upon tables of lead, and deposited in the temple of the Muses, in Bœotia: The ten commandments, delivered to Moses, were written upon stone; and Solon's laws upon wooden planks. Tables of wood, box, and ivory, were common among the ancients: When of wood, they were frequently covered with wax, that people might write upon them with more ease, or blot out what they had written. The leaves of the palm-tree were afterwards used instead of wooden planks, and the finest and thinnest part of the bark of such trees, as the lime, the ash, the maple, and the elm; from hence comes the word *liber*, which signifies the inner bark of the trees: and as these barks are rolled up, in order to be removed with greater ease, these rolls were called *volumen*, a volume; a name afterwards given to the like rolls of paper or parchment.

Thus we find books were first written on stones, witness the Decalogue given to Moses: Then on the parts of plants; as leaves, chiefly of the palm-tree, the rind and barks, especially of the tilia, or phillyrea, and the Egyptian papyrus. By degrees wax, then leather, were introduced, especially the skins of goats and sheep, of which at length parchment was prepared; then lead came into use; also linen, silk, horn, and lastly paper itself.

The first books were in the form of blocks and tables; but as flexible matter came to be wrote on, they found it more convenient to make their books in the form of rolls: These were composed of several sheets fastened to each other, and rolled upon a stick, or *umbilicus*; the whole making a kind of column, or cylinder, which was to be managed by the umbilicus as a handle, it being reputed a crime to take hold of the roll itself: The outside of the volume was called *frons*; the ends of the umbilicus, *cornua*, which were usually carved, and adorned with silver, ivory, or even gold and precious stones: The title, συλλαβος, was struck on the outside; the whole volume, when extended, might make a yard and a half wide, and fifty long. The form which obtains among us is the square, composed of separate leaves; which was also known, though little used, by the ancients.

To the form of books belongs also the internal economy, as the order and arrangement of points and letters into lines and pages, with margins and other appurtenances. This has undergone many varieties. At first the letters were only divided into lines; then into separate words; which, by degrees, were noted with accents, and distributed, by points and stops, into periods, paragraphs, chapters, and other divisions. In some countries, as among the orientals, the lines began from the right and ran leftward; in others, as the northern and western nations, from left to right; others, as the Greeks, followed both directions, alternately going in the one, and returning in the other, called *boustrophedon*: In most countries, the lines run from

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from one side to the other; in some, particularly the Chinese, from top to bottom.

Multitude of Books has been long complained of: the complaint is as old as Solomon, who lived three thousand years ago: they are grown too numerous not only to procure and read, but to see, to learn the names of, or even to number. England has more to fear on this score than other countries; since, besides our own produce, we have for some years past drained our neighbours. However, as Bishop Caramuel's scheme miscarried, which was to write about an hundred volumes in folio, and then prevail on the civil and military powers to oblige all their subjects to read them, we need not much regret the multitude of books.

As knowledge, however, is naturally advantageous, and as every man ought to be in the way of information, even a superfluity of books is not without its use, since hereby they are brought to obtrude themselves on us, and engage us when we had least design. This advantage, an ancient father observes, we owe to the multiplicity of books on the same subject, that one falls in the way of one man, and another best suits the level or the apprehension of another. "Every thing that is written (says he) does not come into the hands of all persons: perhaps some may meet with my books, who may hear nothing of others which have treated better of the same subject. It is of service, therefore, that the same questions be handled by several persons, and after different methods, though all on the same principles, that the explication of difficulties and arguments for the truth may come to the knowledge of every one by one way or other." Add, that the multitude is the only security against the total loss or destruction of books: it is this that has preserved them against the injuries of time, the rage of tyrants, the zeal of persecutors, and the ravages of barbarians; and handed them down, through long intervals of darkness and ignorance, safe to our days. *Solaque non norunt hæc monumenta mori.*

Scarcity of Books. Of the scarcity and value of books during the seventh and many subsequent centuries, the following curious account is given by Mr Warton in his history of English Poetry, vol. i.

