

BREWSTER, SIR DAVID, natural philosopher, distinguished especially for his original discoveries in the science of optics and his numerous and varied contributions to scientific literature, was born on the 11th December 1781 at Jedburgh, where his father, a teacher of high reputation, was rector of the grammar school. At the early age of twelve he was sent to the University of Edinburgh, being intended for the clerical profession. Even before this, however, he had shown a strong inclination for physical inquiries, which had been fostered by his intimacy with a "self-taught philosopher, astronomer, and mathematician," as Sir Walter Scott called him, of great local fame—James Veitch of Inchbonny. Veitch was particularly skilful in making telescopes, and may thus have had some influence in determining the precise direction of his young companion's future researches. Though he duly finished his theological course and was licensed to preach, Brewster's natural preference for other pursuits, combined with a constitutional nervousness, prevented him from engaging in the active duties of his profession. In 1799 he was induced by his fellow-student, Brougham, to study the inflection of light, repeating Newton's experiments; and from this date he carried on, almost without interruption, the course of original discovery in the science of physical optics which constitutes one of his chief claims to distinction. The results of his investigations were communicated from time to time in papers to the *Philosophical Transactions* of London and other scientific journals, and were admirably and impartially summarized by Professor James D. Forbes in his preliminary dissertation to the eighth edition of this Encyclopædia. The fact that other philosophers, notably Malus and Fresnel, were pursuing the same investigations contemporaneously in France does not invalidate Brewster's claim to independent discovery, even though in one or two cases the priority must be assigned to others.

The most important subjects of his inquiries are enumerated by Forbes under the following five heads:—1. The laws of polarization by reflection and refraction, and other quantitative laws of phenomena; 2. The discovery of the polarizing structure induced by heat and pressure; 3. The discovery of crystals with two axes of double refraction, and many of the laws of their phenomena, including the connection of optical structure and crystalline forms; 4. The laws of metallic reflection; 5. Experiments on the absorption of light. In this line of investigation the prime importance belongs to the discovery (1) of the connection between the refractive index and the polarizing angle, (2) of biaxial crystals, and (3) of the production of double refraction by irregular heating. These discoveries were promptly acknowledged by those best qualified to estimate their value. So early as the year 1807 the degree of LL.D. was conferred upon Brewster by Marischal College, Aberdeen; in 1815 he was made a member of the Royal Society of London, and received the Copley medal; in 1818 he received the Rumford medal of the Society; and in 1816 the French Institute awarded him one-half of the prize of three thousand francs for the two most important discoveries in physical science made in Europe during the two preceding years. Among the non-scientific public his fame was spread more effectually by the invention, in 1816, of the elegant philosophical toy, the kaleidoscope, for which there was so great a demand both in England and America that for some time the supply could not meet it. An instrument of higher interest, the stereoscope, which, though of much later date (1849–50), may be mentioned here, since along with the kaleidoscope it did more than anything else to popularize his name, was not, as has often been asserted, the invention of Brewster. Wheatstone discovered

its principle and applied it as early as 1838 to the construction of a cumbersome but effective instrument, in which the binocular pictures were made to combine by means of mirrors. To Brewster is due the merit of suggesting the use of lenses for the purpose of uniting the dissimilar pictures; and, accordingly, the lenticular stereoscope, now in exclusive use, may fairly be said to be his invention. A much more valuable practical result of Brewster's optical researches may be traced in the vast improvement of the lighthouse system during the last half century. It is true that the dioptric apparatus was perfected independently by Fresnel, who had also the satisfaction of being the first to put it into operation, the French Government being in this, as in many other cases, quicker than the English to perceive the value of new scientific discoveries. But it is indisputable that Brewster was earlier in the field than Fresnel; that he described the dioptric apparatus in 1812; that he pressed its adoption on those in authority at least as early as 1820, two years before Fresnel suggested it; and that it was finally introduced into British lighthouses mainly by his persistent efforts. The tribute paid to his memory by his successor at the head of the University of Edinburgh was therefore as just as it was graceful:—"Every lighthouse that burns round the shores of the British empire is a shining witness to the usefulness of Brewster's life."

