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# THE ENCYCLOPÆDIA BRITANNICA

# A DICTIONARY OF ARTS, SCIENCES, LITERATURE AND GENERAL INFORMATION

## ELEVENTH EDITION

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## VOLUME IV SLICE IV

## Bradford, William to Brequigny, Louis

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## Articles in This Slice

**BRADFORD, WILLIAM** (1590-1657), American colonial governor and historian, was born in Austerfield, Yorkshire, England, probably in March 1590. He became somewhat estranged from his family, which was one of considerable importance in the locality, when in early youth he joined the Puritan sect known as Separatists, and united in membership with the congregation at Scrooby. He prepared in 1607, with other members of the church, to migrate to Holland, but the plan was discovered and several of the leaders, among them Bradford, were imprisoned. In the year following, however, he joined the English colony at Amsterdam, where he learned the trade of silk weaving. He subsequently sold his Yorkshire property and embarked in business on his own account at Leiden, where the English refugees had removed. He became an active advocate of the proposed emigration to America, was one of the party that sailed in the "Mayflower" in September 1620, and was one of the signers of the compact on shipboard in Cape Cod Bay. After the death of Governor John Carver in April 1621, Bradford was elected governor of Plymouth Colony, and served as such, with the exception of five years (1633, 1634, 1636, 1638 and 1644) until shortly before his death. After 1624, at Bradford's suggestion, a board of five and later seven assistants was chosen annually to share the executive responsibility. Bradford's rule was firm and judicious, and to his guidance more than to that of any other man the prosperity of the Plymouth Colony was due. His tact and kindness in dealing with the Indians helped to relieve the colony from the conflicts with which almost every other settlement was afflicted. In 1630 the council for New England granted to "William Bradford, his heires, associatts, and assignes," a new patent enlarging the original grant of territory made to the Plymouth settlers. This patent Bradford in the name of the trustees made over to the body corporate of the colony in 1641. Bradford died in Plymouth on the 9th of May 1657. He was the author of a very important historical work, the *History of Plimouth Plantation* (until 1646), first published in the *Proceedings* of the Massachusetts Historical Society for 1856, and later by the state of Massachusetts (Boston, 1898), and in facsimile, with an introduction by John A. Doyle, in 1896. The manuscript disappeared from Boston during the War of Independence, was discovered in the Fulham library, London, in 1855, and was returned by the bishop of London to the state of Massachusetts in 1897. This work has been of inestimable value to writers on the history of the Pilgrims, and was freely used, in manuscript, by Morton, Hubbard, Mather, Prince and Hutchinson. Bradford was also undoubtedly part author, with Edward Winslow, of the "Diary of Occurrences" published in Mourts' *Relation*, edited by Dr H.M. Dexter (Boston, 1865). He also wrote a series of *Dialogues*, on church government, published in the Massachusetts Historical Society's Publications (1870.)

For Bradford's ancestry and early life see Joseph Hunter, *Collections concerning the Founders of New Plymouth*, in Massachusetts Historical Society's *Collections* (Boston, 1852); also the quaint sketch in Cotton Mather's *Magnalia* (London, 1702), and a chapter in Williston Walker's *Ten New England Leaders* (New York, 1901).

**BRADFORD, WILLIAM** (1663-1752), American colonial printer, was born in Leicestershire, England, on the 20th of May 1663. He learned the printer's trade in London with Andrew Sowle, and in 1682 emigrated with William Penn to Pennsylvania, where in 1685 he introduced the "art and mystery" of printing into the Middle Colonies. His first imprint was an almanac, *Kalendarium Pennsilvaniense or America's Messenger* (1685). At the outset he was ordered "not to print anything but what shall have lycence from ye council," and in 1692, the colony then being torn by schism, he issued a tract for the minority sect of Friends, whereupon his press was seized and he was arrested. He was released, however, and his press was restored on his appeal to Governor Benjamin Fletcher. In 1690, with William Rittenhouse (1644-1708) and others, he established in Roxboro, Pennsylvania, now a part of Philadelphia, the first paper mill in America. In the spring of 1693 he removed to New York, where he was appointed royal printer for the colony, a position which he held for more than fifty years; and on the 8th of November 1725 he issued the first number of the *New York Gazette*, the first paper established in New York and from 1725 to 1733 the only paper in the colony. Bradford died in New York on the 23rd of May 1752.

His son, ANDREW SOWLE BRADFORD (1686-1742), removed from New York to Philadelphia in 1712, and there on the 22nd of December 1719 issued the first number of the *American Weekly Mercury*, the first newspaper in the Middle Colonies. Benjamin Franklin, for a time a compositor in the office, characterized the paper as "a paltry thing, in no way interesting"; but it was continued for many years and was edited by Bradford until his death.

The latter's nephew, WILLIAM BRADFORD (1722-1791), established in December 1742 the *Pennsylvania Journal and Weekly Advertiser*, which was for sixty years under his control or that of his son, and which in 1774-1775 bore the oft-reproduced device of a divided serpent with the motto "Unite or Die." He served in the War of American Independence, rising to the rank of colonel. His son, WILLIAM BRADFORD (1755-1795), also served in the War of Independence, and afterwards was attorney-general of Pennsylvania (1791), a judge of the supreme court of the state, and in 1794-1795 attorney-general of the United States.

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**BRADFORD, WILLIAM** (1827-1892), American marine painter, was born at New Bedford, Massachusetts. He was a Quaker, and was self-taught, painting the ships and the marine views he saw along the coast of Massachusetts, Labrador and Nova Scotia; he went on several Arctic expeditions with Dr Hayes, and was the first American painter to portray the frozen regions of the north. His pictures attracted much attention by reason of their novelty and gorgeous colour effects. His "Steamer 'Panther' in Melville Bay, under the Light of the Midnight Sun" was exhibited at the Royal Academy in London in 1875. Bradford was a member of the National Academy of Design, New York, and died in that city on the 25th of April 1892. His style was somewhat influenced by Albert van Beest, who worked with Bradford at Fairhaven for a time; but Bradford is minute and observant of detail where van Beest's aim is general effect.

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**BRADFORD,** a city, and municipal, county and parliamentary borough, in the West Riding of Yorkshire, England, 192 m. N.N.W. of London and 8 m. W. of Leeds. Pop. (1891) 265,728; (1901) 279,767. It is served by the Midland and the North Eastern railways (Midland station), and by the Great Northern and the Lancashire & Yorkshire railways (Exchange station). It lies in a small valley opening southward from that of the Aire, and extends up the hills on either side. Most of the principal streets radiate from a centre between the Midland and Exchange stations and the town hall. This last is a handsome building, opened in 1873, surmounted by a bell tower. The exterior is ornamented with statues of English monarchs. The council-chamber contains excellent wood-carving. The extension of the building was undertaken in 1905. The parish church of St Peter is Perpendicular, dating from 1485, and occupies the site of a Norman church. Its most noteworthy feature is the fine original roof of oak. There was no other church in the town until 1815, but modern churches and chapels are numerous. Among educational institutions, the grammar school existed in the 16th century, and in 1663 received a charter of incorporation from Charles II. It occupies a building erected in 1873, and is largely endowed, possessing several

scholarships founded by prominent citizens. The technical college, under the corporation since 1899, was opened in 1882. A mechanics' institute was founded in 1832, and in 1871 the handsome mechanics' hall, close to the town hall, was opened. Other establishments are the Airedale College of students for the Independent ministry, and the United Independent College (1888). The general infirmary is the principal of numerous charitable institutions. The most noteworthy public buildings beside the town hall are St George's hall (1853), used for concerts and public meetings, the exchange (1867), extensive market buildings, and two court-houses. The Cartwright memorial hall, principally the gift of Lord Masham, opened in 1904 and containing an art gallery and museum, commemorates Dr Edmund Cartwright (1743-1823) as the inventor of the power-loom and the combing-machine. The hall stands in Lister Park, and was opened immediately before, and used in connexion with, the industrial exhibition held here in 1904. The Temperance hall is of interest inasmuch as the first hall of this character in England was erected at Bradford in 1837. Some of the great warehouses are of considerable architectural merit. Statues commemorate several of those who have been foremost in the development of the city, such as Sir Titus Salt, Mr S.C. Lister (Lord Masham), and W.E. Forster. Of several parks the largest are Lister, Peel, and Bowling parks, each exceeding fifty acres. In the last is an ancient and picturesque mansion, which formerly belonged to the Bowling or Bolling family. A large acreage of high-lying moorland near the city is maintained by the corporation as a public recreation ground.

As a commercial centre Bradford is advantageously placed with regard to both railway communication and connexion with the Humber and with Liverpool by canal, and through the presence in its immediate vicinity of valuable deposits of coal and iron. The principal textile manufactures in order of importance are worsted, employing some 36,000 hands, females considerably outnumbering males; woollens, employing some 8000, silk and cotton. The corporation maintains a conditioning-hall for testing textile materials. A new hall was opened in 1902. Engineering and iron works (as at Bowling and Low Moor) are extensive; and the freestone of the neighbourhood is largely quarried, and in Bradford itself its use is general for building. It blackens easily under the influence of smoke, and the town has consequently a somewhat gloomy appearance. The trade of Bradford, according to an official estimate, advanced between 1836 and 1884 from a total of five to at least thirty-five millions sterling, and from not more than six to at least fifty staple articles. The annual turn-over in the staple trade is estimated at about one hundred millions sterling.

Bradford was created a city in 1897. The parliamentary borough returned two members from 1832 until 1885, when it was divided into three divisions, each returning one member. The county borough was created in 1888. Its boundaries include the suburbs, formerly separate urban districts, of Eccleshill, Idle and others. The corporation consists of a lord mayor (this dignity was conferred in 1907), 21 aldermen, and 63 councillors. One feature of municipal activity in Bradford deserves special notice—there is a municipal railway, opened in 1907, extending from Pateley Bridge to Lofthouse (6 m.) and serving the Nidd valley, the district from which the main water-supply of the city is obtained. Area of the city, 22,879 acres.

Bradford, which is mentioned as having belonged before 1066, with several other manors in Yorkshire, to one Gamel, appears to have been almost destroyed during the conquest of the north of England and was still waste in 1086. By that time it had been granted to Ilbert de Lacy, in whose family it continued until 1311. The inquisition taken after the death of Henry de Lacy, earl of Lincoln, in that year gives several interesting facts about the manor; the earl had there a hall or manor-house, a fulling mill, a market every Sunday, and a fair on the feast of St Andrew. There were also certain burgesses holding twenty-eight burgages. Alice, only daughter and heiress of Henry de Lacy, married Thomas Plantagenet, earl of Lancaster, and on the attainder of her husband she and Joan, widow of Henry, were obliged to release their rights in the manor to the king. The earl of Lancaster's attainder being reversed in 1327, Bradford, with his other property, was restored to his brother and heir, Henry Plantagenet, but again passed to the crown on the accession of Henry IV., through the marriage of John of Gaunt with Blanche, one of the daughters and heirs of Henry Plantagenet. Bradford was evidently a borough by prescription and was not incorporated until 1847. Previous to that date the chief officer in the town had been the chief constable, who was appointed annually at the court leet of the manor. Before the 19th century Bradford was never represented in parliament, but in 1832 it was created a parliamentary borough returning two members. A weekly market on Thursdays was granted to Edward de Lacy in 1251 and confirmed in 1294 to Henry de Lacy, earl of Lincoln, with the additional grant of a fair on the eve and day of St Peter ad Vincula and three days following. In 1481 Edward IV. granted to certain feoffees in whom he had vested his manor of Bradford a market on Thursday every week and two yearly fairs, one on the feast of the Deposition of St William of York and two days preceding, the other on the feast of St Peter in Cathedra and two days preceding.

From the mention of a fulling mill in 1311 it is possible that woollen manufacture had been begun at that time. By the reign of Henry VIII. it had become an important industry and added much to the status of the town. Towards the end of the 17th and beginning of the 18th century the woollen trade decreased and worsted manufacture began to take its place. Leland in his

*Itinerary* says that Bradford is “a praty quik Market Toune. It standith much by clothing.” In 1773 a piece hall was erected and for many years served as a market-place for the manufacturers and merchants of the district. On the introduction of steam-power and machinery the worsted trade advanced with great rapidity. The first mill in Bradford was built in 1798; there were 20 mills in the town in 1820, 34 in 1833, and 70 in 1841; and at the present time there are over 300, of much greater magnitude than the earlier factories. In 1836 Mr (afterwards Sir) Titus Salt developed the alpaca manufacture in the town; mohair was shortly afterwards introduced; and the great works at Saltaire were opened (see SHIPLEY). Later, Mr S.C. Lister (Lord Masham) introduced the silk and velvet manufacture, having invented a process of manipulating silk waste, whereby what was previously treated as refuse is made into goods that will compete with those manufactured from the perfect cocoon.

See John James, *History of Bradford* (1844, new and enlarged ed., 1866); A. Holroyd, *Collectanea Bradfordiana* (1873); *Victoria County History—Yorkshire*.

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**BRADFORD,** a city of McKean county, Pennsylvania, U.S.A., near the N. border of the state, about 80 m. E. by S. of Erie. Pop. (1890) 10,514; (1900) 15,029, of whom 2211 were foreign-born; (1910 census) 14,544. It is served by the Pennsylvania, the Erie, and the Buffalo, Rochester & Pittsburg railways, and is connected with Olean, New York, by an electric line. Bradford is situated 1427 ft. above sea-level in the valley of the Tuna, and is shut in by hills on either side. Since 1876 it has been one of the most important oil centres of the state, and it has been connected by pipe lines with cities along the Atlantic coast; petroleum refining is an important industry. Among the city’s manufactures are boilers, machines, glass, chemicals, terra cotta, brick, iron pipes and couplings, gas engines, cutlery and silk. The place was first settled about 1827; in 1838 it was laid out as a town and named Littleton; in 1858 the present name, in honour of William Bradford (1755-1795), was substituted; and Bradford was incorporated as a borough in 1873, and was chartered as a city in 1879. Kendall borough was annexed to Bradford in 1893.



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**BRADFORD CLAY,** in geology, a thin, rather inconstant bed of clay or marl situated in England at the base of the Forest Marble, the two together constituting the Bradfordian group in the Bathonian series of Jurassic rocks. The term “Bradford Clay” appears to have been first used by J. de. C. Sowerby in 1823 (*Mineral Conchology*, vol. v.) as an alternative for W. Smith’s “Clay on Upper Oolite.” The clay came into notice late in the 18th century on account of the local abundance of the crinoid *Apiocrinus Parkinsoni*. It takes its name from Bradford-on-Avon in Wiltshire, whence it is traceable southward to the Dorset coast and northward towards Cirencester. It may be regarded as a local phase of the basement beds of the Forest Marble, from which it cannot be separated upon either stratigraphical or palaeontological grounds. It is seldom more than 10 ft. thick, and it contains as a rule a few irregular layers of limestone and calcareous sandstone. The lowest layer is often highly fossiliferous; some of the common forms being *Arca minuta, Ostrea gregaria, Waldheimia digona, Terebratula coarctata, Cidaris bradfordensis*, &c.

See H.B. Woodward, “Jurassic Rocks of Britain,” *Mem. Geol. Survey*, vol. iv. (1904).

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**BRADFORD-ON-AVON,** a market town in the Westbury parliamentary division of Wiltshire, England, on the rivers Avon and Kennet, and the Kennet & Avon Canal, 98 m. W. by S. of London by the Great Western railway. Pop. of urban district (1901) 4514. Its houses, all built of grey stone, rise in picturesque disorder up the steep sides of the Avon valley, here crossed by an ancient bridge of nine arches, with a chapel in the centre. Among many places of worship may be mentioned the restored parish church of Holy Trinity, which dates from the 12th century and contains some interesting monuments and brasses; and the Perpendicular Hermitage or Tory chapel, with a 15th or 16th century chantry-house. But most notable is the Saxon church of St Lawrence, the foundation of which is generally attributed, according to William of Malmesbury (1125), to St Aldhelm, early in the 8th century. It consists of a chancel, nave and porch, in such unchanged condition that E.A. Freeman considered it “the most perfect surviving church of its

kind in England, if not in Europe." It has more lately, however, been held that the present building is not Aldhelm's, but a restoration, dating from about 975, and attributable to the influence of Dunstan, archbishop of Canterbury. Kingston House, long the seat of the dukes of Kingston, is a beautiful example of early 17th-century domestic architecture. The local industries include the manufacture of rubber goods, brewing, quarrying and iron-founding.

Bradford (Bradauford, Bradeford) was the site of a battle in 652 between Kenwal and his kinsman Cuthred. A monastery existed here in the 8th century, of which St Aldhelm was abbot at the time of his being made bishop of Sherborne in A.D. 705. In 1001 Æthelred gave this monastery and the town of Bradford to the nunnery of Shaftesbury, in order that the nuns might have a safe refuge against the insults of the Danes. No mention of the monastery occurs after the Conquest, but the nunnery of Shaftesbury retained the lordship of the manor until the dissolution in the reign of Henry VIII. In a synod held here in 954, Dunstan was elected bishop of Winchester. Bradford appears as a borough in the Domesday survey, and is there assessed at 42 hides. No charter of incorporation is recorded, however, and after returning two members to the parliament of 1295 the town does not appear to have enjoyed any of the privileges of a borough. The market is of ancient origin, and was formerly held on Monday; in the survey the tolls are assessed at 45 shillings. Bradford was at one time the centre of the clothing industry in the west of England, and was especially famous for its broadcloths and mixtures, the waters of the Avon being especially favourable to the production of good colours and superior dyes. The industry declined in the 18th century, and in 1740 we find the woollen merchants of Bradford petitioning for an act of parliament to improve their trade and so re-establish their credit in foreign markets.