"Towards the close of the seventh century (says he), even in the papal library at Rome, the number of books was so inconsiderable, that Pope Saint Martin requested Sanctamund bishop of Maestricht, if possible, to supply this defect from the remotest parts of Germany. In the year 855, Lupus, abbot of Ferrieres in France, sent two of his monks to Pope Benedict III. to beg a copy of *Cicero de Oratore,* and Quintilian's Institutes, and some other books: 'for (says the abbot) although we have part of these books, yet there is no whole or complete copy of them in all France.' Albert, abbot of Gemblours, who with incredible labour and immense expence had collected a hundred volumes on theological, and fifty on profane subjects, imagined he had formed a splendid library. About the year 790, Charlemagne granted an unlimited right of hunting to the abbot and monks of Sithin, for making their gloves and girdles of the skins of the deer they killed, and covers for their books. We may imagine that these religious were more fond of hunting than reading. It is certain that they were obliged to hunt before they could read: and at least it is probable, that under these circumstances, and of such materials, they did not manufacture many volumes. At the beginning of the tenth century books were so scarce in Spain, that one and the same copy of the Bible, Saint Jerome's epistles, and some volumes of ecclesiastical offices and martyrologies, often served several different monasteries. Among the constitutions given to the monks of England by Archbishop Lanfranc, in the year 1072, the following injunction occurs. At the beginning of Lent, the librarian is ordered to deliver a book to each of the religious: a whole year was allowed for the perusal of this book; and at the returning Lent, those monks who had neglected to read the books they had respectively received, are commanded to prostrate themselves before the abbot, and to supplicate his indulgence. This regulation was partly occasioned by the low state of literature which Lanfranc found in the English monasteries. But at the same time it was a matter of necessity, and is in a great measure to be referred to the scarcity of copies of useful and suitable authors. In an inventory of the goods of John de Pontissara, bishop of Winchester, contained in his capital palace of Wulvesey, all the books which appear are nothing more than *Septendecem species librorum de diversis scientiis.* This was in the year 1294. The same prelate, in the year 1299, borrows of his cathedral convent of St Swithin at Winchester, *Bibliam bene glossatam;* that is, the Bible with marginal annotations, in two large folio volumes; but gives a bond for due return of the loan, drawn up with great solemnity. This Bible had been bequeathed to the convent the same year by Pontissara's predecessor, Bishop Nicholas de Ely: and in consideration of so important a bequest, that is, *pro bona Biblia dicti episcopi bene glossata,* and one hundred merks in money, the monks founded a daily mass for the soul of the donor. When a single book was bequeathed to a friend or relation, it was seldom without many restrictions and stipulations. If any person gave a book to a religious house, he believed that so valuable a donation merited eternal salvation; and he offered it on the altar with great ceremony. The most formidable anathemas were peremptorily denounced against those who should dare to alienate a book presented to the cloister or library of a religious house. The prior and convent of Rochester declare, that they will every year pronounce the irrevocable sentence of damnation on him who shall purloin or conceal a Latin translation of Aristotle's Physics, or even obliterate the title. Sometimes a book was given to a monastery on condition that the donor should have the use of it during his life; and sometimes to a private person, with the reservation that he who receives it should pray for the soul of his benefactor. The gift of a book to Lincoln cathedral, by Bishop Repingdon, in the year 1422, occurs in this form, and under these curious circumstances. The memorial is written in Latin with the bishop's own hand, which I will give in English, at the beginning of Peter's Breviary of the Bible. 'I Philip of Repyndon, late bishop of Lincoln, give this book, called *Peter de Aureolis,* to the new library to be built within the church of Lincoln: reserving the use and possession of it to Richard Trysely, clerk, canon, and prebendary, of Miltoun, in fee, and to the term of his life; and afterwards to be given up and restored to the said library, or the keepers