Brewster's own discoveries, important though they were, were not his only, perhaps not even his chief, service to science. The extent and variety of his contributions to scientific literature were little short of marvellous. He commenced literary work in 1799 as a regular contributor to the *Edinburgh Magazine*, of which he acted as editor at the age of twenty. In 1807 he entered on a much larger undertaking, which cost him long continued labour, and, especially towards its close, great vexation and anxiety. The chance suggestion of a friend, who knew his varied powers, led to the projection, under his editorship, of the *Edinburgh Encyclopædia*, of which the first part appeared in 1808, and the last not until 1830. The work was, as might have been expected, strongest in the scientific department, and many of its most valuable articles were from the pen of its editor. At a later period he was one of the leading scientific contributors to the *Encyclopædia Britannica* (seventh and eighth editions), the articles Electricity, Hydrodynamics, Magnetism, Microscope, Optics, Stereoscope, Voltaic Electricity, &c., being from his pen. In 1819 Brewster undertook further editorial work by establishing, in conjunction with Jameson, the *Edinburgh Philosophical Journal*, which took the place of the *Edinburgh Magazine*. After a time the title was again changed to the *Edinburgh Journal of Science*, sixteen volumes of which appeared under Brewster's sole editorship, with very many articles from his own pen. To the transactions of various learned societies he contributed from first to last between three and four hundred papers, and few of his contemporaries wrote so much for the various reviews. In the *North British Review* alone seventy-five articles of his appeared. A list of his larger separate works will be found below. Special mention, however, must be made of the most important of them all—his biography of Newton. In 1831 he published a short popular account of the philosopher's life in Murray's *Family Library*; but it was not until 1855 that he was able to issue the much fuller *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, a work which embodied the results of more than twenty years' patient investigation of original manuscripts and all other available sources.

Brewster's relations as editor brought him into frequent communication with the most eminent scientific men, and he was naturally among the first to recognize the benefit

that would accrue from regular intercourse among labourers in the field of science. In an article in the *Quarterly Review* he threw out a suggestion for "an association of our nobility, clergy, gentry, and philosophers," which was taken up by others and found speedy realization in the British Association for the Advancement of Science. Its first meeting was held at York in 1831; and Brewster, along with Babbage and Herschel, had the chief part in shaping its constitution. It was this service mainly that was referred to when it was said of him after his death that "the improved position of men of science in our times is chiefly due to Sir David Brewster." In the same year in which the British Association held its first meeting Brewster received the honour of knighthood and the decoration of the Guelphic order of Hanover. In 1838 he was appointed principal of the united colleges of St Salvator and St Leonard, St Andrews. Two of the highest honours of the scientific world were conferred upon him in 1849, when he filled the office of president of the British Association and was elected one of the eight foreign associates of the Institute of France in succession to Berzelius. In 1859 he accepted the office of principal of the University of Edinburgh, the duties of which he continued to discharge vigorously until within a few months of his death, which took place at Allerly, Melrose, on the 10th February 1868.

In estimating Brewster's place among scientific discoverers the chief thing to be borne in mind is that the bent of his genius was not characteristically mathematical. His method was empirical; he was a painstaking and accurate observer and classifier of facts rather than a theorizer; and the laws which he established, some of them, as has been pointed out, of prime importance, were generally the result of repeated experiment. To the ultimate explanation of the phenomena with which he dealt he contributed nothing, and it is noteworthy in this connection, that if he did not maintain to the end of his life the corpuscular theory he never explicitly adopted the undulatory theory of light. These limitations, however, are to be taken as characterizing his genius rather than as detracting from it. Few will be inclined to dispute the verdict of Forbes:—"His scientific glory is different in kind from that of Young and Fresnel; but the discoverer of the law of polarization, of biaxial crystals, of optical mineralogy, and of double refraction by compression, will always occupy a foremost rank in the intellectual history of the age." In addition to the various works of Brewster already noticed the following may be mentioned:—Notes and Introduction to Carlyle's translation of Legendre's *Elements of Geometry* (1824); *Treatise on Optics* (1831); *Letters on Natural Magic*, addressed to Sir Walter Scott (1831); *The Martyrs of Science, or the Lives of Galileo, Tycho Brahe, and Kepler* (1841); *More Worlds than One* (1854). (See *The Home Life of Sir David Brewster*, by his daughter Mrs Gordon.)