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**BRADLAUGH, CHARLES** (1833-1891), English free-thinker and politician, was born at Hoxton, London, on the 26th of September 1833. His father was a poor solicitor's clerk, who also had a small business as a law stationer, and his mother had been a nursemaid. At twelve years old he became office-boy to his father's employer, and at fourteen wharf-clerk and cashier to a coal merchant in the City Road. He had been baptized and brought up in the Church of England, but he now came into contact with a group of free-thinkers who were disciples of Richard Carlile. He was hastily labelled an "atheist," and was turned out of his situation. Thus driven into the arms of the secularists, he managed to earn a living by odd jobs, and became further immersed in the study of free-thought. At the end of 1850 he enlisted as a soldier, but in 1853 was bought out with money provided by his mother. He then found employment as a lawyer's clerk, and gradually became known as a free-thought lecturer, under the name of "Iconoclast." From 1860 he conducted the *National Reformer* for several years, and displayed much resource in legal defence when the paper was prosecuted by the government on account of its alleged blasphemy and sedition in 1868-1869. Bradlaugh became notorious as a leading "infidel," and was supported by the sympathy of those who were enthusiasts at that time for liberty of speech and thought. He was a constant figure in the law courts; and his competence to take the oath was continually being called in question, while his atheism and republican opinions were adduced as reasons why no jury should give damages for attacks on his character. In 1874 he became acquainted with Mrs Annie Besant (b. 1847), who afterwards became famous for her gifts as a lecturer on socialism and theosophy. She began by writing for the *National Reformer* and soon became co-editor. In 1876 the Bristol publisher of an American pamphlet on the population question, called *Fruits of Philosophy*, was indicted for selling a work full of indecent physiological details, and, pleading guilty, was lightly sentenced; but Bradlaugh and Mrs Besant took the matter up, in order to vindicate their ideas of liberty, and aggressively republished and circulated the pamphlet. The prosecution which resulted created considerable scandal. They were convicted and sentenced to a heavy fine and imprisonment, but the sentence was stayed and the indictment ultimately quashed on a technical point. The affair, however, had several side issues in the courts and led to much prejudice against the defendants, the distinction being ignored between a protest against the suppression of opinion and the championship of the particular opinions in question. Mrs Besant's close alliance with Bradlaugh eventually terminated in 1886, when she drifted from secularism, first into socialistic and labour agitation and then into theosophy as a pupil of Mme Blavatsky. Bradlaugh himself took up politics with increasing fervour. He had been unsuccessful in standing for Northampton in 1868, but in 1880 he was returned by that constituency to parliament as an advanced Radical. A long and sensational parliamentary struggle now began. He claimed to be allowed to affirm under the Parliamentary Oaths Act, and the rejection of this pretension, and the refusal to allow him to take the oath on his professing his willingness to do so, terminated in Bradlaugh's victory in 1886. But this result was not obtained without protracted scenes in the House, in which Lord Randolph Churchill took a leading part. When the long struggle was over, the public had gradually got used to Bradlaugh, and his transparent honesty and courageous contempt for mere popularity gained him increasing respect. Experience of public life in the House of Commons appeared to give him a more

balanced view of things; and before he died, on the 30th of January 1891, the progress of events was such that it was beginning to be said of him that he was in a fair way to end as a Conservative. Hard, arrogant and dogmatic, with a powerful physique and a real gift for popular oratory, he was a natural leader in causes which had society against them, but his sincerity was as unquestionable as his combativeness.



His *Life* was written, from a sympathetic point of view, with much interesting detail as to the history of secularism, by his daughter, Mrs Bradlaugh Bonner, and J.M. Robertson (1894).

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**BRADLEY, GEORGE GRANVILLE** (1821-1903), English divine and scholar, was born on the 11th of December 1821, his father, Charles Bradley, being at that time vicar of Glasbury, Brecon. He was educated at Rugby under Thomas Arnold, and at University College, Oxford, of which he became a fellow in 1844. He was an assistant master at Rugby from 1846 to 1858, when he succeeded G.E.L. Cotton as headmaster at Marlborough. In 1870 he was elected master of his old college at Oxford, and in August 1881 he was made dean of Westminster in succession to A.P. Stanley, whose pupil and intimate friend he had been, and whose biographer he became. Besides his *Recollections of A.P. Stanley* (1883) and *Life of Dean Stanley* (1892), he published *Aids to writing Latin Prose Composition* and *Lectures on Job* (1884) and *Ecclesiastes* (1885). He took part in the coronation of Edward VII., resigned the deanery in 1902, and died on the 13th of March 1903.

Dean Bradley's family produced various other members distinguished in literature. His half-brother, Andrew Cecil Bradley (b. 1851), fellow of Balliol, Oxford, became professor of modern literature and history (1881) at University College, Liverpool, and in 1889 regius professor of English language and literature at Glasgow University; and he was professor of poetry at Oxford (1901-1906). Of Dean Bradley's own children the most distinguished in literature were his son, Arthur Granville Bradley (b. 1850), author of various historical and topographical works; and especially his daughter, Mrs Margaret Louisa Woods (b. 1856), wife of the Rev. Henry George Woods, president of Trinity, Oxford (1887-1897), and master of the Temple (1904), London. Mrs Woods became well known for her accomplished verse (*Lyrics and Ballads*, 1889), largely influenced by Robert Bridges, and for her novels, of which her *Village Tragedy* (1887) was the earliest and strongest.

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**BRADLEY, JAMES** (1693-1762), English astronomer, was born at Sherborne in Gloucestershire in March 1693. He entered Balliol College, Oxford, on the 15th of March 1711, and took degrees of B.A. and M.A. in 1714 and 1717 respectively. His early observations were made at the rectory of Wanstead in Essex, under the tutelage of his uncle, the Rev. James Pound (1669-1724), himself a skilled astronomer, and he was elected a fellow of the Royal Society on the 6th of November 1718. He took orders on his presentation to the vicarage of Bridstow in the following year, and a small sinecure living in Wales was besides procured for him by his friend Samuel Molyneux (1689-1728). He, however, resigned his ecclesiastical preferments in 1721, on his appointment to the Savilian professorship of astronomy at Oxford, while as reader on experimental philosophy (1729-1760) he delivered 79 courses of lectures in the Ashmolean museum. His memorable discovery of the aberration of light (see Aberration) was communicated to the Royal Society in January 1729 (*Phil. Trans.* xxxv. 637). The observations upon which it was founded were made at Molyneux's house on Kew Green. He refrained from announcing the supplementary detection of nutation (*q.v.*) until the 14th of February 1748 (*Phil. Trans.* xlv. 1), when he had tested its reality by minute observations during an entire revolution (18.6 years) of the moon's nodes. He had meantime (in 1742) been appointed to succeed Edmund Halley as astronomer royal; his enhanced reputation enabled him to apply successfully for an instrumental outfit at a cost of £1000; and with an 8-foot quadrant completed for him in 1750 by John Bird (1700-1776), he accumulated at Greenwich in ten years materials of inestimable value for the reform of astronomy. A crown pension of £250 a year was conferred upon him in 1752. He retired in broken health, nine years later, to Chalford in Gloucestershire, and there died on the 13th of July 1762. The printing of his observations was delayed by disputes about their ownership; but they were finally issued from the Clarendon Press, Oxford, in two folio volumes (1798, 1805). The insight and industry of F.W. Bessel were, however, needed for the development of their fundamental importance.

Rigaud's Memoir prefixed to *Miscellaneous Works and Correspondence of James Bradley, D.D.* (Oxford, 1832), is practically exhaustive. Other sources of information are: *New and General Biographical Dictionary*, xii. 54 (1767); *Biog. Brit.* (Kippis); Fouchy's "Éloge," *Paris Memoirs* (1762), p. 231 (Histoire); Delambre's *Hist. de l'astronomie au 18$^{me}$ siècle*, p. 413.

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**BRADSHAW, GEORGE** (1801-1853), English printer and publisher, was born at Windsor Bridge, Pendleton, Lancashire, on the 29th of July 1801. On leaving school he was apprenticed to an engraver at Manchester, eventually setting up on his own account in that city as an engraver and printer—principally of maps. His name was already known as the publisher of *Bradshaw's Maps of Inland Navigation*, when in 1839, soon after the introduction of railways, he published, at sixpence, *Bradshaw's Railway Time Tables*, the title being changed in 1840 to *Bradshaw's Railway Companion*, and the price raised to one shilling. A new volume was issued at occasional intervals, a supplementary monthly time-sheet serving to keep the book up to date. In December 1841, acting on a suggestion made by his London agent, Mr W.J. Adams, Bradshaw reduced the price of his time-tables to the original sixpence, and began to issue them monthly under the title *Bradshaw's Monthly Railway Guide.* In June 1847 was issued the first number of *Bradshaw's Continental Railway Guide*, giving the time-tables of the Continental railways just as *Bradshaw's Monthly Railway Guide* gave the time-tables of the railways of the United Kingdom. Bradshaw, who was a well-known member of the Society of Friends, and gave considerable time to philanthropic work, died in 1853.

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**BRADSHAW, HENRY** (*c.* 1450-1513), English poet, was born at Chester. In his boyhood he was received into the Benedictine monastery of St Werburgh, and after studying with other novices of his order at Gloucester (afterwards Worcester) College, Oxford, he returned to his monastery at Chester. He wrote a Latin treatise *De antiquitate et magnificentia Urbis Cestriae*, which is lost, and a life of the patron saint of his monastery in English seven-lined stanza. This work was completed in the year of its author's death, 1513, mentioned in "A balade to the auctour" printed at the close of the work. A second ballad describes him as "Harry Braddeshaa, of Chestre abbey monke." Bradshaw disclaims the merit of originality and quotes the authorities from which he translates—Bede, William of Malmesbury, Giraldus Cambrensis, Alfred of Beverley, Henry of Huntingdon, Ranulph Higden, and especially the "Passionary" or life of the saint preserved in the monastery. The poem, therefore, which is defined by its editor, Dr Carl Horstmann, as a "legendary epic," is rather a compilation than a translation. It contains a good deal of history beside the actual life of the saint. St Werburgh was the daughter of Wulfere, king of Mercia, and Bradshaw gives a description of the kingdom of Mercia, with a full account of its royal house. He relates the history of St Ermenilde and St Sexburge, mother and grandmother of Werburgh, who were successively abbesses of Ely. He does not neglect the miraculous elements of the story, but he is more attracted by historical fact than legend, and the second book narrates the Danish invasion of 875, and describes the history and antiquities of Chester, from its foundation by the legendary giant Leon Gaur, from which he derives the British name of Caerleon, down to the great fire which devastated the city in 1180, but was suddenly extinguished when the shrine of St Werburgh was carried in procession through the streets. *The Holy Lyfe and History of saynt Werburge very frutefull for all Christen people to rede* (printed by Richard Pynson, 1521) has been very variously estimated. Thomas Warton, who deals with Bradshaw at some length,[1] quotes as the most splendid passage of the poem the description of the feast preceding Werburgh's entry into the religious life. He considered Bradshaw's versification "infinitely inferior to Lydgate's worst manner." Dr Horstmann, on the other hand, finds in the poem "original genius, of a truly epic tone, with a native simplicity of feeling which sometimes reminds the reader of Homer." Most readers will probably adopt a view between these extremes. Bradshaw expresses the humblest opinion of his own abilities, and he certainly had no delicate ear for rhythm. His sincerity is abundantly evident, and his piety is admitted even by John Bale[2], hostile as he was to monkish writers. W. Herbert[3] thought that a *Lyfe of Saynt Radegunde*, also printed by Pynson, was certainly by Bradshaw. The only extant copy is in the Britwell library.



Pynson's edition of the *Holy Lyfe* is very rare, only five copies being known. A reprint copying the original type was edited by Mr. Edward Hawkins for the Chetham Society in 1848, and by Dr Carl Hortsmann for the Early English Text Society in 1887.

1 *History of English Poetry* (ed. W.C. Hazlitt, 1871; iii. pp. 140-149).

2 *Scriptorum Illustrium, cant. ix.* No. 17.

3 Ames, *Typographical Antiquities* (ed. W. Herbert, 1785; i. p. 294).

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**BRADSHAW, HENRY** (1831-1886), British scholar and librarian, was born in London on the 2nd of February 1831, and educated at Eton. He became a fellow of King's College, Cambridge, and after a short scholastic career in Ireland he accepted an appointment in the Cambridge university library as an extra assistant. When he found that his official duties absorbed all his leisure he resigned his post, but continued to give his time to the examination of the MSS. and early printed books in the library. There was then no complete catalogue of these sections, and Bradshaw soon showed a rare faculty for investigations respecting old books and curious MSS. In addition to his achievements in black-letter bibliography he threw great light on ancient Celtic language and literature by the discovery, in 1857, of the *Book of Deer*, a manuscript copy of the Gospel in the Vulgate version, in which were inscribed old Gaelic charters. This was published by the Spalding Club in 1869. Bradshaw also discovered some Celtic glosses on the MS. of a metrical paraphrase of the Gospels by Juvencus. He made another find in the Cambridge library of considerable philological and historical importance. Cromwell's envoy, Sir Samuel Morland (1625-1695), had brought back from Piedmont MSS. containing the earliest known Waldensian records, consisting of translations from the Bible, religious treatises and poems. One of the poems referred the work to the beginning of the 11th century, though the MSS. did not appear to be of earlier date than the 15th century. On this Morland had based his theory of the antiquity of the Waldensian doctrine, and, in the absence of the MSS., which were supposed to be irretrievably lost, the conclusion was accepted. Bradshaw discovered the MSS. in the university library, and found in the passage indicated traces of erasure. The original date proved to be 1400. Incidentally the correct date was of great value in the study of the history of the language. He had a share in exposing the frauds of Constantine Simonides, who had asserted that the *Codex Sinaiticus* brought by Tischendorf from the Greek monastery of Mount Sinai was a modern forgery of which he was himself the author. Bradshaw exposed the absurdity of these claims in a letter to the *Guardian* (January 26, 1863). In 1866 he made a valuable contribution to the history of Scottish literature by the discovery of 2200 lines on the siege of Troy incorporated in a MS. of Lydgate's *Troye Booke*, and of the *Legends of the Saints*, an important work of some 40,000 lines. These poems he attributed, erroneously, as has since been proved, to Barbour (*q.v.*). Unfortunately Bradshaw allowed his attention to be distracted by a multiplicity of subjects, so that he has not left any literary work commensurate with his powers. The strain upon him was increased when he was elected (1867) university librarian, and as dean of his college (1857-1865) and praelector (1863-1868) he was involved in further routine duties. Besides his brilliant isolated discoveries in bibliography, he did much by his untiring zeal to improve the standard of library administration. He died very suddenly on the 10th of February 1886. His fugitive papers on antiquarian subjects were collected and edited by Mr F. Jenkinson in 1889.

An excellent *Memoir of Henry Bradshaw*, by Mr G.W. Prothero, appeared in 1888. See also C.F. Newcombe, *Some Aspects of the Work of Henry Bradshaw* (1905).

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**BRADSHAW, JOHN** (1602-1659), president of the "High Court of Justice" which tried Charles I., was the second son of Henry Bradshaw, of Marple and Wibersley in Cheshire. He was baptized on the 10th of December 1602, was educated at Banbury in Cheshire and at Middleton in Lancashire, studied subsequently with an attorney at Congleton, was admitted into Gray's Inn in 1620, and was called to the bar in 1627, becoming a bencher in 1647. He was mayor of Congleton in 1637, and later high steward or recorder of the borough. According to Milton he was assiduous in his legal studies and acquired considerable reputation and practice at the bar. On the 21st of September 1643 he was appointed judge of the sheriff's court in London. In October 1644 he was counsel with Prynne in the prosecution of Lord Maguire and Hugh Macmahon, implicated in the Irish rebellion, in 1645 for John Lilburne in his appeal to the Lords against the sentence of the Star Chamber, and in 1647 in the prosecution of Judge Jenkins. On the 8th of October 1646 he had been nominated by the Commons a commissioner of the great seal, but his appointment was not confirmed by the Lords. In 1647 he was made chief justice of Chester and a judge in Wales, and on the 12th of October 1648 he was presented to the degree of serjeant-at-law. On the 2nd of January 1649 the Lords threw out the ordinance for bringing the king to trial, and the small

remnant of the House of Commons which survived Pride's Purge, consisting of 53 independents, determined to carry out the ordinance on their own authority. The leading members of the bar, on the parliamentary as well as on the royalist side, having refused to participate in proceedings not only illegal and unconstitutional, but opposed to the plainest principles of equity, Bradshaw was selected to preside, and, after some protestations of humility and unfitness, accepted the office. The king refused to plead before the tribunal, but Bradshaw silenced every legal objection and denied to Charles an opportunity to speak in his defence. He continued after the king's death to conduct, as lord president, the trials of the royalists, including the duke of Hamilton, Lord Capel, and Henry Rich, earl of Holland, all of whom he condemned to death, his behaviour being especially censured in the case of Eusebius Andrews, a royalist who had joined a conspiracy against the government. He received large rewards for his services. He was appointed in 1649 attorney-general of Cheshire and North Wales, and chancellor of the duchy of Lancaster, and was given a sum of £1000, together with confiscated estates worth £2000 a year. He had been nominated a member of the council of state on the 14th of February 1649, and on the 10th of March became president. He disapproved strongly of the expulsion of the Long Parliament, and on Cromwell's coming subsequently to dismiss the council Bradshaw is said, on the authority of Ludlow, to have confronted him boldly, and denied his power to dissolve the parliament. An ardent republican, he showed himself ever afterwards an uncompromising adversary of Cromwell. He was returned for Stafford in the parliament of 1654, and spoke strongly against vesting power in a single person. He refused to sign the "engagement" drawn up by Cromwell, and in consequence withdrew from parliament and was subsequently suspected of complicity in plots against the government. He failed to obtain a seat in the parliament of 1656, and in August of the same year Cromwell attempted to remove him from the chief-justiceship of Cheshire. After the abdication of Richard Cromwell, Bradshaw again entered parliament, became a member of the council of state, and on the 3rd of June 1659 was appointed a commissioner of the great seal. His health, however, was bad, and his last public effort was a vehement speech, in the council, when he declared his abhorrence of the arrest of Speaker Lenthall. He died on the 31st of October 1659, and was buried in Westminster Abbey. His body was disinterred at the Restoration, and exposed on a gibbet along with those of Cromwell and Ireton. Bradshaw married Mary, daughter of Thomas Marbury of Marbury, Cheshire, but left no children.