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Books. keepers of the same, for the time being, faithfully, and without delay. Written with my own hand, A. D. 1422." When a book was bought, the affair was of so much importance, that it was customary to assemble persons of consequence and character, and to make a formal record that they were present on this occasion. Among the royal manuscripts, in the book of the Sentences of Peter Lombard, an archdeacon of Lincoln has left this entry: 'This book of the Sentences belongs to master Robert archdeacon of Lincoln, which he bought of Geoffrey the chaplain, brother of Henry vicar of Northelkington, in the presence of master Robert de Lee, master John of Lirling, Richard of Luda clerk, Richard the almoner, the said Henry the vicar, and his clerk, and others: and the said archdeacon gave the said book to God and St Oswald, and to Peter abbot of Barton, and the convent of Barden.' The disputed property of a book often occasioned the most violent altercations. Many claims appear to have been made to a manuscript of Matthew Paris, belonging to the last-mentioned library; in which John Russel, bishop of Lincoln, thus conditionally defends or explains his right of possession. 'If this book can be proved to be or to have been the property of the exempt monastery of St Alban in the diocese of Lincoln, I declare this to be my mind, that in that case I use it at present as a loan under favour of those monks who belong to the said monastery. Otherwise, according to the condition under which this book came into my possession, I will that it shall belong to the college of the blessed Winchester Mary at Oxford, of the foundation of William Wykham. Written with my own hand at Buckdane, 1st Jan. A. D. 1488. Jo. Lincoln. Whoever shall obliterate or destroy this writing, let him be anathema.' About the year 1225, Roger de Insula, dean of York, gave several Latin Bibles to the university of Oxford, with a condition that the students who perused them should deposit a cautionary pledge. The library of that university, before the year 1300, consisted only of a few tracts, chained or kept in chests in the choir of St Mary's church. In the year 1327, the scholars and citizens of Oxford assaulted and entirely pillaged the opulent Benedictine abbey of the neighbouring town of Abingdon. Among the books they found there, were one hundred psalters, as many grayles, and 40 missals, which undoubtedly belonged to the choir of the church: but besides these, there were only twenty-two codices, which I interpret books on common subjects. And although the invention of paper, at the close of the eleventh century, contributed to multiply manuscripts, and consequently to facilitate knowledge, yet, even so late as the reign of our Henry VI. I have discovered the following remarkable instance of the inconveniences and impediments to study, which must have been produced by a scarcity of books. It is in the statutes of St Mary's college at Oxford, founded as a seminary to Oseney abbey in the year 1446: 'Let no scholar occupy a book in the library above one hour, or two hours at most, so that others be hindered from the use of the same.' The famous library established in the university of Oxford, by that munificent patron of literature Humphrey duke of Gloucester, contained only 600 volumes. About the commencement of the 14th century there were only four classics in the royal library of Paris. These were one copy of Cicero, Ovid, Lucan, and Boethius. The rest were chiefly books of devotion, which included but few of the fathers: many treatises of astrology, geomancy, chiromancy, and medicine, originally written in Arabic, and translated into Latin or French: pandects, chronicles, and romances. This collection was principally made by Charles V. who began his reign in 1365. This monarch was passionately fond of reading; and it was the fashion to send him presents of books from every part of the kingdom of France. These he ordered to be elegantly transcribed and richly illuminated; and he placed them in a tower of the Louvre, from thence called *La Tour de la Libraire*. The whole consisted of 900 volumes. They were deposited in three chambers; which, on this occasion were wainscotted with Irish oak, and ceiled with cypress curiously carved. The windows were of painted glass, fenced with iron bars and copper wire. The English became masters of Paris in the year 1425; on which event the duke of Bedford, regent of France, sent the whole library, then consisting of only 853 volumes, and valued at 2223 livres, into England; where perhaps they became the ground-work of Duke Humphrey's library, just mentioned. Even so late as the year 1471, when Louis XI. of France borrowed the works of the Arabian physician Rhasis from the faculty of medicine at Paris, he not only deposited, by way of pledge, a quantity of valuable plate, but was obliged to procure a nobleman to join with him as surety in a deed, by which he bound himself to return it under a considerable forfeiture. The excessive prices of books in the middle ages afford numerous and curious proofs. I will mention a few only. In the year 1174, Walter, prior of St Swithin's at Winchester, afterwards elected abbot of Westminster, a writer in Latin of the lives of the bishops who were his patrons, purchased of the monks of Dorchester in Oxfordshire, Bede's Homilies and St Austin's Psalter, for twelve measures of barley, and a pall on which was embroidered in silver the history of St Birinus converting a Saxon king. Among the royal manuscripts in the British museum, there is Comestor's Scholastic History in French; which as it is recorded in a blank page at the beginning, was taken from the king of France at the battle of Poictiers; and being purchased by William Montague earl of Salisbury for 100 marcs, was ordered to be sold by the last will of his countess Elizabeth for 40 livres. About the year 1400, a copy of John of Meun's *Roman de la Rose*, was sold at Paris for 40 crowns, or 33l. 6s. 6d. See BIBLIOGRAPHY, SUPPLEMENT.

Books, Burning of, was a kind of punishment much in use among the Romans, by legal sentence: sometimes the care of the execution was committed to *triumviri* appointed on purpose; sometimes to the prætors, and sometimes to the ædiles. Labienus, whom from his satirical spirit some have called *Rabienus*, is said to have been the first who underwent the severity of it. His enemies procured a *senatusconsultum*, whereby all his books published during seven years were ordered to be collected and burnt. "The thing (says Seneca) then appeared new and strange, to take revenge on learning!" *Res nova et insueta! supplicium de studiis sumi.* Cassius Servius, a friend of Labienus, hearing the sentence pronounced, cried aloud, "That they must burn him too, since he had got all the books by heart:" *Nunc*

Book. *Nunc me vivum uri oportet, quia illos didici.* Labienus could not survive his books, but shutting himself up in the tomb of his ancestors, pined away, and was buried alive. Divers other ancient testimonies concerning the burning of books are given in Reimm. *Idea Syst. Antiq. Liter.* p. 389.

Book is also used for a part or division of a volume or large work. In this sense we say, the *book of Genesis*, the *first book of Kings*, the *five books of Moses*, &c. The Digest is contained in fifty books, the Code in twelve books.

Books are usually subdivided into chapters, sometimes into sections or paragraphs: accurate writers quote chapter and book.

Everlasting Book.—We find in Signior Castaquo's account of the asbestus, a scheme for the making of a book, which, from its imperishable nature, he is for calling *the book of eternity*. The leaves of this book were to be of the asbestus paper, the covers of a thicker sort of work of the same matter, and the whole sewed with thread spun from the same substance. The things to be commemorated in this book were to be written in letters of gold; so that the whole matter of the book being incombustible, and everlastingly permanent against the force of all the elements, and subject to no changes from fire, water, or air, must remain for ever, and always preserve the writing committed to it. He carried this project so far towards execution, as to find a way of making a sort of paper from the asbestus, which was so tractable and soft, that it very well resembled a thin parchment; this, by the same process, was capable of being thickened or thinned at pleasure, and in either state equally resisted the fire. The covering of the thinnest kind of this paper with fire, only makes it red hot and very clear, the fire seeming to pass through it without wasting or altering any part of it. Copper, iron, or any other metal except gold or silver, exposed to the same degree of fire in the same thin plates, would be found not to bear it in this manner, but to scale and burn into scoriæ at the surface, which this stone does not.

END OF THE THIRD VOLUME.

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