BRIANÇON, a very strongly fortified town of France, the capital of an arrondissement in the department of Hautes-Alpes, situated on a hill about 4300 feet above the level of the sea, near the source of the Durance, in lat. 44° 53' N. and 6° 47' E. long. It commands the road across Mount Genève between France and Italy, and is well defended by its natural position; while the surrounding eminences are crowned with strong fortifications communicating with each other and the town by subterranean passages. The town itself is one of the highest in Europe, and the neighbouring village of St Veran has the loftiest situation of any in France. The principal buildings in Briançon are a church in the Italian style, the departmental prison, and a communal college. A single-arch bridge, 127 feet in span and 180 feet high, crosses the valley of the Clarée, affording access from the town to the principal parts of the fortifications. There is an extensive silk-factory

in the old convent of St Catherine, which manufactures floss silk, stockings, hats, and other silk goods; and the other industrial articles in the town comprise small iron wares, leather, and lavender water. A considerable traffic is carried on in chalk, and in turpentine and other forest productions. The chalk, though known as Briançon chalk, is obtained at Fenestrelles in Piedmont; the Briançon manna is a kind of resin. Briançon is identified with *Brigantium*, a city of great antiquity and dubious origin, which became an important military post under the Romans. For a long time after the fall of the Roman empire it maintained itself as an independent republic, and was not united to France till 1349. Made over by the peace of Ryswick to the duke of Savoy, it was restored to France in 1713. In 1815 the town made a noble defence. Population in 1872, 3579.

BRIANSK, a town of Russia, in the government of Orloff, 98 miles E.N.E. of the city of that name, in 53° 15' N. lat., and 22° 50' E. long., on both banks of the Desna, opposite the mouth of the River Snezheta. It is divided into four parts by several smaller streams. The town is mentioned in 1146, and then bore the names of Briansk and Debriansk. It afterwards formed a separate principality, which came to an end in 1356 with the death of Prince Basil Alexandrovitch. After the Mongolian invasion Briansk and the whole Siever country fell under the power of the Lithuanians; but from time to time it was united with Russia, and finally became incorporated with the empire in the beginning of the 17th century in the reign of Michael Theodorovitch. Under the first Demetrius Briansk was taken by the rebels, but successfully resisted the attacks of the second impostor. Under the Empress Anna, according to the plan of Paul I., there was constructed a dock for the building of ships, but it was closed in 1739. In 1778 the town was made the capital of a department in Orloff, and in 1783 an arsenal, which still exists, was established for the manufacture of artillery. Briansk has thirteen churches, of which the cathedral was built in 1526, and restored in the end of the 17th century. In the sacristy is preserved a manuscript copy of the gospels in the writing of Michael Theodorovitch, which dates from 1637. In the convent of Peter and Paul is buried Oleg Romanovitch, prince of Chernigoff and Briansk, who lived in the 13th century. There are two high schools in the town, a hospital, and a dispensary; and the industrial establishments include rope-walks, tobacco-factories, brick-works, tallow-boiling works, flour-mills, and a brewery. A considerable trade is carried on, especially in wood, pitch, linseed-oil, and cattle, which are exported to Moscow and St Petersburg. There are markets twice a week, and one annual fair. In 1860 the population was 12,816, all of the Greek Church except 268 Catholics and 35 Jews. In 1867 it amounted to 13,881.

BRIAREUS, or *ÆGÆON*, one of the three hundred-armed (*Hekatoncheires*) sons of Uranus and Gaia,—his brothers being named Cottus and Gyges. The legends regarding them are various and somewhat contradictory. According to the most widely-spread myth, Briareus and his brothers were called by Zeus to his assistance when the Titans were making war upon Olympus. The gigantic enemies were defeated and consigned to Tartarus, at the gates of which the three brothers were placed. Other accounts make Briareus one of the assailants of Olympus, who, after his defeat, was buried under Mount Ætna. Homer mentions him as assisting Jupiter when the other Olympian deities were plotting against the king of gods and men. It would be difficult to determine exactly what natural phenomena are symbolized by the Hekatoncheires. They may represent the gigantic forces of nature which appear in earthquakes and other convulsions, or the multitudinous motion of the

sea waves. The latter interpretation is rendered more probable by the fact that Briareus is frequently called a marine deity, and is sometimes said to have been a son of Pontus and Gaia.