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**BRADWARDINE, THOMAS** (*c.* 1290-1349), English archbishop, called "the Profound Doctor," was born either at Hartfield in Sussex or at Chichester. He was educated at Merton College, 375
Oxford, where he took the degree of doctor of divinity, and acquired the reputation of a profound scholar, a skilful mathematician and an able divine. He was afterwards raised to the high offices of chancellor of the university and professor of divinity. From being chancellor of the diocese of London, he became chaplain and confessor to Edward III., whom he attended during his wars in France. On his return to England, he was successively appointed prebendary of Lincoln, archdeacon of Lincoln (1347), and in 1349 archbishop of Canterbury. He died of the plague at Lambeth on the 26th of August 1349, forty days after his consecration. Chaucer in his *Nun's Priest's Tale* ranks Bradwardine with St Augustine. His great work is a treatise against the Pelagians, entitled *De causa Dei contra Pelagium et de virtute causarum*, edited by Sir Henry Savile (London, 1618). He wrote also *De Geometria speculativa* (Paris, 1530); *De Arithmetica practica* (Paris, 1502); *De Proportionibus* (Paris, 1495; Venice, 1505); *De Quadratura Circuli* (Paris, 1495); and an *Ars Memorativa*, Sloane MSS. No. 3974 in the British Museum.

See Quétif-Échard, *Script. Praedic.* (1719), i. 744; W.F. Hook, *Lives of the Archbishops of Canterbury*, vol. iv.

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**BRADY, NICHOLAS** (1659-1726), Anglican divine and poet, was born at Bandon, Co. Cork, on the 28th of October 1659. He received his education at Westminster school, and at Christ Church, Oxford; but he graduated at Trinity College, Dublin. He took orders, and in 1688 was made a prebendary of Cork. He was a zealous promoter of the Revolution and suffered in consequence. When the troubles broke out in Ireland in 1690, Brady, by his influence, thrice prevented the burning of the town of Bandon, after James II. had given orders for its destruction; and the same year he was employed by the people of Bandon to lay their grievances before the English parliament. He soon afterwards settled in London, where he obtained various preferments. At the time of his death, on the 20th of May 1726, he held the livings of Clapham

and Richmond. Brady's best-known work is his metrical version of the Psalms, in which Nahum Tate collaborated with him. It was licensed in 1696, and largely ousted the old version of T. Sternhold and J. Hopkins. He also translated Virgil's *Aeneid*, and wrote several smaller poems and dramas, as well as sermons.

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**BRAEKELEER, HENRI JEAN AUGUSTIN DE** (1840-1888), Belgian painter, was born at Antwerp. He was trained by his father, a *genre* painter, and his uncle, Baron Henri Leys, and devoted himself to scenes of everyday Antwerp life. The first pictures he exhibited, "The Laundry" (Van Cutsem collection, Brussels), and "The Coppersmith's Workshop" (Vleeshovwer collection, Antwerp), were shown at the Antwerp exhibition in 1861. He received the gold medal at Brussels in 1872 for "The Geographer" and "The Lesson" (both in the Brussels gallery); the gold medal at Vienna in 1873 for "The Painter's Studio" and "Grandmother's Birthday"; and the medal of honour at the Exposition Universelle at Amsterdam for "The Pilot House." Among his more notable works are "A Shoemaker" (1862), "A Tailor's Workroom" (1863), "A Gardener" (1864, Antwerp gallery), "Interior of a Church" (1866), "Interior, Flanders" (1867), "Woman spinning" (1869), "Man reading" (1871), "The rue du Serment, Antwerp" (1875), "A Copperplate Printer," "The Sailor's Return," "The Man at the Window" (Couteaux collection, Brussels), "The Horn-blower" (Couteaux collection), "Man retouching a Picture" (Couteaux collection), "The Potters" (Marlier collection, Brussels), "Staircase in the Hydraulic House at Antwerp" (Marlier collection), and "The Brewer's House at Antwerp" (Marlier collection). The last, better known as "A Man sitting," is generally regarded as his masterpiece. As a lithographer and etcher, his work resembles that of Henri Leys. Towards the end of his life de Braekeleer did some dot painting (*pointillisme*), in which he achieved admirable effects of light.

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**BRAEMAR,** a district in S.W. Aberdeenshire, Scotland, extending from Ballater in the E. to Glen Dee in the W., a distance of 24 m. with a breadth varying from 3 to 6 m. It is drained throughout by the river Dee, both banks of which are bounded by hills varying from 1000 to nearly 3000 ft. in height. The whole area is distinguished by typical Highland scenery, and is a resort alike for sportsmen and tourists. The villages and clachans (Gaelic for hamlet) being situated at an altitude of from 600 to more than 1000 ft. above the sea, the air is everywhere pure and bracing. The deer forests comprise the royal forests of Balmoral and Ballochbuie, Glen Ey Forest, Mar Forest and Invercauld Forest. At various points on either side of the Dee, granite castles, mansions and lodges have been built, mostly in the Scottish baronial style, and all effectively situated with reference to the wooded hills or the river. The chief of these are Balmoral and Abergeldie Castles belonging to the crown, Invercauld House, Braemar Castle, Mar Lodge and Old Mar Lodge. Castleton of Braemar is the foremost of the villages, being sometimes styled the capital of the Deeside Highlands. Its public buildings include halls erected by the duke of Fife and Colonel Farquharson of Invercauld to commemorate the Victorian jubilee of 1887. Not far from the spot where the brawling Clunie joins the Dee the earl of Mar raised the standard of revolt in 1715. His seat, Braemar Castle, reputed to be a hunting-lodge of Malcolm Canmore, was forfeit along with the estates. The new castle built by the purchasers in 1720 was acquired at a later date by Farquharson of Invercauld, who gave government the use of it during the pacification of the Highlands after the battle of Culloden in 1746. Population of Crathie and Braemar (1901) 1452.

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**BRAG,** a very old game of cards, probably evolved from the ancient Spanish *primero*, played by five or six, or more players. It is the ancestor of poker. A full pack is used, the cards ranking as at whist, with certain exceptions. There are no trumps. Each player receives three cards and puts up three stakes. The last round is dealt face upwards: the holder of the highest card irrespective of suits wins the first stake from all the players. In the case of equality the elder hand wins, but the ace of diamonds is always a winning card. For the second stake the players *brag* or bet against each other, if they hold either a pair, or a pair-royal (three cards of the same rank). Pairs and pairs-royal take precedence according to the value of the cards composing them, but any

pair-royal beats any pair. The knave of clubs may be counted as any card, *e.g.* two twos and the knave of clubs rank as a pair-royal in twos; two aces and the knave as a pair-royal in aces. Sometimes the knave of diamonds is allowed the same privilege, but is inferior to the club knave; *e.g.* two threes and the club would beat the other two threes and the diamond. Players who accept another's brag must cover his. bet and offer another. The third stake is won by the player whose cards make 31 or are nearest to 31 by their pips, aces and court counting ten; but the ace may by arrangement count as 1 or 11. Players may draw from the stock, losing if they over-draw. If one player wins all three stakes, he may receive the value of another stake, or of two or three stakes, all round, as arranged. The deal passes as at whist. Each player should have the same number of deals before the game is abandoned.

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**BRAGA,** a city of northern Portugal, formerly included in the province of Entre Minho e Douro, situated on the right-bank of the small river Deste near its source, and at the head of a railway from Oporto. Pop. (1900) 24,202. Braga, which ranks after Lisbon and Oporto as the third city of the kingdom, is the capital of an administrative district, and an archiepiscopal see. Its cathedral, founded in the 12th century, was rebuilt during the 16th century in the blend of Moorish and florid Gothic styles known as Manoellian. It contains several tombs of considerable historical interest, some fine woodwork carved in the 15th century, and a collection of ancient vestments, plate and other objects of art. Among the other churches Santa Cruz is noteworthy for its handsome façade, which dates from 1642. There are several convents, an archiepiscopal palace, a library, containing many rare books and manuscripts, an orphan asylum, and a large hospital; also the ruins of a theatre, a temple and an aqueduct of Roman workmanship, and a great variety of minor antiquities of different ages. The principal manufactures are firearms, jewelry, cutlery, cloth and felt hats. Large cattle fairs are held in June and September, for cattle-breeding and dairy-farming are among the foremost local industries. On a hill about 3 m. E. by S. stands the celebrated sanctuary of Bom Jesus, or Bom Jesus do Monte, visited at Whitsuntide by many thousands of pilgrims, who do public penance as they ascend to the shrine; and about 1 m. beyond it is Mount Sameiro (2535 ft.), crowned by a colossal statue of the Virgin Mary, and commanding a magnificent view of the mountainous country which culminates in the Serra do Gerez, on the north-east.



Braga is the Roman *Bracara Augusta*, capital of the *Callaici Bracarii*, or *Bracarenses*, a tribe who occupied what is now Galicia and northern Portugal. Early in the 5th century it was taken by the Suevi; but about 485 it passed into the hands of the Visigothic conquerors of Spain, whose renunciation of the Arian and Priscillianist heresies, at two synods held here in the 6th century, marks the origin of its ecclesiastical greatness. The archbishops of Braga retain the title of primate of Portugal, and long claimed supremacy over the Spanish church also; but their authority was never accepted throughout Spain. From the Moors, who captured Braga early in the 8th century, the city was retaken in 1040 by Ferdinand I., king of Castile and Leon; and from 1093 to 1147 it was the residence of the Portuguese court.

The administrative district of Braga coincides with the central part of the province of Entre Minho e Douro (*q.v.*). Pop. (1900) 357,159. Area, 1040 sq. m.

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**BRAGANZA** (*Bragança*), the capital of an administrative district formerly included in the province of Traz-os-Montes, Portugal; situated in the north-eastern extremity of the kingdom, on a branch of the river Sabor, 8 m. S. of the Spanish frontier. Pop. (1900) 5535. Braganza is an episcopal city. It consists of a walled upper town, containing the cathedral college and hospital, and of a lower or modern town. Large tracts of the surrounding country are uncultivated, partly because railway communication is lacking and the roads are bad. Except farming, the chief local industry is silkworm-rearing and the manufacture of silk. The administrative district of Braganza coincides with the eastern part of Traz-os-Montes (*q.v.*). Pop. (1900) 185,162; area, 2513 sq. m.

The city gave its name to the family of Braganza, members of which were rulers of Portugal from 1640 to 1853, and emperors of Brazil from 1822 to 1889. This family is descended from Alphonso (d. 1461), a natural son of John I., king of Portugal (d. 1433), who was a natural son of King Peter I., and consequently belonged to the Portuguese branch of the Capetian family. Alphonso was made duke of Braganza in 1442, and in 1483 his grandson, Duke Ferdinand II., lost his life through heading an insurrection against King John II. In spite of this Ferdinand's

descendants acquired great wealth, and several of them held high office under the kings of Portugal. Duke John I. (d. 1583) married into the royal family, and when King Henry II. died without direct heirs in 1580, he claimed the crown of Portugal in opposition to Philip II. of Spain. John, however, was unsuccessful, but, when the Portuguese threw off the Spanish dominion in 1640, his grandson, John II., duke of Braganza, became king as John IV. In 1807, when Napoleon declared the throne of Portugal vacant, King John VI. fled to Brazil; but he regained his inheritance after the fall of Napoleon in 1814, although he did not return to Europe until 1821, when he left his elder son Peter to govern Brazil. In 1822 a revolution established the independence of Brazil with Peter as emperor. In 1826 Peter became king of Portugal on the death of his father; but he at once resigned the crown to his young daughter Maria, and appointed his brother Miguel to act as regent. Miguel soon declared himself king, but after a stubborn struggle was driven from the country in 1833, after which Maria became queen. Maria married for her second husband Ferdinand (d. 1851), son of Francis, duke of Saxe-Coburg; and when she died in 1853 the main Portuguese branch of the family became extinct. Maria was succeeded by her son Louis I., father of Charles I., who ascended the throne of Portugal in 1889. The empire of Brazil descended on the death of Peter I. to his son Peter II., who was expelled from the country in 1889. When Peter died in 1891 this branch of the family also became extinct in the male line. His only child, Isabella, married Louis Gaston of Orleans, count of Eu. The exiled king, Miguel, founded a branch of the family of Braganza which settled in Bavaria, and various noble families in Portugal are descended from cadets of this house. The title of duke of Braganza is now borne by the eldest son of the king of Portugal.

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**BRAGG, BRAXTON** (1817-1876), American soldier, was born in Warren county, North Carolina, on the 22nd of March 1817. He graduated at the United States military academy in 1837, and as an artillery officer served in the Seminole wars of 1837 and 1841, and under General Taylor in Mexico. For gallant conduct at Fort Brown, Monterey and Buena Vista, he received the brevets of captain, major and lieutenant-colonel. He resigned from the regular army on the 3rd of January 1856, and retired to his plantation in Louisiana. From 1859 to 1861 he was commissioner of the board of public works of the state. When in 1861 the Civil War began, Bragg was made a brigadier-general in the Confederate service, and assigned to command at Pensacola. In February 1862, having meanwhile become major-general, he took up a command in the Army of the Mississippi, and he was present at the battle of Shiloh (April). The vacancy created by the death of Sidney Johnston at that battle was filled by the promotion of Bragg to full general's rank, and he succeeded General Beauregard when that officer retired from the Western command. In the autumn of 1862 he led a bold advance from Eastern Tennessee across Kentucky to Louisville, but after temporary successes he was forced to retire before Buell, and after the battle of Perryville (8th October) retired into Tennessee. Though the material results of his campaign were considerable, he was bitterly censured, and his removal from his command was urged. But the personal favour of Jefferson Davis kept him, as it had placed him, at the head of the central army, and on the 31st of December 1862 and 2nd of January 1863 he fought the indecisive battle of Murfreesboro (or Stone river) against Rosecrans, Buell's successor. In the campaign of 1863 Rosecrans constantly outmanoeuvred the Confederates, and forced them back to the border of Georgia. Bragg, however, inflicted a crushing defeat on his opponent at Chickamauga (September 19-20) and for a time besieged the Union forces in Chattanooga. But enormous forces under Grant were concentrated upon the threatened spot, and the great battle of Chattanooga (November 23-25) ended in the rout of the Confederates. Bragg was now deprived of his command, but President Davis made him his military adviser, and in that capacity he served during 1864. In the autumn of that year he led an inferior force from North Carolina to Georgia to oppose Sherman's march. In February 1865 he joined Johnston, and he was thus included in the surrender of that officer to Sherman. After the war he became chief engineer to the state of Alabama, and supervised improvements in Mobile harbour. He died suddenly at Galveston, Texas, on the 27th of September 1876. General Bragg, in spite of his want of success, was unquestionably a brave and skilful officer. But he was a severe martinet, and rarely in full accord with the senior officers under his orders, the consequent friction often acting unfavourably on the conduct of the operations.

His brother, THOMAS BRAGG (1810-1872), was governor of North Carolina 1855-1859, U.S. senator 1859-1861, and attorney-general in the Confederate cabinet from Nov. 1861 to March 1862.

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**BRAGI,** in Scandinavian mythology, the son of Odin, and god of wisdom, poetry and eloquence. At the Scandinavian sacrificial feasts a horn consecrated to Bragi was used as a drinking-cup by the guests, who then vowed to do some great deed which would be worthy of being immortalized in verse.

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**BRAHAM, JOHN** (*c.* 1774-1856), English vocalist, was born in London about 1774, of Jewish parentage, his real name being Abraham. His father and mother died when he was quite young. Having received lessons in singing from an Italian artist named Leoni, he made his first appearance in public at Covent Garden theatre on the 21st of April 1787, when he sang "The soldier tired of war's alarms" and "*Ma chère arrive*." On the breaking of his voice, he had to support himself by teaching the pianoforte. In a few years, however, he recovered his voice, which proved to be a tenor of exceptionally pure and rich quality. His second début was made in 1794 at the Bath concerts, to the conductor of which, Rauzzini, he was indebted for careful training extending over a period of more than two years. In 1796 he reappeared in London at Drury Lane in Storace's opera of *Mahmoud*. Such was his success that he obtained an engagement the next year to appear in the Italian opera house in Grétry's *Azor et Zémire*. He also sang in oratorios and was engaged for the Three Choir festival at Gloucester. With the view of perfecting himself in his art he set out for Italy in the autumn of 1797. On the way he gave some concerts at Paris, which proved so successful that he was induced to remain there for eight months. His career in Italy was one of continuous triumph; he appeared in all the principal opera-houses, singing in Milan, Genoa, Leghorn and Venice. His compass embraced about nineteen notes, his management of the falsetto being perfect. In 1801 he returned to his native country, and appeared once more at Covent Garden in the opera *Chains of the Heart*, by Mazzinghi and Reeve. So great was his popularity that an engagement he had made when abroad to return after a year to Vienna was renounced, and he remained henceforward in England. In 1824 he sang the part of Max in the English version of Weber's *Der Freischütz*, and he was the original Sir Huon in that composer's *Oberon* in 1826. Braham made two unfortunate speculations on a large scale, one being the purchase of the Colosseum in the Regent's Park in 1831 for £40,000, and the other the erection of the St James's theatre at a cost of £26,000 in 1836. In 1838 he sang the part of William Tell at Drury Lane, and in 1839 the part of Don Giovanni. His last public appearance was at a concert in March 1852. He died on the 17th of February 1856. There is, perhaps, no other case upon record in which a singer of the first rank enjoyed the use of his voice so long; between Braham's first and last public appearances considerably more than sixty years intervened, during forty of which he held the undisputed supremacy alike in opera, oratorio and the concert-room. Braham was the composer of a number of vocal pieces, which being sung by himself had great temporary popularity, though they had little intrinsic merit, and are now deservedly forgotten. A partial exception must be made in favour of "The Death of Nelson," originally written in 1811 as a portion of the opera *The American*; this still keeps its place as a standard popular English song.



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**BRAHE, PER,** Count (1602-1680), Swedish soldier and statesman, was born on the island of Rydboholm, near Stockholm, on the 18th of February 1602. He was the grandson of Per Brahe (1520-1590), one of Gustavus I.'s senators, created count of Visingsborg by Eric XIV., known also as the continuator of Peder Svart's chronicle of Gustavus I., and author of *Oeconomia* (1585), a manual for young noblemen. Per Brahe the younger, after completing his education by several years' travel abroad, became in 1626 chamberlain to Gustavus Adolphus, whose lasting friendship he gained. He fought with distinction in Prussia during the last three years of the Polish War (1626-1629) and also, as colonel of a regiment of horse, in 1630 in Germany. After the death of Gustavus Adolphus in 1632 his military yielded to his political activity. He had been elected president (*Landsmarskalk*) of the diet of 1629, and in the following year was created a senator (*Riksråd*). In 1635 he conducted the negotiations for an armistice with Poland. In 1637-1640 and again in 1648-1654 he was governor-general in Finland, to which country he rendered inestimable services by his wise and provident rule. He reformed the whole administration, introduced a postal system, built ten new towns, improved and developed commerce and agriculture, and very greatly promoted education. In 1640 he opened the university of Åbo, of which he was the founder, and first chancellor. After the death of Charles X. in 1660, Brahe, as *rikskansler* or chancellor of Sweden, became one of the regents of Sweden for the second time (he had held a similar office during the minority of Christina, 1632-1644), and during the difficult year 1660 he had entire control of both foreign and domestic affairs. He died on the 2nd of

September 1680, at his castle at Visingsborg, where during his lifetime he had held more than regal pomp.

His brother, Nils Brahe (1604-1632), also served with distinction under Gustavus Adolphus. He took part in the siege and capture of Riga in 1621, served with distinction in Poland (1626-1627) and assisted in the defence of Stralsund in 1628. In 1630 he accompanied Gustavus into Germany, and in 1631 was appointed colonel of "the yellow regiment," the king's world-renowned life-guards, at the head of which he captured the castle of Würzburg on the 8th of October 1631. He took part in the long duel between Gustavus and Wallenstein round Nuremberg as general of infantry, and commanded the left wing at Lützen (November 6, 1632), where he was the only Swedish general officer present. At the very beginning of the fight he was mortally wounded. The king regarded Brahe as the best general in the Swedish army after Lennart Torstensen.

A direct descendant of Nils, Magnus Brahe (1790-1844), fought in the campaign of 1813-14, under the crown prince Bernadotte, with whom, after his accession to the throne as Charles XIV., he was in high favour. He became marshal of the kingdom, and, especially from 1828 onwards, exercised a preponderant influence in public affairs.

See Martin Veibull, *Sveriges Storhetstid*, vol. iv. (Stockholm, 1881); *Letters to Axel Oxenstjerna* (Swed.) 1832-1851 (Stockholm, 1890); Petrus Nordmann, *Per Brahe* (Helsingfors, 1904).

(R. N. B.)

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**BRAHE, TYCHO** (1546-1601), Danish astronomer, was born on the 14th of December 1546 at the family seat of Knudstrup in Scania, then a Danish province. Of noble family, he was early adopted by his uncle, Jörgen Brahe, who sent him, in April 1559, to study philosophy and rhetoric at Copenhagen. The punctual occurrence at the predicted time, August 21st, 1560, of a total solar eclipse led him to regard astronomy as "something divine"; he purchased the *Ephemerides* of Johann Stadius (3rd ed., 1570), and the works of Ptolemy in Latin, and gained some insight into the theory of the planets. Entered as a law-student at the university of Leipzig in 1562, he nevertheless secretly prosecuted celestial studies, and began continuous observations with a globe, a pair of compasses and a "cross-staff." He quitted Leipzig on the 17th of May 1565, but his uncle dying a month later, he repaired to Wittenberg, and thence to Rostock, where, in 1566, he lost his nose in a duel, and substituted an artificial one made of a copper alloy. In 1569 he matriculated at Augsburg, and devoted himself to chemistry for two years (1570-1572). On his return to Denmark, in 1571, he was permitted by his maternal uncle, Steno Belle, to instal a laboratory at his castle of Herritzvad, near Knudstrup; and there, on the 11th of November 1572, he caught sight of the famous "new star" in Cassiopeia. He diligently measured its position, and printed an account of his observations in a tract entitled *De Novâ Stellâ* (Copenhagen, 1573), a facsimile of which was produced in 1901, as a tercentenary tribute to the author's memory.

Tycho's marriage with a peasant-girl in 1573 somewhat strained his family relations. He delivered lectures in Copenhagen by royal command in 1574; and in 1575 travelled through Germany to Venice. The execution of his design to settle at Basel was, however, anticipated by the munificence of Frederick II., king of Denmark, who bestowed upon him for life the island of Hveen in the Sound, together with a pension of 500 thalers, a canonry in the cathedral of Roskilde, and the income of an estate in Norway. The first stone of the magnificent observatory of Uraniborg was laid on the 8th of August 1576; it received the finest procurable instrumental outfit; and was the scene, during twenty-one years, of Tycho's labours in systematically collecting materials—the first made available since the Alexandrian epoch—for the correction of astronomical theories. James VI. of Scotland, afterwards James I. of England, visited him at Uraniborg on the 20th of March 1590. But by that time his fortunes were on the wane; for Frederick II. died in 1588, and his successor, Christian IV., was less tolerant of Tycho's arrogant and insubordinate behaviour. His pension and fief having been withdrawn, he sailed for Rostock in June 1597, and re-commenced observing before the close of the year, in the castle of Wandsbeck near Hamburg. He spent the following winter at Wittenberg, and reached Prague in June 1599, well assured of favour and protection from the emperor Rudolph II. That monarch, accordingly, assigned him the castle of Benatky for his residence, with a pension of 3000 florins; his great instruments were moved thither from Hveen, and Johannes Kepler joined him there in January 1600. But this phase of renewed prosperity was brief. After eleven days' illness, Tycho Brahe died on the 24th of October 1601, at Benatky, and was buried in the Teynkirche, Prague.



Tycho's principal work, entitled *Astronomiae Instauratae Progymnasmata* (2 vols., Prague, 1602-1603) was edited by Kepler. The first volume treated of the motions of the sun and moon, and gave the places of 777 fixed stars (this number was increased to 1005 by Kepler in 1627 in the "Rudolphine Tables"). The second, which had been privately printed at Uraniborg in 1588

with the heading *De Mundi Aetherei recentioribus Phaenomenis*, was mainly concerned with the comet of 1577, demonstrated by Tycho from its insensible parallax to be no terrestrial exhalation, as commonly supposed, but a body traversing planetary space. It included, besides, an account of the Tychonic plan of the cosmos, in which a *via media* was sought between the Ptolemaic and Copernican systems. The earth retained its immobility; but the five planets were made to revolve round the sun, which, with its entire cortège, annually circuited the earth, the sphere of the fixed stars performing meanwhile, as of old, its all-inclusive diurnal rotation (see ASTRONOMY: *History*). Under the heading *Astronomiae Instauratae Mechanica*, Tycho published at Wandsbeck, in 1598, a description of his instruments, together with an autobiographical account of his career and discoveries, including the memorable one of the moon's "variation" (see MOON). The book was reprinted at Nuremberg in 1602 (cf. Hasselberg, *Vierteljahrsschrift Astr. Ges.* xxxix. iii. 180). His *Epistolae Astronomicae*, printed at Uraniborg in 1596 with a portrait engraved by Geyn of Amsterdam in 1586, were embodied in a complete edition of his works issued at Frankfort in 1648. Tycho vastly improved the art of astronomical observation. He constructed a table of refractions, allowed for instrumental inaccuracies, and eliminated by averaging accidental errors. He, moreover, corrected the received value of nearly every astronomical quantity; but the theoretical purpose towards which his practical reform was directed, was foiled by his premature death.

See J.L.E. Dreyer's *Tycho Brahe* (Edinburgh, 1890), which gives full and authentic information regarding his life and work. Also Gassendi's *Vita* (Paris, 1654); *Lebensbeschreibung*, collected from various Danish sources, and translated into German by Philander von der Weistritz (Copenhagen and Leipzig, 1756); *Tyge Brahe*, by F.R. Friis (Copenhagen, 1871); *Prager Tychoniana*, collected by Dr F.I. Studnicka (Prague, 1901), a description of the scanty Tychonian relics which survived the Thirty Years' War and are still preserved at Prague.

(A. M. C.)

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**BRAHMAN,** a Sanskrit noun-stem which, differently accented, yields in the two nominatives *Brahmă* (neut.) and *Brahmā* (masc.), the names of two deities which occupy prominent places in the orthodox system of Hindu belief. Brahmă (n.) is the designation generally applied to the Supreme Soul (*paramātman*), or impersonal, all-embracing divine essence, the original source and ultimate goal of all that exists; Brahmā (m.), on the other hand, is only one of the three hypostases of that divinity whose creative activity he represents, as distinguished from its preservative and destructive aspects, ever apparent in life and nature, and represented by the gods Vishṇu and Śiva respectively. The history of the two cognate names reflects in some measure the development of Indian religious speculation generally.

The neuter term *brahmă* is used in the *Rigveda* both in the abstract sense of "devotion, worship," and in the concrete sense of "devotional rite, prayer, hymn." The spirit of Vedic worship is pervaded by a devout belief in the efficacy of invocation and sacrificial offering. The earnest and well-expressed prayer or hymn of praise cannot fail to draw the divine power to the worshipper and make it yield to his supplication; whilst offerings, so far from being mere acts of devotion calculated to give pleasure to the god, constitute the very food and drink which render him vigorous and capable of battling with the enemies of his mortal friend. It is this intrinsic power of fervent invocation and worship which found an early expression in the term *brahmă*; and its independent existence as an active moral principle in shaping the destinies of man became recognized in the Vedic pantheon in the conception of a god *Bṛihaspati* or *Brahmaṇaspati*, "lord of prayer or devotion," the divine priest and the guardian of the pious worshipper. By a natural extension of the original meaning, the term *brahmă*, in the sense of sacred utterance, was subsequently likewise applied to the whole body of sacred writ, the *tri-vidyā* or "triple lore" of the Veda; whilst it also came to be commonly used as the abstract designation of the priestly function and the Brāhmanical order generally, in the same way as the term *kshatra*, "sway, rule," came to denote the aggregate of functions and individuals of the Kshatriyas or Rājanyas, the nobility or military class.

The universal belief in the efficacy of invocation as an indispensable adjunct to sacrifices and religious rites generally, could not fail to engender and maintain in the minds of the people feelings of profound esteem and reverence towards those who possessed the divine gift of inspired utterance, as well as for those who had acquired an intimate knowledge of the approved forms of ritual worship. A common designation of the priest is brahman (nom. *brahma*), originally denoting, it would seem, "one who prays, a worshipper," perhaps also "the composer of a hymn" (*brahman*, n.); and the same term came subsequently to be used not only for one of the sacerdotal order generally, but also, and more commonly, as the designation of a special class of priests who officiated as superintendents during sacrificial performances, the complicated nature of which required the co-operation of a whole staff of priests, and who accordingly were expected to

possess a competent knowledge of the entire course of ritual procedure, including the correct form and mystic import of the sacred texts to be repeated or chanted by the several priests. The Brahman priest (*brahmā*) being thus the recognized head of the sacerdotal order (*brahmă*), which itself is the visible embodiment of sacred writ and the devotional spirit pervading it (*brahmă*), the complete realization of theocratic aspirations required but a single step, which was indeed taken in the theosophic speculations of the later Vedic poets and the authors of the Brāhmanas (*q.v.*), viz. the recognition of this abstract notion of the Brahma as the highest cosmic principle and its identification with the pantheistic conception of an all-pervading, self-existent spiritual substance, the primary source of the universe; and subsequently coupled therewith the personification of its creative energy in the form of Brahmā, the divine representative of the earthly priest, who was made to take the place of the earlier conception of *Prajāpati*, "the lord of creatures" (see Brahmanism). By this means the very name of this god expressed the essential oneness of his nature with that of the divine spirit as whose manifestation he was to be considered. In the later Vedic writings, especially the Brāhmanas, however, Prajāpati still maintains throughout his position as the paramount personal deity; and Brahma, in his divine capacity, is rather identified with Bṛihaspati, the priest of the gods. Moreover, the exact relationship between Prajāpati and the Brahmă (n.) is hardly as yet defined with sufficient precision; it is rather one of simple identification: in the beginning the Brahma was the All, and Prajapati is the Brahma. It is only in the institutes of Manu, where we find the system of castes propounded in its complete development, that Brahmā has his definite place assigned to him in the cosmogony. According to this work, the universe, before undiscerned, was made discernible in the beginning by the sole, self-existent lord Brahmă (n.). He, desirous of producing different beings from his own self, created the waters by his own thought, and placed in them a seed which developed into a golden egg; therein was born Brahmā (m.), the parent of all the worlds; and thus "that which is the undiscrete Cause, eternal, which is and is not, from it issued that male who is called in the world Brahmā." Having dwelt in that egg for a year, that lord spontaneously by his own thought split that egg in two; and from the two halves he fashioned the heaven and the earth, and in the middle, the sky, and the eight regions (the points of the compass), and the perpetual place of the waters. This theory of Brahmā being born from a golden egg is, however, a mere adaptation of the Vedic conception of *Hiranya-garbha* ("golden embryo"), who is represented as the supreme god in a hymn of the tenth (and last) book of the *Rigveda*. Another still later myth, which occurs in the epic poems, makes Brahma be born from a lotus which grew out of the navel of the god Vishṇu whilst floating on the primordial waters. In artistic representations, Brahmā usually appears as a bearded man of red colour with four heads crowned with a pointed, tiara-like head-dress, and four hands holding his sceptre, or a sacrificial spoon, a bundle of leaves representing the Veda, a bottle of water of the Ganges, and a string of beads or his bow Parivīta. His vehicle (*vāhana*) is a goose or swan (*hamsa*), whence he is also called *Haṃsāvhana*; and his consort is Sarasvatī, the goddess of learning.



One could hardly expect that a colourless deity of this description, so completely the product of priestly speculation, could ever have found a place in the hearts of the people generally, And indeed, whilst in theoretic theology Brahma has retained his traditional place and function down to our own days, his practical cult has at all times remained extremely limited, the only temple dedicated to the worship of this god being found at Pushkar (Pokhar) near Ajmir in Rājputāna. On the other hand, his divine substratum, the impersonal Brahma, the world-spirit, the one and only reality, remains to this day the ultimate element of the religious belief of intelligent India of whatever sect. Being devoid of all attributes, it can be the object only of meditation, not of practical devotional rites; and philosophy can only attempt to characterize it in general and vague terms, as in the favourite formula which makes it to be *sachchidānanda*, *i.e.* being (*sat*), thinking (*chit*), and bliss (*ānanda*).

(J. E.)

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**BRĀHMAṆA,** the Sanskrit term applied to a body of prose writings appended to the collections (*samhitā*) of Vedic texts, the meaning and ritual application of which they are intended to elucidate, and like them regarded as divinely revealed. From a linguistic point of view, these treatises with their appendages, the more mystic and recondite Āraṇyakas and the speculative Upanishads, have to be considered as forming the connecting link between the Vedic and the classical Sanskrit. The exact derivation and meaning of the name is somewhat uncertain. Whilst the masculine term *brāhmaṇa* (nom. *brāhmaṇas*), the ordinary Sanskrit designation of a man of the Brahmanical caste, is clearly a derivative of *brahman* (nom. *brahmā*), a common Vedic term for a priest (see Brahman), thus meaning the son or descendant of a Brahman, the neuter word *brāhmaṇa* (nom. *brāhmaṇam*) on the other hand, with which we are here concerned, admits of two derivations: either it is derived from the same word *brahman*, and would then seem to mean a *dictum* or observation ascribed to, or intended for the use of, a Brahman, or superintendent

priest; or it has rather to be referred to the neuter noun *brahmān* (nom. *brahmă*), in the sense of "sacred utterance or rite," in which case it might mean a comment on a sacred text, or explanation of a devotional rite, calculated to bring out its spiritual or mystic significance and its bearing on the Brahma, the world-spirit embodied in the sacred writ and ritual. This latter definition seems on the whole the more probable one, and it certainly would fit exactly the character of the writings to which the term relates. It will thus be seen that the term *brāhmaṇam* applies not only to complete treatises of an exegetic nature, but also to single comments on particular texts or rites of which such a work would be made up.

The gradual elaboration of the sacrificial ceremonial, as the all-sufficient expression of religious devotion, and a constantly growing tendency towards theosophic and mystic speculation on the significance of every detail of the ritual, could not fail to create a demand for explanatory treatises of this kind, which, to enhance their practical utility, would naturally deal with the special texts and rites assigned in the ceremonial to the several classes of officiating priests. At a subsequent period the demand for instruction in the sacrificial science called into existence a still more practical set of manuals, the so-called *Kalpa-sūtras*, or ceremonial rules, detailing, in succinct aphorisms, the approved course of sacrificial procedure, without reference to the supposed origin or import of the several rites. These manuals are also called *Śrauta-sūtras*, treating as they do, like the Brāhmaṇas, of the Śrauta rites—*i.e.* the rites based on the *śruti* or revelation—requiring at least three sacrificial fires and a number of priests, as distinguished from the *gṛihya* (domestic) or *smārta* (traditional) rites, supposed to be based on the *smriti* or tradition, which are performed on the house-fire and dealt with in the *Gṛihya-sūtras*.

The ritual recognizes four principal priests (*ṛitvij*), each of whom is assisted by three subordinates: viz. the *Brahman* or superintending priest; the *Hotṛi* or reciter of hymns and verses; the *Udgātri* or chanter; and the *Adhvaryu* or offerer, who looks after the details of the ceremonial, including the preparation of the offering-ground, the construction of fire-places and altars, the making of oblations and muttering of the prescribed formulae. Whilst the two last priests have assigned to them special liturgical collections of the texts to be used by them, the *Sāmaveda-saṃhitā* and *Yajurveda-saṃhitā* respectively, the Hotṛi has to deal entirely with hymns and verses taken from the *Ṛigveda-saṃhitā*, of which they would, however, form only a comparatively small portion. As regards the Brahman, he would doubtless be chosen from one of those other three classes, but would be expected to have made himself thoroughly conversant with the texts and ritual details appertaining to all the officiating priests. It is, then, to one or other of those three collections of sacred texts and the respective class of priests, that the existing Brāhmaṇas attach themselves. At a later period, when the Atharvan gained admission to the Vedic canon, a special connexion with the Brahman priest was sometimes claimed, though with scant success, for this fourth collection of hymns and spells, and the comparatively late and unimportant Gopatha-brāhmaṇa attached to it.

The Udgātṛi's duties being mainly confined to the chanting of hymns made up of detached groups of verses of the *Ṛigveda*, as collected in the Sāmaveda-saṃhitā, the more important Brāhmaṇas of this sacerdotal class deal chiefly with the various modes of chanting, and the modifications which the verses have to undergo in their musical setting. Moreover, the performance of chants being almost entirely confined to the Soma-sacrifice, it is only a portion, though no doubt the most important portion, of the sacrificial ceremonial that enters into the subject matter of the Sāmaveda Brāhmaṃas.