BRIBERY, as a public offence, may be defined as the administration of a bribe or reward, that it may be a motive in the performance of functions for which the proper motive ought to be a conscientious sense of duty. When this is superseded by the sordid impulses created by the bribe, a person is said to be corrupted, and thus corruption is a term sometimes held equivalent to bribery. The offence may be divided into two great classes,—the one characteristic of despotisms, where a person invested with power is induced by payment to use it unjustly; the other, which is an unfortunate characteristic of constitutional governments, where power is obtained by purchasing the suffrages of those who can impart it. The former offence is in every sense the more odious and formidable, and indeed it may be said, that until a country has outgrown it, there is no room for the existence of elective bribery, since the nations among which justice is habitually sold appear to be far below the capacity of possessing constitutional rights.

When Samuel in his old age challenges a rigid scrutiny of his conduct, he says, "Whose ox have I taken, or whose ass have I taken? or whom have I defrauded? or whom have I oppressed? or of whose hands have I received any bribe to blind mine eyes therewith." And Amos, when denouncing the condition of the Israelites under Jeroboam, says, "They afflict the just, they take a bribe, and they turn aside the poor in the gate from their right." It is a natural propensity, removable only by civilization or some powerful counteracting influence, to feel that every element of power is to be employed as much as possible for the owner's own behoof, and that its benefits should be conferred not on those who best deserve them, but on those who will pay most for them. Hence judicial corruption is an inveterate vice of imperfect civilization. It is so deeply seated among Oriental races, that the attempts by controlling authority to eradicate it have been often futile.

It has been the main impediment to the employment of natives in the British Eastern empire, since no external appearance of respectability, or apparent systematic routine of business, can be relied on as securities that the whole organization is not contaminated by systematic bribery. It is difficult to get the Oriental mind to understand how it is reasonable to expect the temptation of a bribe to be resisted. In the Russian empire this Oriental characteristic has had another conflict with the demands of a higher civilization. The organization of the Government requires that the empire should be honestly served by its official men, but their morality is of the humblest Oriental standard, and force will not change it. In no country, perhaps, has the offence been visited with more dire chastisement where it has been discovered, yet by the concurring testimony of all who are acquainted with Russian society, not only the official departments, but the courts of law are still influenced by systematic bribery. There is, perhaps, no other crime on which the force of law, if unaided by public opinion and morals, can have so little influence; for in other crimes, such as violence or fraud, there is generally some person immediately injured by the act, who can give his aid in the detection of the offender, but in the perpetration of the offence of bribery all the immediate parties obtain what they desire, and are satisfied.

The purification of the bench from judicial bribery has been gradual in most of the European countries. In France it received an impulse in the 16th century from the high-minded chancellor L'Hôpital. In England judicial corruption acquired a painful, but perhaps a wholesome renown, from the fate of the illustrious Bacon. In Scotland

for some years after the Revolution the bench was not without a suspicion of interested partiality; but during the present century, at least, there has been in all parts of the empire a perfect reliance on its purity. The same may be said of the higher class of ministerial officers. There is no doubt that in the period from the Revolution to the end of Queen Anne's reign, when a speaker of the House of Commons was expelled for bribery, and the great Marlborough could not clear his character from pecuniary dishonesty, there was much corruption in the highest official quarters. The level of the offence of official bribery has gradually descended, until it has become an extremely rare thing for the humbler officers connected with the revenue to be charged with it. It has had a more lingering existence with those who, because their power is more of a constitutional than an official character, have been deemed less responsible to the public. During Walpole's administration there is no doubt that members of Parliament were paid in cash for votes; and the memorable saying, that every man has his price, has been preserved as a characteristic indication of his method of government.

One of the forms in which administrative corruption is most difficult of eradication is the appointment to office. It is sometimes maintained that the purity which characterizes the administration of justice is here unattainable, because in giving a judgment there is but one form in which it can be justly given, but when an office has to be filled many people may be equally fitted for it, and personal motives must influence a choice. It very rarely happens, however, that direct bribery is supposed to influence such appointments.

It does not appear that bribery was conspicuous in England until, in the early part of the 18th century, constituencies had thrown off the feudal dependence which lingered among them; and, indeed, it is often said, that bribery is essentially the defect of a free people, since it is the sale of that which is taken from others without payment. It is alluded to by Fielding and Smollett, and had become conspicuous in the days of Hogarth, who represents it in its double shape of demoralization; one picture shows a reckless expenditure of money among profligate expectants, whose demoralization is a systematic source of profit to them, while another presents us with the impoverished father of a family urged against his conscience to relieve the misery of his wife and children by the sale of his vote.

In England electoral bribery has been the subject of much legislation, which culminated in the Corrupt Practices Prevention Act of 1854 (17 and 18 Vict. c. 102). By this Act the following persons shall be deemed guilty of bribery, and shall be punishable accordingly:—

1. Every person who shall directly or indirectly, by himself or by any other person on his behalf, give, lend, &c., or offer, promise, or promise to procure, &c., any money or valuable consideration to or for any voter or any other person in order to induce any voter to vote or refrain from voting, or shall corruptly do any such act on account of such voter having voted or refrained from voting at any election.
2. Every person who shall similarly give or procure or promise, &c., any office, place, or employment to or for any voter or other person in order to induce him to vote, &c.
3. Every person who shall make any gift, loan, promise, &c., as aforesaid to any person to induce such person to procure the return of any person to serve in Parliament or the vote of any voter.
4. Every person who shall, in consequence or such gift, procure or engage, promise or endeavour to procure the return of any person or the vote of any voter.
5. Every person who shall pay any money with the

intent that it should be spent in bribery, or who shall pay money in repayment of any money wholly or in part expended in bribery.

Persons so offending are guilty of a misdemeanour (in Scotland, of an offence punishable by fine and imprisonment), and shall be liable to forfeit the sum of £100 to any person who will sue for the same, together with costs.

Sect. 3 extends the offence (1) to persons who before or during an election shall receive or contract for any money, &c., for voting, or refraining, or agreeing to vote or to refrain from voting; and (2) to persons who, after the election, receive money, &c., on account of any person having voted or refrained, &c. Such persons shall be guilty of a misdemeanour and forfeit £10.

Treating is defined in Sect. 4. Every candidate who gives, procures, or pays for any expenses incurred for meat, drink, or entertainment, or provision to or for any person in order to be elected, or for being elected, or for the purpose of corruptly influencing such person to give or refrain from giving his vote at an election, &c., shall be deemed guilty of treating, and forfeit £50 to any person who shall sue for the same; and every person corruptly accepting such meat, drink, &c., shall be incapable of voting at such election. Persons found guilty of bribery, &c., or from whom penalties as above mentioned have been recovered, shall be struck off the list of voters by the revising barrister. Prosecutions and actions under the Act must be begun within one year. Other sections of the Act prohibit giving cockades to voters at elections, or supplying them with refreshments on account of their having polled or being about to poll. Any candidate for a county, city, or borough found guilty by an election committee of bribery, treating, or undue influence by himself or his agents shall be incapable of being elected or sitting in Parliament for such county, city, or borough, during the Parliament then in existence. Up to 1868 disputed elections were dealt with by committees of the House of Commons, but the Parliamentary Elections Act (31 and 32 Vict. c. 125) has transferred the jurisdiction to Her Majesty's judges (see ELECTIONS). The report of the judge is to have the same effect as the report of an election committee under the old law; and if he reports that corrupt practices have extensively prevailed, a commission of inquiry may be issued under 15 and 16 Vict. c. 57. Candidates reputed by the judge to be guilty of bribery shall be incapable of being elected to the House of Commons for seven years, and during the same period may not (1) be registered as voters; or (2) hold office under 5 and 6 Will. IV. c. 76, or 3 and 4 Vict. c. 108, or any municipal office; or (3) hold any judicial office, or act as justice of the peace. Other persons found guilty of bribery after having had an opportunity of being heard suffer the same disqualifications. Similar provisions against bribery, &c., at municipal elections are contained in the Act 35 and 36 Vict. c. 60.