As regards the Brāhmaṇas of the *Ṛigveda*, two of such works have been handed down, the *Aitareya* and the *Kaushītaki* (or *Śānkhāyana*)-*Brāhmaṇas*, which have a large amount of their material in common. But while the former work (transl. into English by M. Haug) is mainly taken up with the Soma-sacrifice, the latter has in addition thereto chapters on the other forms of sacrifice. Being intended for the Hotṛi's use, both these works treat exclusively of the hymns and verses recited by that priest and his assistants, either in the form of connected litanies or in detached verses invoking the deities to whom oblations are made, or uttered in response to the solemn hymns chanted by the Udgātṛis.

It is, however, to the Brāhmaṇas and Sūtras of the *Yajurveda*, dealing with the ritual of the real offering-priest, the Adhvaryu, that we have to turn for a connected view of the sacrificial procedure in all its material details. Now, in considering the body of writings connected with this Veda, we are at once confronted by the fact that there are two different schools, an older and a younger one, in which the traditional body of ritualistic matter has been treated in a very different way. For while the younger school, the *Vājasaneyins*, have made a clear severance between the sacred texts or mantras and the exegetic discussions thereon—as collected in the *Vājasaneyi-saṃhitā* and the *Śatapatha-Brāhmaṇa* (trans. by J. Eggeling, in *Sacred Books of the East*) respectively—arranged systematically in accordance with the ritual divisions, the older school on the other hand present their materials in a hopelessly jumbled form; for not only is each type of sacrifice not dealt with continuously and in orderly fashion, but short textual sections of mantras are constantly followed immediately by their dogmatic exegesis; the term *brāhmaṇa* thus applying in their case only to these detached comments and not to the connected

series of them. Thus the most prominent subdivision of the older school, the *Taittirīyas*, in their *Saṃhitā*, have treated the main portion of the ceremonial in this promiscuous fashion, and to add to the confusion they have, by way of supplement, put forth a so-called *Taittirīya-brāhmaṇa*, which, so far from being a real Brāhmaṇa, merely deals with some additional rites in the same confused mixture of sacrificial formulae and dogmatic explanations. It is not without reason, therefore, that those two schools, the older and the younger, are commonly called the Black (*kṛishṇa*) and the White (*sukla*) Yajus respectively.

Although the ritualistic discussions of the Brāhmaṇas are for the most part of a dry and uninteresting nature to an even greater degree than is often the case with exegetic theological treatises, these works are nevertheless of considerable importance both as regards the history of Indian institutions and as "the oldest body of Indo-European prose, of a generally free, vigorous, simple form, affording valuable glimpses backwards at the primitive condition of unfettered Indo-European talk" (Whitney). Of especial interest in this respect are the numerous myths and legends scattered through these works. From the archaic style in which these mythological tales are usually composed, as well as from the fact that not a few of them are found in Brāhmaṇas of different schools and Vedas, though often with considerable variations, it seems pretty evident that the groundwork of them must go back to times preceding the composition or final redaction of the existing Brāhmaṇas. In the case of some of these legends—as those of Śunaḥ-Śepha, and the fetching of Soma from heaven—we can even see how they have grown out of germs contained in some of the Vedic hymns. If the literary style in which the exegetic discussion of the texts and rites is carried on in the Brāhmaṇas is, as a rule, of a very bald and uninviting nature, it must be borne in mind that these treatises are of a strictly professional and esoteric character, and in no way lay claim to being considered as literary compositions in any sense of the word. And yet, notwithstanding the general emptiness of their ritualistic discussions and mystic speculations, "there are passages in the Brāhmaṇas full of genuine thought and feeling, and most valuable as pictures of life, and as records of early struggles, which have left no trace in the literature of other nations" (M. Müller).

The chief interest, however, attaching to the Brāhmaṇas is doubtless their detailed description of the sacrificial system as practised in the later Vedic ages; and the information afforded by them in this respect should be all the more welcome to us, as the history of religious institutions knows of no other sacrificial ceremonial with the details of which we are acquainted to anything like the same extent. An even more complete and minutely detailed view of the sacrificial system is no doubt obtained from the ceremonial manuals, the Kalpa-sūtras; but it is just by the speculative discussions of the Brāhmaṇas—the mystic significance and symbolical colouring with which they invest single rites—that we gain a real insight into the nature and gradual development of this truly stupendous system of ritual worship.

The sacrificial ritual recognizes two kinds of *śrauta* sacrifices, viz. *haviryajnas* (meat-offerings), consisting of oblations (*ishti*) of milk, butter, cereals or flesh, and *somayāgas* or oblations of the juice of the soma plant. The setting up, by a householder, of a set of three sacrificial fires of his own constitutes the first ceremony of the former class, the *Agny-ādhāna* (or (?) *Agny-ādheya*). The first of the three fires laid down is the *gārhapatya*, or householder's fire, so called because, though not taken from his ordinary house-fire, but as a rule specially produced by friction, it serves for cooking the sacrificial food, and thus, as it were, represents the domestic fire. From it the other two fires, the *ānavanīya*, or offering fire, and the *dakshiṇāgni*, or southern fire, used for certain special purposes, are taken. The principal other ceremonies of this class are the new and full moon offerings, the oblations made at the commencement of the three seasons, the offering of first-fruits, the animal sacrifice, and the *Agnihotra*, or daily morning and evening oblation of milk, which, however, is also included amongst the *gṛihya*, or domestic rites, as having to be performed daily on the domestic fire by the householder who keeps no regular set of sacrificial fires.

Of a far more complicated nature than these offerings are the Soma-sacrifices, which, besides the simpler ceremonies of this class, such as the *Agnishtoma* or "Praise of Agni," also include great state functions, such as the *Rājasūya* or consecration of a king, and the *Aśvamedha* or horse-sacrifice, which, in addition to the sacrificial rites, have a considerable amount of extraneous, often highly interesting, ceremonial connected with them, which makes them seem to partake largely of the nature of public festivals. Whilst the oblations of Soma-juice, made thrice on each offering-day, amidst chants and recitations, constitute the central rites of those services, their ritual also requires numerous single oblations of the *ishti* kind, including at least three animal offerings, and in some cases the immolation of many hecatombs of victims. Moreover, a necessary preliminary to every Soma-sacrifice is the construction, in five layers, of a special fire-altar of large dimensions, consisting of thousands of bricks, formed and baked on the spot, to each, or each group, of which a special symbolic meaning is attached. The building of this altar is spread over a whole year, during which period the sacrificer has to carry about the sacrificial fire in an earthen pan for at least some time each day, until it is finally deposited on the completed altar to serve as the offering-fire for the Soma oblations. The altar itself is constructed in the form of a bird, because Soma was supposed to have been brought down from heaven by the metre

Gāyatrī which had assumed the form of an eagle. Whilst the Soma-sacrifice has been thus developed by the Brāhmaṇas in an extraordinary degree, its essential identity with the Avestan Haoma-cult shows that its origin goes back at all events to the Indo-Iranian period.

Among the symbolic conceits in which the authors of the Brāhmaṇas so freely indulge, there is one overshadowing all others—if indeed they do not all more or less enter into it—which may be considered as the sum and substance of these speculations, and the esoteric doctrine of the sacrifice, involved by the Brāhmanical ritualists. This is what may conveniently be called the Prajāpati theory, by which the "Lord of Creatures," the efficient cause of the universe, is identified with both the sacrifice (*yajna*) and the sacrificer (*yajamāna*). The origin of this theory goes back to the later Vedic hymns. In the so-called Purusha-sūkta (*Ṛigv.* x. 90) in which the supreme spirit is conceived of as *the* person or man (*purusha*), born in the beginning, and consisting of "whatever hath been and whatever shall be," the creation of the visible and invisible universe is represented as originating from an "all-offered" (holocaust) sacrifice in which the Purusha himself forms the offering-material (*havis*), or, as we might say, the victim. In this primeval, or rather timeless because ever-proceeding, sacrifice, time itself, in the shape of its unit the year, is made to take its part, inasmuch as the three seasons—spring, summer and autumn—of which it consists, constitute the ghee (clarified butter), the offering-fuel and the oblation respectively. These speculations may be said to have formed the foundation on which the theory of the sacrifice, as propounded in the Brāhmaṇas, has been reared. Prajāpati—who (probably for practical considerations, as better representing the sacrificer, the earthly ruler, or "lord of the creatures") here takes the place of the Purusha, the world-man or all-embracing personality—is offered up anew in every sacrifice; and inasmuch as the very dismemberment of the lord of creatures, which took place at that archtypal sacrifice, was in itself the creation of the universe, so every sacrifice is also a repetition of that first creative act. Thus the periodical sacrifice is nothing else than a microcosmic representation of the ever-proceeding destruction and renewal of all cosmic life and matter. The ritualistic theologians, however, go an important step further by identifying Prajāpati with the performer, or patron, of the sacrifice, the sacrificer; every sacrifice thus becoming invested—in addition to its cosmic significance—with the mystic power of regenerating the sacrificer by cleansing him of all guilt and securing for him a seat in the eternal abodes.



Whilst forming the central feature of the ritualistic symbolism, this triad—Prajāpati, sacrifice (oblation, victim), sacrificer—is extended in various ways. An important collateral identification is that of Prajāpati (and the sacrificer) with Agni, the god of fire, embodied not only in the offering-fire, but also in the sacred Soma-altar, the technical name of which is *agni*. For this reason the altar, as representative of the universe, is built in five layers, representing earth, air and heaven, and the intermediate regions; and in the centre of the altar-site, below the first layer, on a circular gold plate (the sun), a small golden man (*purusha*) is laid down with his face looking upwards. This is Prajāpati, and the sacrificer, who when regenerated will pass upwards through the three worlds to the realms of light, naturally perforated bricks being for this purpose placed in the middle of the three principal altar-layers. One of the fourteen sections of the Śatapatha-brāhmana, the tenth, called *Agni-rahasya* or "the mystery of Agni (the god and altar)," is entirely devoted to this feature of the sacrificial symbolism. Similarly the sacrificer, as the human representatiye of the Lord of Creatures, is identified with Soma (as the supreme oblation), with Time, and finally with Death: by the sacrificer thus becoming Death himself, the fell god ceases to have power over him and he is assured of everlasting life. And now we get the Supreme Lord in his last aspect; nay, his one true and real aspect, in which the sacrificer, on shuffling off this mortal coil, will himself come to share—that of pure intellectuality, pure spirituality—he is Mind: such is the ultimate source of being, the one Self, the Purusha, the Brahman. As the sum total of the wisdom propounded in the mystery of Agni, the searcher after truth is exhorted to meditate on that Self, made up of intelligence, endowed with a body of spirit, a form of light, and of an ethereal nature; holding sway over all the regions and pervading this All, being itself speechless and devoid of mental states; and by so doing he shall gain the assurance that "even as a grain of rice, or the smallest granule of millet, so is the golden Purusha in my heart; even as a smokeless light, it is greater than the sky, greater than the ether, greater than the earth, greater than all existing things;—that Self of the Spirit is my Self; on passing away from hence, I shall obtain that Self. And, verily, whosoever has this trust, for him there is no uncertainty."

(J. E.)

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**BRAHMANISM,** a term commonly used to denote a system of religious institutions originated and elaborated by the *Brāhmans*, the sacerdotal and, from an early period, the dominant caste of the Hindu community (see Brahman). In like manner, as the language of the Āryan Hindūs has undergone continual processes of modification and dialectic division, so their religious belief has

passed through various stages of development broadly distinguished from one another by certain prominent features. The earliest phases of religious thought in India of which a clear idea can now be formed are exhibited in a body of writings, looked upon by later generations in the light of sacred writ, under the collective name of *Veda* ("knowledge") or *Śruti* ("revelation"). The Hindū scriptures consist of four separate collections, or *Samhitās*, of sacred texts, or *mantras*, including hymns, incantations and sacrificial forms of prayer, viz. the *Ṛich* (nom. sing. *ṛik*) or *Ṛigveda*, the *Sāman* or *Sāmaveda*, the *Yajus* or *Yajurveda*, and the *Atharvan* or *Atharvaveda*. Each of these four text-books has attached to it a body of prose writings, called *Brāhmaṇas* (see Brāhmaṇa), intended to explain the ceremonial application of the texts and the origin and import of the sacrificial rites for which these were supposed to have been composed. Usually attached to these works, and in some cases to the Saṃhitās, are two kinds of appendages, the Āraṇyakas and Upanishads, the former of which deal generally with the more recondite rites, while the latter are taken up chiefly with speculations on the problems of the universe and the religious aims of man —subjects often touched upon in the earlier writings, but here dealt with in a more mature and systematic way. Two of the *Saṃhitās*, the *Sāman* and the *Yajus*, owing their existence to purely ritual purposes, and being, besides, the one almost entirely, the other partly, composed of verses taken from the *Ṛigveda*, are only of secondary importance for our present inquiry. The hymns of the *Ṛigveda* constitute the earliest lyrical effusions of the Āryan settlers in India which have been handed down to posterity. They are certainly not all equally old; on the contrary they evidently represent the literary activity of many generations of bards, though their relative age cannot as yet be determined with anything like certainty. The tenth (and last) book of the collection, however, at any rate has all the characteristics of a later appendage, and in language and spirit many of its hymns approach very nearly to the level of the contents of the *Atharvan*. Of the latter collection about one-sixth is found also in the *Ṛigveda*, and especially in the tenth book; the larger portion peculiar to it, though including no doubt some older pieces, appears to owe its origin to an age not long anterior to the composition of the *Brāhmaṇas*.

The state of religious thought among the ancient bards, as reflected in the hymns of the *Ṛigveda*, is that of a worship of the grand and striking phenomena of nature regarded in the light of personal conscious beings, endowed with a power beyond the control of man, though not insensible to his praises and actions. It is a nature worship purer than that met with in any other polytheistic form of belief we are acquainted with—a mythology still comparatively little affected by those systematizing tendencies which, in a less simple and primitive state of thought, lead to the construction of a well-ordered pantheon and a regular organization of divine government. To the mind of the early Vedic worshipper the various departments of the surrounding nature are not as yet clearly defined, and the functions which he assigns to their divine representatives continually flow into one another. Nor has he yet learned to care to determine the relative worth and position of the objects of his adoration; but the temporary influence of the phenomenon to which he addresses his praises bears too strongly upon his mind to allow him for the time to consider the claims of rival powers to which at other times he is wont to look up with equal feelings of awe and reverence. It is this immediateness of impulse under which the human mind in its infancy strives to give utterance to its emotions that imparts to many of its outpourings the ring of monotheistic fervour.

The generic name given to these impersonations, viz. *deva* ("the shining ones"), points to the conclusion, sufficiently justified by the nature of the more prominent objects of Vedic adoration as well as by common natural occurrences, that it was the striking phenomena of light which first and most powerfully swayed the Āryan mind. In the primitive worship of the manifold phenomena of nature it is not, of course, so much their physical aspect that impresses the human heart as the moral and intellectual forces which are supposed to move and animate them. The attributes and relations of some of the Vedic deities, in accordance with the nature of the objects they represent, partake in a high degree of this spiritual element; but it is not improbable that in an earlier phase of Āryan worship the religious conceptions were pervaded by it to a still greater and more general extent, and that the Vedic belief, though retaining many of the primitive features, has on the whole assumed a more sensuous and anthropomorphic character. This latter element is especially predominant in the attributes and imagery applied by the Vedic poets to *Indra*, the god of the atmospheric region, the favourite figure in their pantheon.

While the representatives of the prominent departments of nature appear to the Vedic bard as co-existing in a state of independence of one another, their relation to the mortal worshipper being the chief subject of his anxiety, a simple method of classification was already resorted to at an early time, consisting in a triple division of the deities into gods residing in the sky, in the air, and on earth. It is not, however, until a later stage,—the first clear indication being conveyed in a passage of the tenth book of the *Ṛigveda*—that this attempt at a polytheistic system is followed up by the promotion of one particular god to the dignity of chief guardian for each of these three regions. On the other hand, a tendency is clearly traceable in some of the hymns towards identifying gods whose functions present a certain degree of similarity of nature; attempts which would seem to show a certain advance of religious reflection, the first steps from polytheism towards a comprehension of the unity of the divine essence. Another feature of the old Vedic

worship tended to a similar result. The great problems of the origin and existence of man and the universe had early begun to engage the Hindū mind; and in celebrating the praises of the gods the poet was frequently led by his religious, and not wholly disinterested, zeal to attribute to them cosmical functions of the very highest order. At a later stage of thought, chiefly exhibited in the tenth book of the *Ṛigveda* and in the *Atharvaveda*, inquiring sages could not but perceive the inconsistency of such concessions of a supremacy among the divine rulers, and tried to solve the problem by conceptions of an independent power, endowed with all the attributes of a supreme deity, the creator of the universe, including the gods of the pantheon. The names under which this monotheistic idea is put forth are mostly of an attributive character, and indeed some of them, such as *Prajāpati* ("lord of creatures"), *Viśvakarman* ("all-worker"), occur in the earlier hymns as mere epithets of particular gods. But to other minds this theory of a personal creator left many difficulties unsolved. They saw, as the poets of old had seen, that everything around them, that man himself, was directed by some inward agent; and it needed but one step to perceive the essential sameness of these spiritual units, and to recognize their being but so many individual manifestations of one universal principle or spiritual essence. Thus a pantheistic conception was arrived at, put forth under various names, such as *Purusha* ("soul"), *Kāma* ("desire"), *Brahman* (neutr.; nom. sing. *bráhma*) ("devotion, prayer"). Metaphysical and theosophic speculations were thus fast undermining the simple belief in the old gods, until, at the time of the composition of the *Brāhmanas* and *Upanishads*, we find them in complete possession of the minds of the theologians. Whilst the theories crudely suggested in the later hymns are now further matured and elaborated, the tendency towards catholicity of formula favours the combination of the conflicting monotheistic and pantheistic conceptions; this compromise, which makes *Prajāpati*, the personal creator of the world, the manifestation of the impersonal *Brahma*, the universal self-existent soul, leads to the composite pantheistic system which forms the characteristic dogma of the Brāhmanical period (see Brahman).

In the Vedic hymns two classes of society, the royal (or military) and the priestly classes, were evidently recognized as being raised above the level of the *Viś*, or bulk of the Āryan community. These social grades seem to have been in existence even before the separation of the two Asiatic branches of the Indo-Germanic race, the Āryans of Iran and India. It is true that, although the *Athrava, Rathaēstāo*, and *Vāstrya* of the *Zend Avesta* correspond in position and occupation to the *Brāhman, Rājan* and *Viś* of the Veda, there is no similarity of names between them; but this fact only shows that the common vocabulary had not yet definitely fixed on any specific names for these classes. Even in the Veda their nomenclature is by no means limited to a single designation for each of them. Moreover, *Atharvan* occurs not infrequently in the hymns as the personification of the priestly profession, as the proto-priest who is supposed to have obtained fire from heaven and to have instituted the rite of sacrifice; and although *ratheshtha* ("standing on a car") is not actually found in connexion with the *Rājan* or *Kshatriya*, its synonym *rathin* is in later literature a not unusual epithet of men of the military caste. At the time of the hymns, and even during the common Indo-Persian period, the sacrificial ceremonial had already become sufficiently complicated to call for the creation of a certain number of distinct priestly offices with special duties attached to them. While this shows clearly that the position and occupation of the priest were those of a profession, the fact that the terms *brāhmaṇa* and *brahmaputra*, both denoting "the son of a brahman," are used in certain hymns as synonyms of *brahman*, seems to justify the assumption that the profession had already, to a certain degree, become hereditary at the time when these hymns were composed. There is, however, with the exception of a solitary passage in a hymn of the last book, no trace to be found in the *Ṛigveda* of that rigid division into four castes separated from one another by insurmountable barriers, which in later times constitutes the distinctive feature of Hindū society. The idea of caste is expressed by the Sanskrit term *varna*, originally denoting "colour," thereby implying differences of complexion between the several classes. The word occurs in the Veda in the latter sense, but it is used there to mark the distinction, not between the three classes of the Āryan community, but between them on the one hand and a dark-coloured hostile people on the other. The latter, called Dāsas or Dasyus, consisted, no doubt, of the indigenous tribes, with whom the Āryans had to carry on a continual struggle for the possession of the land. The partial subjection of these comparatively uncivilized tribes as the rule of the superior race was gradually spreading eastward, and their submission to a state of serfdom under the name of *Śūdras*, added to the Āryan community an element, totally separated from it by colour, by habits, by language, and by occupation. Moreover, the religious belief of these tribes being entirely different from that of the conquering people, the pious Āryas, and especially the class habitually engaged in acts of worship, could hardly fail to apprehend considerable danger to the purity of their own faith from too close and intimate a contact between the two races. What more natural, therefore, than that measures should have been early devised to limit the intercourse between them within as narrow bounds as possible? In course of time the difference of vocation, and the greater or less exposure to the scorching influence of the tropical sky, added, no doubt, to a certain admixture of Śūdra blood, especially in the case of the common people, seem to have produced also in the Āryan population different shades of complexion, which greatly favoured a tendency to rigid class-restrictions originally awakened and continually fed by the lot of the servile race. Meanwhile the power of the sacerdotal order having

been gradually enlarged in proportion to the development of the minutiae of sacrificial ceremonial and the increase of sacred lore, they began to lay claim to supreme authority in regulating and controlling the religious and social life of the people. The author of the so-called *Purusha-sūkta*, or hymn of Purusha, above referred to, represents the four castes—the *Brāhmaṇa, Kshatriya, Vaiśya* and *Śūdra*—as having severally sprung respectively from the mouth, the arms, the thighs and the feet of Purusha, a primary being, here assumed to be the source of the universe. It is very doubtful, however, whether at the time when this hymn was composed the relative position of the two upper castes could already have been settled in so decided a way as this theory might lead one to suppose. There is, on the contrary, reason to believe that some time had yet to elapse, marked by fierce and bloody struggles for supremacy, of which only imperfect ideas can be formed from the legendary and frequently biased accounts of later generations, before the Kshatriyas finally submitted to the full measure of priestly authority.

The definitive establishment of the Brāhmanical hierarchy marks the beginning of the Brāhmanical period properly so called. Though the origin and gradual rise of some of the leading institutions of this era can, as has been shown, be traced in the earlier writings, the chain of their development presents a break at this juncture which no satisfactory materials as yet enable us to fill up. A considerable portion of the literature of this time has apparently been lost; and several important works, the original composition of which has probably to be assigned to the early days of Brāhmanism, such as the institutes of Manu and the two great epics, the *Mahābhārata* and *Rāmāyana*, in the form in which they have been handed down to us, show manifest traces of a more modern redaction. Yet it is sufficiently clear from internal evidence that Manu's Code of Laws, though merely a metrical recast of older materials, reproduces on the whole pretty faithfully the state of Hindū society depicted in the sources from which it was compiled. The final overthrow of the Kshatriya power was followed by a period of jealous legislation on the part of the Brāhmans. For a time their chief aim would doubtless be to improve their newly gained vantage-ground by surrounding everything relating to their order with a halo of sanctity calculated to impress the lay community with feelings of awe. In the Brāhmaṇas and even in the Purusha Hymn, and the Atharvan, divine origin had already been ascribed to the Vedic *Saṃhitās*, especially to the three older collections. The same privilege was now successfully claimed for the later Vedic literature, so imbued with Brāhmanic aspirations and pretensions; and the authority implied in the designation of *Śruti* or revelation removed henceforth the whole body of sacred writings from the sphere of doubt and criticism. This concession necessarily involved an acknowledgment of the new social order as a divine institution. Its stability was, however, rendered still more secure by the elaboration of a system of conventional precepts, partly forming the basis of Manu's Code, which clearly defined the relative position and the duties of the several castes, and determined the penalties to be inflicted on any transgressions of the limits assigned to each of them. These laws are conceived with no sentimental scruples on the part of their authors. On the contrary, the offences committed by Brāhmans against other castes are treated with remarkable clemency, whilst the punishments inflicted for trespasses on the rights of higher classes are the more severe and inhuman the lower the offender stands in the social scale.



The three first castes, however unequal to each other in privilege and social standing, are yet united by a common bond of sacramental rites (*saṃskāras*), traditionally connected from ancient times with certain incidents and stages in the life of the Āryan Hindū, as conception, birth, name-giving, the first taking out of the child to see the sun, the first feeding with boiled rice, the rites of tonsure and hair-cutting, the youth's investiture with the sacrificial thread, and his return home on completing his studies, marriage, funeral, &c. The modes of observing these family rites are laid down in a class of writings called *Gṛihya-sūtras*, or domestic rules. The most important of these observances is the *upanayana*, or rite of conducting the boy to a spiritual teacher. Connected with this act is the investiture with the sacred cord, ordinarily worn over the left shoulder and under the right arm, and varying in material according to the class of the wearer. This ceremony being the preliminary act to the youth's initiation into the study of the Veda, the management of the consecrated fire and the knowledge of the rites of purification, including the *sāvitrī*, a solemn invocation to *Savitṛi*, the sun (probl. Saturnus),—as a rule the verse *Ṛigv*. iii. 62. 10, also called *gāyatrī* from the metre in which it is composed—which has to be repeated every morning and evening before the rise and after the setting of that luminary, is supposed to constitute the second or spiritual birth of the Ārya. It is from their participation in this rite that the three upper classes are called the twice-born. The ceremony is enjoined to take place some time between the eighth and sixteenth year of age in the case of a Brāhman, between the eleventh and twenty-second year of a Kshatriya, and between the twelfth and twenty-fourth year of a Vaiśya. He who has not been invested with the mark of his class within this time is for ever excluded from uttering the sacred *sāvitrī* and becomes an outcast, unless he is absolved from his sin by a council of Brāhmans, and after due performance of a purificatory rite resumes the badge of his caste. With one not duly initiated no righteous man is allowed to associate or to enter into connexions of affinity. The duty of the Śudra is to serve the twice-born classes, and above all the Brāhmans. He is excluded from all sacred knowledge, and if he performs sacrificial ceremonies he must do so without using holy mantras. No Brāhman must recite a Vedic text where a man of the servile caste might overhear him, nor must he even teach him the laws of expiating sin. The

occupations of the Vaiśya are those connected with trade, the cultivation of the land and the breeding of cattle; while those of a Kshatriya consist in ruling and defending the people, administering justice, and the duties of the military profession generally. Both share with the Brāhman the privilege of reading the Veda, but only so far as it is taught and explained to them by their spiritual preceptor. To the Brāhman belongs the right of teaching and expounding the sacred texts, and also that of interpreting and determining the law and the rules of caste. Only in exceptional cases, when no teacher of the sacerdotal class is within reach, the twice-born youth, rather than forego spiritual instruction altogether, may reside in the house of a non-Brāhmanical preceptor; but it is specially enjoined that a pupil, who seeks the path to heaven, should not fail, as soon as circumstances permit, to resort to a Brāhman well versed in the Vedas and their appendages.

Notwithstanding the barriers placed between the four castes, the practice of intermarrying appears to have been too prevalent in early times to have admitted of measures of so stringent a nature as wholly to repress it. To marry a woman of a higher caste, and especially of a caste not immediately above one's own, is, however, decidedly prohibited, the offspring resulting from such a union being excluded from the performance of the *śrāddha* or obsequies to the ancestors, and thereby rendered incapable of inheriting any portion of the parents' property. On the other hand, a man is at liberty, according to the rules of Manu, to marry a girl of any or each of the castes below his own, provided he has besides a wife belonging to his own class, for only such a one should perform the duties of personal attendance and religious observance devolving upon a married woman. As regards the children born from unequal marriages of this description, they have the rights and duties of the twice-born, if their mother belong to a twice-born caste, otherwise they, like the offspring of the former class of intermarriages, share the lot of the Śūdra, and are excluded from the investiture and the *sāvitrī*. For this last reason the marriage of a twice-born man with a Śūdra woman is altogether discountenanced by some of the later law books. At the time of the code of Manu the intermixture of the classes had already produced a considerable number of intermediate or mixed castes, which were carefully defined, and each of which had a specific occupation assigned to it as its hereditary profession.

The self-exaltation of the first class was not, it would seem, altogether due to priestly arrogance and ambition; but, like a prominent feature of the post-Vedic belief, the transmigration of souls, it was, if not the necessary, yet at least a natural consequence of the pantheistic doctrine. To the Brāhmanical speculator who saw in the numberless individual existences of animate nature but so many manifestations of the one eternal spirit, to union with which they were all bound to tend as their final goal of supreme bliss, the greater or less imperfection of the material forms in which they were embodied naturally presented a continuous scale of spiritual units from the lowest degradation up to the absolute purity and perfection of the supreme spirit. To prevent one's sinking yet lower, and by degrees to raise one's self in this universal gradation, or, if possible, to attain the ultimate goal immediately from any state of corporeal existence, there was but one way—subjection of the senses, purity of life and knowledge of the deity. "He" (thus ends the code of Manu) "who in his own soul perceives the supreme soul in all beings and acquires equanimity toward them all, attains the highest state of bliss." Was it not natural then that the men who, if true to their sacred duties, were habitually engaged in what was most conducive to these spiritual attainments, that the Brāhmanical class early learnt to look upon themselves, even as a matter of faith, as being foremost among the human species in this universal race for final beatitude? The life marked out for them by that stern theory of class duties which they themselves had worked out, and which, no doubt, must have been practised in early times at least in some degree, was by no means one of ease and amenity. It was, on the contrary, singularly calculated to promote that complete mortification of the instincts of animal nature which they considered as indispensable to the final deliverance from *saṃsāra*, the revolution of bodily and personal existence. 

The pious Brāhman, longing to attain the *summum bonum* on the dissolution of his frail body, was enjoined to pass through a succession of four orders or stages of life, viz. those of *brahmachārin*, or religious student; *gṛihastha* (or *gṛihamedhin*), or householder; *vanavāsin* (or *vānaprastha*), or anchorite; and *sannyāsin* (or *bhikshu*), or religious mendicant. Theoretically this course of life was open and even recommended to every twice-born man, his distinctive class-occupations being in that case restricted to the second station, or that of married life. Practically, however, those belonging to the Kshatriya and Vaiśya castes were, no doubt, contented, with few exceptions, to go through a term of studentship in order to obtain a certain amount of religious instruction before entering into the married state, and plying their professional duties. In the case of the sacerdotal class, the practice probably was all but universal in early times; but gradually a more and more limited proportion even of this caste seem to have carried their religious zeal to the length of self-mortification involved in the two final stages. On the youth having been invested with the badge of his caste, he was to reside for some time in the house of some religious teacher, well read in the Veda, to be instructed in the knowledge of the scriptures and the scientific or theoretic treatises attached to them, in the social duties of his caste, and in the complicated system of purificatory and sacrificial rites. According to the number of Vedas he

intended to study, the duration of this period of instruction was to be, probably in the case of Brāhmanical students chiefly, of from twelve to forty-eight years; during which time the virtues of modesty, duty, temperance and self-control were to be firmly implanted in the youth's mind by his unremitting observance of the most minute rules of conduct. During all this time the student had to subsist entirely on food obtained by begging from house to house; and his behaviour towards the preceptor and his family was to be that prompted by respectful attachment and implicit obedience. In the case of girls no investiture takes place, but for them the nuptial ceremony is considered as an equivalent to that rite. On quitting the teacher's abode, the young man returns to his family and takes a wife. To die without leaving legitimate offspring, and especially a son, capable of performing the periodical rite of obsequies (*śrāddha*), consisting of offerings of water and balls of rice, to himself and his two immediate ancestors, is considered a great misfortune by the orthodox Hindū. There are three sacred "debts" which a man has to discharge in life, viz. that which is due to the gods, and of which he acquits himself by daily worship and sacrificial rites; that due to the *ṛishis*, or ancient sages and inspired seers of the Vedic texts, discharged by the daily study of the scripture; and the "final debt" which he owes to his *manes*, and of which he relieves himself by leaving a son. To these three some authorities add a fourth, viz. the debt owing to humankind, which demands his continually practising kindness and hospitality. Hence the necessity of a man's entering into the married state. When the bridegroom leads the bride from her father's house to his own home, and becomes a *gṛiha-paṭi*, or householder, the fire which has been used for the marriage ceremony accompanies the couple to serve them as their *gārhapatya*, or domestic fire. It has to be kept up perpetually, day and night, either by themselves or their children, or, if the man be a teacher, by his pupils. If it should at any time become extinguished by neglect or otherwise, the guilt incurred thereby must be atoned for by an act of expiation. The domestic fire serves the family for preparing their food, for making the five necessary daily and other occasional offerings, and for performing the sacramental rites above alluded to. No food should ever be eaten that has not been duly consecrated by a portion of it being offered to the gods, the beings and the *manes*. These three daily offerings are also called by the collective name of *vaiśvadeva*, or sacrifice "to all the deities." The remaining two are the offering to Brahmă, *i.e.* the daily lecture of the scriptures, accompanied by certain rites, and that to men, consisting in the entertainment of guests. The domestic observances—many of them probably ancient Āryan family customs, surrounded by the Hindūs with a certain amount of adventitious ceremonial—were generally performed by the householder himself, with the assistance of his wife. There is, however, another class of sacrificial ceremonies of a more pretentious and expensive kind, called *śrauta* rites, or rites based on *śritu*, or revelation, the performance of which, though not indispensable, were yet considered obligatory under certain circumstances (see BRĀHMAṆA). They formed a very powerful weapon in the hands of the priesthood, and were one of the chief sources of their subsistence. However great the religious merit accruing from these sacrificial rites, they were obviously a kind of luxury which only rich people could afford to indulge in. They constituted, as it were, a tax, voluntary perhaps, yet none the less compulsory, levied by the priesthood on the wealthy laity.

When the householder is advanced in years, "when he perceives his skin become wrinkled and his hair grey, when he sees the son of his son," the time is said to have come for him to enter the third stage of life. He should now disengage himself from all family ties—except that his wife may accompany him, if she chooses—and repair to a lonely wood, taking with him his sacred fires and the implements required for the daily and periodical offerings. Clad in a deer's skin, in a single piece of cloth, or in a bark garment, with his hair and nails uncut, the hermit is to subsist exclusively on food growing wild in the forest, such as roots, green herbs, and wild rice and grain. He must not accept gifts from any one, except of what may be absolutely necessary to maintain him; but with his own little hoard he should, on the contrary, honour, to the best of his ability, those who visit his hermitage. His time must be spent in reading the metaphysical treatises of the Veda, in making oblations, and in undergoing various kinds of privation and austerities, with a view to mortifying his passions and producing in his mind an entire indifference to worldly objects. Having by these means succeeded in overcoming all sensual affections and desires, and in acquiring perfect equanimity towards everything around him, the hermit has fitted himself for the final and most exalted order, that of devotee or religious mendicant. As such he has no further need of either mortifications or religious observances; but "with the sacrificial fires reposited in his mind," he may devote the remainder of his days to meditating on the divinity. Taking up his abode at the foot of a tree in total solitude, "with no companion but his own soul," clad in a coarse garment, he should carefully avoid injuring any creature or giving offence to any human being that may happen to come near him. Once a day, in the evening, "when the charcoal fire is extinguished and the smoke no longer issues from the fire-places, when the pestle is at rest, when the people have taken their meals and the dishes are removed," he should go near the habitations of men, in order to beg what little food may suffice to sustain his feeble frame. Ever pure of mind he should thus bide his time, "as a servant expects his wages," wishing neither for death nor for life, until at last his soul is freed from its fetters and absorbed in the eternal spirit, the impersonal self-existent Brahmă.