If the election commissioners, appointed under 15 and 16 Vict. c. 57, report the extensive prevalence of corrupt practices, bills may be brought in for the disfranchisement of the constituency. Bridgewater, Beverley, Sligo, and Cashel were so disfranchised in 1870. Four boroughs—Totnes, Reigate, Great Yarmouth, and Lancaster—were disfranchised by the Representation of the People Act, 1867, for corrupt practices. In the case of a vacancy in a constituency where corrupt practices have prevailed at last election, the House may disfranchise it indefinitely, either by a resolution to that effect or by negating the motion for a new writ.

The judges manifested great repugnance to the new jurisdiction conferred on them by the Elections Act, and vigorously remonstrated against it during the passage of the measure through Parliament. It was feared that the

purity of the bench might be sullied by being brought into close connection with political contests. Public opinion, however, had distinctly condemned the House of Commons Election Committees, which were necessarily anything but judicial in character, and were, besides, tainted with the suspicion of being frequently actuated by political motives. Many petitions have now been tried by the judges, and in a manner which has given great satisfaction to the country. One consequence of the new system which might have been anticipated is the introduction of more precise definitions into the phraseology of election law. "Agency," for example, and "valuable consideration," have been treated by the judges according to the ordinary meaning of the words in courts of law, and candidates have been unseated for the acts of persons, technically their "agents," but personally unknown to them, and for gifts, generally reputed laudable, but legally falling within the definition of bribes. Bribery flourishes most vigorously in the English borough constituencies; and the secret voting introduced by the Ballot Act seems to have had very little effect on the practice, on account of the fidelity with which the corrupt voters keep their promises. In a recent election inquiry before commissioners, witnesses declared their belief that a quarter, or even more, of the constituency was permanently corrupt, and held the balance between the two political parties. Extensive bribery under the guise of charitable distributions of coal, provisions, &c., seems to prevail in many constituencies, and a still more indirect form is the payment of large subscriptions to public purposes. Recently, it has been observed, constituencies have shown a marked preference for wealthy candidates with some local connection.

BRICK, a kind of artificial stone made of baked clay. The usual form of a brick is a parallelepipedon, about 9 inches long, 4½ inches broad, and 3 inches thick. The art of brickmaking dates from very early times. We read that burnt brick was used in building the tower of Babel. The walls and various other buildings of ancient Babylon were made of burnt brick; several varieties of brick figure in Assyrian art, and most of the Assyrian literature was in the form of minute characters in baked clay (see BABYLON, BABYLONIA). Brickmaking formed the chief occupation of the Israelites during their degrading bondage in Egypt. The bricks were made of clay mixed with chopped straw, and were probably sun-dried. We read (2 Sam. xii. 31) that David made the children of Ammon pass through the brick kiln; and

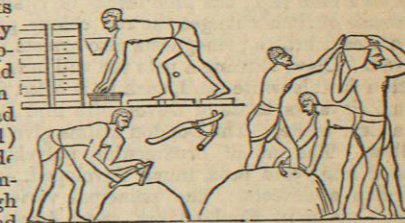


FIG. 1.—Egyptian Brickmakers.

while the meaning of the statement is doubtful, it is thought that the instruments mentioned in the context may have been used in preparation of the clay. Pliny informs us of three different kinds of bricks made by the Greeks. In Italy we have abundant evidence that the Romans used bricks largely; and it was they, probably, who introduced brickmaking into England. By the time of Henry VIII the art had reached great perfection; and many fine brick buildings (e.g., the older part of Hampton Court) are extant from that period. Previous to the great fire of 1666, many of the London houses consisted chiefly of timber framework, filled in with lath and plaster; but after the fire, brick was used almost exclusively in building. Much of the brickwork remaining from that time is finely