The tendency towards a comprehension of the unity of the divine essence had resulted in some

minds, as has been remarked before, in a kind of monotheistic notion of the origin of the universe. In the literature of the Brāhmaṇa period we meet with this conception as a common element of speculation; and so far from its being considered incompatible with the existence of a universal spirit, *Prajāpati*, the personal creator of the world, is generally allowed a prominent place in the pantheistic theories. Yet the state of theological speculation, reflected in these writings, is one of transition. The general drift of thought is essentially pantheistic, but it is far from being reduced to a regular system, and the ancient form of belief still enters largely into it. The attributes of Prajāpati, in the same way, have in them elements of a purely polytheistic nature, and some of the attempts at reconciling this new-fangled deity with the traditional belief are somewhat awkward. An ancient classification of the gods represented them as being thirty-three in number, eleven in each of the three worlds or regions of nature. These regions being  associated each with the name of one principal deity, this division gave rise at a later time to the notion of a kind of triple divine government, consisting of *Agni* (fire), *Indra* sky) or *Vāyu* (wind), and *Sūrya* (sun), as presiding respectively over the gods on earth, in the atmosphere, and in the sky. Of this Vedic triad mention is frequently made in the Brāhmaṇa writings. On the other hand the term *prajāpati* (lord of creatures), which in the *Ṛigveda* occurs as an epithet of the sun, is also once in the *Atharvaveda* applied jointly to Indra and Agni. In the Brāhmaṇas Prajāpati is several times mentioned as the thirty-fourth god; whilst in one passage he is called the fourth god, and made to rule over the three worlds. More frequently, however, the writings of this period represent him as the maker of the world and the father or creator of the gods. It is clear from this discordance of opinion on so important a point of doctrine, that at this time no authoritative system of belief had been agreed upon by the theologians. Yet there are unmistakable signs of a strong tendency towards constructing one, and it is possible that in yielding to it the Brāhmans may have been partly prompted by political considerations. The definite settlement of the caste system and the Brāhmanical supremacy must probably be assigned to somewhere about the close of the Brāhmaṇa period. Division in their own ranks was hardly favourable to the aspirations of the priests at such a time; and the want of a distinct formula of belief adapted to the general drift of theological speculation, to which they could all rally, was probably felt the more acutely, the more determined a resistance the military class was likely to oppose to their claims. Side by side with the conception of the Brahmă, the universal spiritual principle, with which speculative thought had already become deeply imbued, the notion of a supreme personal being, the author of the material creation, had come to be considered by many as a necessary complement of the pantheistic doctrine. But, owing perhaps to his polytheistic associations and the attributive nature of his name, the person of Prajāpati seems to have been thought but insufficiently adapted to represent this abstract idea. The expedient resorted to for solving the difficulty was as ingenious as it was characteristic of the Brāhmanical aspirations. In the same way as the abstract denomination of sacerdotalism, the neuter *brahmă*, had come to express the divine essence, so the old designation of the individual priest, the masculine term *brahmā*, was raised to denote the supreme personal deity which was to take the place and attributes of the Prajāpati of the Brāhmaṇas and Upanishads (see Brahman).

However the new dogma may have answered the purposes of speculative minds, it was not one in which the people generally were likely to have been much concerned; an abstract, colourless deity like Brahmā could awake no sympathies in the hearts of those accustomed to worship gods of flesh and blood. Indeed, ever since the primitive symbolical worship of nature had undergone a process of disintegration under the influence of metaphysical speculation, the real belief of the great body of the people had probably become more and more distinct from that of the priesthood. In different localities the principal share of their affection may have been bestowed on one or another of the old gods who was thereby raised to the dignity of chief deity; or new forms and objects of belief may have sprung up with the intellectual growth of the people. In some cases even the worship of the indigenous population could hardly have remained without exercising some influence in modifying the belief of the Āryan race. In this way a number of local deities would grow up, more or less distinct in name and characteristics from the gods of the Vedic pantheon. There is, indeed, sufficient evidence to show that, at a time when, after centuries of theological speculations, some little insight into the life and thought of the people is afforded by the literature handed down to us, such a diversity of worship did exist. Under these circumstances the policy which seems to have suggested itself to the priesthood, anxious to retain a firm hold on the minds of the people, was to recognize and incorporate into their system some of the most prominent objects of popular devotion, and thereby to establish a kind of catholic creed for the whole community subject to the Brāhmanical law. At the time of the original composition of the great epics two such deities, *Śiva* or *Mahādeva* (“the great god”) and *Vishṇu*, seem to have been already admitted into the Brāhmanical system, where they have ever since retained their place; and from the manner in which they are represented in those works, it would, indeed, appear that both, and especially the former, enjoyed an extensive worship. As several synonyms are attributed to each of them, it is not improbable that in some of these we have to recognize special names under which the people in different localities worshipped these gods, or deities of a similar nature which, by the agency of popular poetry, or in some other way, came to be combined with them. The places assigned to them in the pantheistic system were

coordinate with that of Brahmā; the three deities, *Brahmā, Vishnu* and *Śiva*, were to represent a triple impersonation of the divinity, as manifesting itself respectively in the creation, preservation and destruction of the universe. Śiva does not occur in the Vedic hymns as the name of a god, but only as an adjective in the sense of "kind, auspicious." One of his synonyms, however, is the name of a Vedic deity, the attributes and nature of which show a good deal of similarity to the post-Vedic god. This is *Rudra*, the god of the roaring storm, usually portrayed, in accordance with the element he represents, as a fierce, destructive deity, "terrible as a wild beast," whose fearful arrows cause death and disease to men and cattle. He is also called *kapardin* ("wearing his hair spirally braided like a shell"), a word which in later times became one of the synonyms of Śiva. The *Atharvaveda* mentions several other names of the same god, some of which appear even placed together, as in one passage *Bhava, Sarva, Rudra* and *Paśupati*. Possibly some of them were the names under which one and the same deity was already worshipped in different parts of northern India. This was certainly the case in later times, since it is expressly stated in one of the later works of the Brahmaṇa period, that Sarva was used by the Eastern people and Bhava by a Western tribe. It is also worthy of note that in the same work (the *Śatapatha-brāhmaṇa*), composed at a time when the Vedic triad of Agni, Indra-Vāyu and Sūrya was still recognized, attempts are made to identify this god of many names with Agni; and that in one passage in the *Mahābhārata* it is stated that the Brāhmans said that Agni was Śiva. Although such attempts at an identification of the two gods remained isolated, they would at least seem to point to the fact that, in adapting their speculations to the actual state of popular worship, the Brāhmans kept the older triad distinctly in view, and by means of it endeavoured to bring their new structure into harmony with the ancient Vedic belief. It is in his character as destroyer that Śiva holds his place in the triad, and that he must, no doubt, be identified with the Vedic Rudra. Another very important function appears, however, to have been early assigned to him, on which much more stress is laid in his modern worship—that of destroyer being more especially exhibited in his consort—viz. the character of a generative power, symbolized in the phallic emblem (*linga*) and in the sacred bull (*Nandi*), the favourite attendant of the god. This feature being entirely alien from the nature of the Vedic god, it has been conjectured with some plausibility, that the *linga*-worship was originally prevalent among the non-Āryan population, and was thence introduced into the worship of Śiva. On the other hand, there can, we think, be little doubt that Śiva, in his generative faculty, is the representative of another Vedic god whose nature and attributes go far to account for this particular feature of the modern deity, viz. *Pūshan*. This god, originally, no doubt, a solar deity, is frequently invoked, as the lord of nourishment, to bestow food, wealth and other blessings. He is once, jointly with Soma, called the progenitor of heaven and earth, and is connected with the marriage ceremony, where he is asked to lead the bride to the bridegroom and make her prosperous (*Śivatamā*). Moreover, he has the epithet *kapardin* (spirally braided), as have Rudra and the later Śiva, and is called *Paśupa*, or guardian of cattle, whence the latter derives his name *Paśupati*. But he is also a strong, powerful, and even fierce and destructive god, who, with his goad or golden spear, smites the foes of his worshipper, and thus in this respect offers at least some points of similarity to Rudra, which may have favoured the fusion of the two gods. As regards *Vishṇu*, this god occupies already a place in the Vedic mythology, though by no means one of such prominence as would entitle him to that degree of exaltation implied in his character as one of the three hypostases of the divinity. Moreover, although in his general nature, as a benevolent, genial being, the Vedic god corresponds on the whole to the later Vishṇu, the preserver of the world, the latter exhibits many important features for which we look in vain in his prototype, and which most likely resulted from sectarian worship or from an amalgamation with local deities. In one or two of them, such as his names Vāsudeva and Vaikuntha, an attempt may again be traced to identify Vishṇu with Indra, who, as we have seen, was one of the Vedic triad of gods. The characteristic feature of the elder Vishṇu is his measuring the world with his three strides, which are explained as denoting either the three stations of the sun at the time of rising, culminating and setting, or the triple manifestation of the luminous element, as the fire on earth, the lightning in the atmosphere and the sun in the heavens.



The male nature of the triad was supposed to require to be supplemented by each of the three gods being associated with a female energy (*Śakti*). Thus *Vāch* or *Sarasvatī*, the goddess of speech and learning, came to be regarded as the *śakti*, or consort of Brahmā; *Śrī* or *Lakshmī*, "beauty, fortune," as that of Vishṇu; and *Umā* or *Pārvatī*, the daughter of *Himavat*, the god of the Himālaya mountain, as that of Śiva. On the other hand, it is not improbable that *Pārvatī*—who has a variety of other names, such as *Kālī* ("the black one"), *Durgā* ("the inaccessible, terrible one"), *Māha-devī* ("the great goddess")—enjoyed already a somewhat extensive worship of her own, and that there may thus have been good reason for assigning to her a prominent place in the Brāhmanical system.

A compromise was thus effected between the esoteric doctrine of the metaphysician and some of the most prevalent forms of popular worship, resulting in what was henceforth to constitute the orthodox system of belief of the Brāhmanical community. Yet the Vedic pantheon could not be altogether discarded, forming part and parcel, as it did, of that sacred revelation (*śruti*), which was looked upon as the divine source of all religious and social law (*smṛiti*, "tradition"), and being, moreover, the foundation of the sacrificial ceremonial on which the priestly authority so

largely depended. The existence of the old gods is, therefore, likewise recognized, but recognized in a very different way from that of the triple divinity. For while the triad represents the immediate manifestation of the eternal, infinite soul—while it constitutes, in fact, the Brahmă itself in its active relation to mundane and seemingly material occurrences, the old traditional gods are of this world, are individual spirits or portions of the Brahma like men and other creatures, only higher in degree. To them an intermediate sphere, the heaven of Indra (the *svarloka* or *svarga*), is assigned to which man may raise himself by fulfilling the holy ordinances; but they are subject to the same laws of being; they, like men, are liable to be born again in some lower state, and, therefore, like them, yearn for emancipation from the necessity of future individual existence. It is a sacred duty of man to worship these superior beings by invocations and sacrificial observances, as it is to honour the *piṭris* ("the fathers"), the spirits of the departed ancestors. The spirits of the dead, on being judged by *Yama*, the Pluto of Hindū mythology, are supposed to be either passing through a term of enjoyment in a region midway between the earth and the heaven of the gods, or undergoing their measure of punishment in the nether world, situated somewhere in the southern region, before they return to the earth to animate new bodies. In Vedic mythology Yama was considered to have been the first mortal who died, and "espied the way to" the celestial abodes, and in virtue of precedence to have become the ruler of the departed; in some passages, however, he is already regarded as the god of death. Although the pantheistic system allowed only a subordinate rank to the old gods, and the actual religious belief of the people was probably but little affected by their existence, they continued to occupy an important place in the affections of the poet, and were still represented as exercising considerable influence on the destinies of man. The most prominent of them were regarded as the appointed *Lokapālas*, or guardians of the world; and as such they were made to preside over the four cardinal and (according to some authorities) the intermediate points of the compass. Thus *Indra*, the chief of the gods, was regarded as the regent of the east; *Agni*, the fire (*ignis*), was in the same way associated with the south-east; *Yama* with the south; *Śurya*, the sun (Ἥλιος), with the south-west; *Varūṇa*, originally the representative of the all-embracing heaven (Οὐρανός) or atmosphere, now the god of the ocean, with the west; *Vāyu* (or *Pavana*), the wind, with the north-west; *Kubera*, the god of wealth, with the north; and *Soma* (or *Chaṇdra*) with the north-east. In the institutes of Manu the *Lokapālas* are represented as standing in close relation to the ruling king, who is said to be composed of particles of these his tutelary deities. The retinue of Indra consists chiefly of the *Gandharvas* (probably etym. connected with κένταυρος), a class of genii, considered in the epics as the celestial musicians; and their wives, the *Apsaras*, lovely nymphs, who are frequently employed by the gods to make the pious devotee desist from carrying his austere practices to an extent that might render him dangerous to their power. *Nārada*, an ancient sage (probably a personification of the cloud, the "water-giver"), is considered as the messenger between the gods and men, and as having sprung from the forehead of Brahmā. The interesting office of the god of love is held by *Kāmadeva*, also called *Ananga*, the bodyless, because, as the myth relates, having once tried by the power of his mischievous arrow to make Śiva fall in love with Pārvatī, whilst he was engaged in devotional practices, the urchin was reduced to ashes by a glance of the angry god. Two other mythological figures of some importance are considered as sons of Śiva and Pārvatī, viz. *Kārttikeya* or *Skanda*, the leader of the heavenly armies, who was supposed to have been fostered by the six *Kṛittikās* or Pleiades; and *Gaṇeśa* ("lord of troops"), the elephant-headed god of wisdom, and at the same time the leader of the *dii minorum gentium*.

Orthodox Brāhmanical scholasticism makes the attainment of final emancipation (*mukti*, *moksha*) dependent on perfect knowledge of the divine essence. This knowledge can only be obtained by complete abstraction of the mind from external objects and intense meditation on the divinity, which again presupposes the total extinction of all sensual instincts by means of austere practices (*tapas*). The chosen few who succeed in gaining complete mastery over their senses and a full knowledge of the divine nature become absorbed into the universal soul immediately on the dissolution of the body. Those devotees, on the other hand, who have still a residuum, however slight, of ignorance and worldliness left in them at the time of their death, pass to the world of Brahmā, where their souls, invested with subtile corporeal frames, await their reunion with the Eternal Being.

The pantheistic doctrine which thus forms the foundation of the Brahmanical system of belief found its most complete exposition in one of the six orthodox *darśanas*, or philosophical systems, the *Vedānta* philosophy. These systems are considered as orthodox inasmuch as they recognize the Veda as the revealed source of religious belief, and never fail to claim the authority of the ancient seers for their own teachings, even though—as in the case of Kapila, the founder of the materialistic Sānkhya system—they involve the denial of so essential a dogmatic point as the existence of a personal creator of the world. So much, indeed, had freedom of speculative thought become a matter of established habit and intellectual necessity, that no attempt seems ever to have been made by the leading theological party to put down such heretical doctrines, so long as the sacred character of the privileges of their caste was not openly called in question. Yet internal dissensions on such cardinal points of belief could not but weaken the authority of the hierarchical body; and as they spread beyond the narrow bounds of the Brāhmanical schools, it

wanted but a man of moral and intellectual powers, and untrammelled by class prejudices, to render them fatal to priestly pretensions. Such a man arose in the person of a Śākya prince of Kapilavastu, Gotama, the founder of Buddhism (about the 6th century B.C.). Had it only been for the philosophical tenets of Buddha, they need scarcely have caused, and probably did not cause, any great uneasiness to the orthodox theologians. He did, indeed, go one step beyond Kapila, by altogether denying the existence of the soul as a substance, and admitting only certain intellectual faculties as attributes of the body, perishable with it. Yet the conception which Buddha substituted for the transmigratory soul, viz. that of *karma* ("work"), as the sum total of the individual's good and bad actions, being the determinative element of the form of his future existence, might have been treated like any other speculative theory, but for the practical conclusions he drew from it. Buddha recognized the institution of caste, and accounted for the social inequalities attendant thereon as being the effects of *karma* in former existences. But, on the other hand, he altogether denied the revealed character of the Veda and the efficacy of the Brāhmanical ceremonies deduced from it, and rejected the claims of the sacerdotal class to be the repositaries and divinely appointed teachers of sacred knowledge. That Buddha never questioned the truth of the Brāhmanical theory of transmigration shows that this early product of speculative thought had become firmly rooted in the Hindū mind as a tenet of belief amounting to moral conviction. To the Hindū philosopher this doctrine seemed alone to account satisfactorily for the apparent essential similarity of the vital element in all animate beings, no less than for what elsewhere has led honest and logical thinkers to the stern dogma of predestination. The belief in eternal bliss or punishment, as the just recompense of man's actions during this brief term of human life, which their less reflective forefathers had at one time held, appeared to them to involve a moral impossibility. The equality of all men, which Buddha preached with regard to the final goal, the *nirvāna*, or extinction of *karma* and thereby of all future existence and pain, and that goal to be reached, not by the performance of penance and sacrificial worship, but by practising virtue, could not fail to be acceptable to many people. It would be out of place here to dwell on the rapid progress and internal development of the new doctrine. Suffice it to say that, owing no doubt greatly to the sympathizing patronage of ruling princes, Buddhism appears to have been the state religion in most parts of India during the early centuries of our era. To what extent it became the actual creed of the body of the people it will probably be impossible ever to ascertain. One of the chief effects it produced on the worship of the old gods was the rapid decline of the authority of the orthodox Brāhmanical dogma, and a considerable development of sectarianism. (See HINDUISM.)

See H.H. Wilson, *Essays on the Religion of the Hindus*; J. Muir, *Original Sanskrit Texts*; M. Müller, *History of Ancient Sanskrit Literature*; C. Lassen, *Indische Alterthumskunde*; Elphinstone, *History of India*, ed. by E.B. Cowell.

(J. E.)

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**BRAHMAPUTRA,** a great river of India, with a total length of 1800 m. Its main source is in a great glacier-mass of the northernmost chain of the Himalayas, called Kubigangri, about 82° N., and receives various tributaries including one formerly regarded as the true source from the pass of Mariam La (15,500 ft.), which separates its basin from the eastern affluents of the Mansarowar lakes, at least 100 m. south-east of those of the Indus. It flows in a south-easterly direction for 170 m., and then adheres closely to a nearly easterly course for 500 m. more, being at the end of that distance in 29° 10′ N. lat. It then bends north-east for 150 m. before finally shaping itself southwards towards the plains of Assam. Roughly speaking, the river may be said so far to run parallel to the main chain of the Himalaya at a distance of 100 m. therefrom. Its early beginnings take their rise amidst a mighty mass of glaciers which cover the northern slopes of the watershed, separating them from the sources of the Gogra on the south; and there is evidence that two of its great southern tributaries, the Shorta Tsanpo (which joins about 150 m. from its source), and the Nyang Chu (the river of Shigatse and Gyantse), are both also of glacial origin. From the north it receives five great tributaries, namely, the Chu Nago, the Chachu Tsanpo and the Charta Tsanpo (all within the first 200 m. of its course), and the Raka Tsanpo and Kyi-chu (or river of Lhasa) below. The Chachu and the Charta are large clear streams, evidently draining from the great central lake district. Both of them measure more than 100 yds. in width at the point of junction, and they are clearly non-glacial. The Raka Tsanpo is a lateral affluent, flowing for 200 m. parallel to the main river course and some 20 to 30 m. north of it, draining the southern slopes of a high snowy range. It is an important feature as affording foothold for the Janglam (the great high road of southern Tibet connecting Ladakh with China), which is denied by the actual valley of the Brahmaputra. The great river itself is known in Tibet by many names, being generally called the Nari Chu, Maghang Tsanpo or Yaro Tsanpo, above Lhasa; the word "tsanpo" (tsang-po) meaning (according to Waddell) the "pure one," and applying to all great rivers. Fifty miles from its source the river and the Janglam route touch each other, and from that

point past Tadum (the first important place on its banks) for another 130 m., the road follows more or less closely the left bank of the river. Then it diverges northwards into the lateral valley of the Raka, until the Raka joins the Brahmaputra below Janglache. The upper reaches are nowhere fordable between Tadum and Lhasa, but there is a ferry at Likche (opposite Tadum on the southern bank), where wooden boats covered with hide effect the necessary connexion between the two banks and ensure the passage of the Nepal trade. From Janglache (13,800 ft.) to Shigatse the river is navigable, the channel being open and wide and the course straight. This is probably the most elevated system of navigation in the world. From Shigatse, which stands near the mouth of the Nyang Chu, to the Kyi-chu, or Lhasa river, there is no direct route, the river being unnavigable below Shigatse. The Janglam takes a circuitous course southwards to Gyantse and the Yamdok Cho before dropping again over the Khambala pass to the ferry at Khamba barje near Chushul. Thence the valley of the Kyi-chu (itself navigable for small boats for about 30 m.) leads to Lhasa northwards. At Chushul there is an iron chain-and-rope suspension bridge over the deepest part of the river, but it does not completely span the river, and it is too insecure for use. The remains of a similar bridge exist at Janglache; but there are no wooden or twig suspension bridges over the Tsanpo. At Tadum the river is about one half as wide again as the Ganges at Hardwar in December, *i.e.* about 250 to 300 yds. At Shigatse it flows in a wide extended bed with many channels, but contracts again at Chushul, where it is no wider than it is at Janglache, *i.e.* from 600 to 700 yds. At Chushul (below the Kyi-chu) the discharge of the river is computed to be about 35,000 cub. ft. per second, or seven times that of the Ganges at Hardwar.

For about 250 m. below Kyi-chu to a point about 20 m. below the great southerly bend (in 94° E. long.) the course of the Brahmaputra has been traced by native surveyors. Then it is lost amidst the jungle-covered hills of the wild Mishmi and Abor tribes to the east of Bhutan for another 100 m., until it is again found as the Dihong emerging into the plains of Assam. About the intervening reaches of the river very little is known except that it drops through 7000 ft. of altitude, and that in one place, at least, there exist some very remarkable falls. These are placed in 29° 40′ N. lat., between Kongbu and Pema-Koi. Here the river runs in a narrow precipitous defile along which no path is practicable. The falls can only be approached from below, where a monastery has been erected, the resort of countless pilgrims. Their height is estimated at 70 ft., and by Tibetan report the hills around are enveloped in perpetual mist, and the Sangdong (the “lion’s face”), over which the waters rush, is demon-haunted and full of mystic import. Up to comparatively recent years it was matter for controversy whether the Tsanpo formed the upper reaches of the Dihong or of the Irrawaddy. From the north-eastern extremity of Assam where, near Sadya, the Lohit, the Dibong and the Dihong unite to form the wide placid Brahmaputra of the plains—one of the grandest rivers of the world—its south-westerly course to the Bay of Bengal is sufficiently well known. It still retains the proud distinction of being unbridged, and still the River Flotilla Company appoints its steamers at regular intervals to visit all the chief ports on its banks as far as Dibrugarh. Here, however, a new feature has been introduced in the local railway, which extends for some 80 m. to Sadya, with a branch to the Buri Dihing river at the foot of the Patkoi range. The Patkoi border the plains of Upper Assam to the south-east, and across these hills lies the most reasonable probability of railway extension to Burma.



The following are the “lowest level” discharges of the principal affluents of the Brahmaputra in Upper Assam, estimated in cubic feet per second:—

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| Lohit river, 9 m. above Sadya | 38,800 |
| Dibong, 1 m. above junction with Dihong | 27,200 |
| Dihong ” ” Dibong | 55,400 |
| Subansiri | 16,900 |

The basins of the Dibong and Subansiri are as yet very imperfectly known. That of the Lohit has been fairly well explored. Near Goalpara the discharge of the river in January 1828 was computed to be 140,000 cub. ft., or nearly double that of the Ganges. The length of the river is 700 m. to the Dihong junction, and about 1000 in Tibet and eastern Bhutan, above the Dihong. The Brahmaputra, therefore, exceeds the Ganges in length by about 400 m. The bed of the great river maintains a fairly constant position between its extreme banks, but the channels within that bed are so constantly shifting as to require close supervision on the part of the navigation authorities; so much detritus is carried down as to form a perpetually changing series of obstructions to steamer traffic.

An enormous development of agricultural resources has taken place within the Brahmaputra basin of late years, chiefly in the direction of tea cultivation, as well as in the production of jute and silk. Gold is found in the sands of all its upper tributaries, and coal and petroleum are amongst the chief mineral products which have been brought into economic prominence. During the rains the Brahmaputra floods hundreds of square miles of country, reaching a height of 30 to 40 ft. above its usual level. This supersedes artificial irrigation, and the plains so watered yield abundantly in rice, jute and mustard.

See *Reports* of the native explorers of the Indian Survey, edited by Montgomery and Harman; *Imperial Gazetteer of India* (1908); Sir T.H. Holdich, *India* (“Regions of the World” series, 1903);

Ryder, *Geographical Journal*, 1905; Rawlings, *The Great Plateau* (1906).

(T. H. H.*)

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**BRAHMA SAMAJ,** a religious association in India which owes its origin to (Raja) Ram Mohan Roy, who began teaching and writing in Calcutta soon after 1800. The name means literally the "Church of the One God," and the word *Samaj*, like the word Church, bears both a local and a universal, or an individual and a collective meaning. Impressed with the perversions and corruptions of popular Hinduism, Ram Mohan Roy investigated the Hindu Shastras, the Koran and the Bible, repudiated the polytheistic worship of the Shastras as false, and inculcated the reformed principles of monotheism as found in the ancient Upanishads of the Vedas. In 1816 he established a society, consisting only of Hindus, in which texts from the Vedas were recited and theistic hymns chanted. This, however, soon died out through the opposition it received from the Hindu community. In 1830 he organized the society known as the Brahma Samaj.

The following extract from the trust-deed of the building dedicated to it will show the religious belief and the purposes of its founder. The building was intended to be "a place of public meeting for all sorts and descriptions of people, without distinction, who shall behave and conduct themselves in an orderly, sober, religious and devout manner, for the worship and adoration of the eternal, unsearchable and immutable Being, who is the author and preserver of the universe, but not under and by any other name, designation or title, peculiarly used for and applied to any particular being or beings by any man or set of men whatsoever; and that no graven image, statue or sculpture, carving, painting, picture, portrait or the likeness of anything shall be admitted within the said messuage, building, land, tenements, hereditament and premises; and that no sacrifice, offering or oblation of any kind or thing shall ever be permitted therein; and that no animal or living creature shall within or on the said messuage, &c., be deprived of life either for religious purposes or food, and that no eating or drinking (except such as shall be necessary by any accident for the preservation of life), feasting or rioting be permitted therein or thereon; and that in conducting the said worship or adoration, no object, animate or inanimate, that has been or is or shall hereafter become or be recognized as an object of worship by any man or set of men, shall be reviled or slightingly or contemptuously spoken of or alluded to, either in preaching or in the hymns or other mode of worship that may be delivered or used in the said messuage or building; and that no sermon, preaching, discourse, prayer or hymns be delivered, made or used in such worship, but such as have a tendency to the contemplation of the Author and Preserver of the universe or to the promotion of charity, morality, piety, benevolence, virtue and the strengthening of the bonds of union between men of all religious persuasions and creeds."

The new faith at this period held to the Vedas as its basis. Ram Mohan Roy soon after left India for England, and took up his residence in Bristol, where he died in 1835. The Brahma Samaj maintained a bare existence till 1841, when Babu Debendra Nath Tagore, a member of a famous and wealthy Calcutta family, devoted himself to it. He gave a printing-press to the Samaj, and established a monthly journal called the *Tattwabodhinī Patrikā*, to which the Bengali language now owes much for its strength and elegance. About 1850 some of the followers of the new religion discovered that the greater part of the Vedas is polytheistic, and a schism took place,—the advanced party holding that nature and intuition form the basis of faith. Between 1847 and 1858 branch societies were formed in different parts of India, especially in Bengal, and the new society made rapid progress, for which it was largely indebted to the spread of English education and the work of Christian missionaries. In fact the whole Samaj movement is as distinct a product of the contest of Hinduism with Christianity in the 19th century, as the *Panth* movement was of its contest with Islam 300 years earlier.

The Brahma creed was definitively formulated as follows:—(1) The book of nature and intuition supplies the basis of religious faith. (2) Although the Brahmas do not consider any book written by man the basis of their religion, yet they do accept with respect and pleasure any religious *truth* contained in any book. (3) The Brahmas believe that the religious condition of man is progressive, like the other departments of his condition in this world. (4) They believe that the fundamental doctrines of their religion are also the basis of every true religion. (5) They believe in the existence of one Supreme God—a God endowed with a distinct personality, moral attributes worthy of His nature and an intelligence befitting the Governor of the universe, and they worship Him alone. They do not believe in any of His incarnations. (6) They believe in the immortality and progressive state of the soul, and declare that there is a state of conscious existence succeeding life in this world and supplementary to it as respects the action of the universal moral government. (7) They believe that repentance is the only way to salvation. They do not recognize any other mode of reconcilement to the offended but loving Father. (8) They pray for *spiritual* welfare and believe in the *efficacy* of such prayers. (9) They believe in the

providential care of the divine Father. (10) They avow that love towards Him and the performances of the works which He loves, constitute His worship. (11) They recognize the necessity of public worship, but do not believe that communion with the Father depends upon meeting in any fixed place at any fixed time. They maintain that they can adore Him at any time and at any place, provided that the time and the place are calculated to compose and direct the mind towards Him. (12) They do not believe in pilgrimages and declare that holiness can only be attained by elevating and purifying the mind. (13) They put no faith in rites or ceremonies, nor do they believe in penances as instrumental in obtaining the grace of God. They declare that moral righteousness, the gaining of wisdom, divine contemplation, charity and the cultivation of devotional feelings are their rites and ceremonies. They further say, govern and regulate your feelings, discharge your duties to God and to man, and you will gain everlasting blessedness; purify your heart, cultivate devotional feelings and you will see Him who is unseen. (14) Theoretically there is no distinction of caste among the Brahmas. They declare that we are all the children of God, and therefore must consider ourselves as brothers and sisters.



For long the Brahmas did not attempt any social reforms. But about 1865 the younger section, headed by Babu Keshub Chunder Sen, who joined the Samaj in 1857, tried to carry their religious theories into practice by demanding the abandonment of the external signs of caste distinction. This, however, the older members opposed, declaring such innovations to be premature. A schism resulted, Keshub Chunder Sen and his followers founding the Progressive Samaj, while the conservative stock remained as the Adi (*i.e.* original) Samaj, their aim being to "fulfil" rather than to abrogate the old religion. The vitality of the movement, however, had left it, and its inconsistencies, combined with the lack of strong leadership, landed it in a position scarcely distinguishable from orthodox Hinduism. Debendra Nath Tagore sought refuge from the difficulty by becoming an ascetic. The "Brahma Samaj of India," as Chunder Sen's party styled itself, made considerable progress extensively and intensively until 1878, when a number of the most prominent adherents, led by Anand Mohan Bose, took umbrage at Chunder Sen's despotic rule and at his disregard of the society's regulations concerning child marriage. This led to the formation of the Sadharana (Universal) Brahma Samaj, now the most popular and progressive of the three sections of the movement and conspicuous for its work in the cause of literary culture, social reform and female education in India. But even when we add all sections of the Brahma Samaj together, the total number of adherents is only about 4000, mostly found in Calcutta and its neighbourhood. A small community (about 130) in Bombay, known as the Prarthna (Prayer) Samaj, was founded in 1867 through Keshub Chunder's influence; they have a similar creed to that of the Brahma Samaj, but have broken less decisively with orthodox and ceremonial Hinduism.

See the articles on ARYA, SAMAJ, KESHUB CHUNDER SEN, RAM MOHAN ROY. Also John Robson, *Hinduism and Christianity*; and the *Theistic Quarterly Review* (the organ of the Society since 1880).

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**BRAHMS, JOHANNES** (1833-1897), German composer, was born in Hamburg on the 7th of May 1833. He was the son of a double-bass player in the Hamburg city theatre and received his first musical instruction from his father. After some lessons from O. Cossel, he went to Cossel's master, Eduard Marxsen of Altona, whose experience and artistic taste directed the young man's genius into the highest paths. A couple of public appearances as a pianist were hardly an interruption to the course of his musical studies, and these were continued nearly up to the time when Brahms accepted an engagement as accompanist to the Hungarian violinist, Remenyi, for a concert tour in 1853. At Göttingen there occurred a famous *contretemps* which had a most important though indirect influence on the whole after-life of the young player. A piano on which he was to play the "Kreutzer" sonata of Beethoven with Remenyi turned out to be a semitone below the required pitch; and Brahms played the part by heart, transposing it from A to B flat, in such a way that the great violinist, Joachim, who was present and discerned what the feat implied, introduced himself to Brahms, and laid the foundation of a life-long friendship. Joachim gave him introductions to Liszt at Weimar and to Schumann at Düsseldorf; the former hailed him for a time as a member of the advanced party in music, on the strength of his E flat minor scherzo, but the misapprehension was not of long continuance. The introduction to Schumann impelled that master, now drawing near the tragic close of his career, to write the famous article "Neue Bahnen," in which the young Brahms was proclaimed to be the great composer of the future, "he who was to come." The critical insight in Schumann's article is all the more surprising when it is remembered how small was the list of Brahms's works at the time. A string quartet, the first pianoforte sonata, the scherzo already mentioned, and the earliest group of songs, containing the dramatic "Liebestreu," are the works which drew forth the warm commendations of Schumann. In December 1853 Brahms gave a concert at Leipzig, as a result of which the firms

of Breitkopf & Haertel and of Senff undertook to publish his compositions. In 1854 he was given the post of choir-director and music-master to the prince of Lippe-Detmold, but he resigned it after a few years, going first to Hamburg, and then to Zürich, where he enjoyed the friendship and artistic counsel of Theodor Kirchner. The unfavourable verdict of the Leipzig Gewandhaus audience upon his pianoforte concerto in D minor op. 15, and several remarkably successful appearances in Vienna, where he was appointed director of Ihe Singakademie in 1863, were the most important external events of Brahms's life, but again he gave up the conductorship after a few months of valuable work, and for about three years had no fixed place of abode. Concert tours with Joachim or Stockhausen were undertaken, and it was not until 1867 that he returned to Vienna, or till 1872 that he chose it definitely as his home, his longest absence from the Austrian capital being between 1874 and 1878, when he lived near Heidelberg. From 1871 to 1874 he conducted the concerts of the "Gesellschaft der Musikfreunde," but after the later date he occupied no official position of any kind. With the exception of journeys to Italy in the spring, or to Switzerland in the summer, he rarely left Vienna. He refused to come to England to take the honorary degree of Mus.D. offered by the university of Cambridge; the university of Breslau made him Ph.D. in 1881; in 1886 he was created a knight of the Prussian order *Pour le mérite*, and in 1889 was presented with the freedom of his native city. He died in Vienna on the 3rd of April 1897.

The works of Brahms may be summarized as follows:—Various *sacred compositions for chorus*, op. 12, 13, 22, 27, 29, 30, 37, leading up to op. 45, the "German Requiem" first performed at Bremen in 1868, and subsequently completed by a soprano solo with chorus; the "Triumphlied" in commemoration of the German victories of 1870-71; and some choral songs and motets, op. 74, 109 and 110. *Secular choral works*, op. 17, 41, 42, 44, 50 ("Rinaldo" for tenor solo and male choir), 53 ("Rhapsodie," alto solo and male choir), 54 ("Schicksalslied"), 62, 82 (Schiller's Nänie), 89 ("Gesang der Parzen"), 93, 104, 113. *Concerted vocal-works*, op. 20, 28, 31, 52 ("Liebeslieder-Walzer"), 61, 64, 65 ("Neue Liebeslieder"), 75, 92, 103, 112. *Solo songs*, nearly 300. *Orchestral works*: four symphonies, op. 68, 73, 90 and 98; two serenades, op. 11 and 16; two pianoforte concertos, op. 15 and 83, one violin concerto, op. 77; concerto for violin and violoncello, op. 102; variations on a theme by Haydn, op. 56; two overtures, "Academische Festouvertüre," op. 80, and "Tragic Overture," op. 81. *Chamber music*: two sextets, op. 18 and 36; quintet, piano and strings, op. 34, strings, op. 88 and 111, clarinet and strings, op. 115; three string quartets, op. 51 and 67, three quartets for piano and strings, op. 25, 26 and 60. Three trios for piano and strings, op. 8, 87 and 101; trio for piano, violin and horn, op. 40; piano, clarinet and violoncello, op. 114. Duet sonatas, three for piano and violin, op. 78, 100 and 108; two for piano and violoncello, op. 38 and 99; two for piano and clarinet, op. 120. *Pianoforte solos*: three sonatas, op. 1, 2 and 5; scherzo, op. 4; variations, op. 9, 21, 23, 24, 35; 4 ballads, op. 10; waltzes, op. 39; two rhapsodies, op. 79; caprices and intermezzi, op. 76, 116, 117, 118 and 119. 5 *studies* and 51 *Uebungen* without opus-number, and a *chorale-prelude and fugue* for organ, besides four books of *Hungarian Dances* arranged for pianoforte duet.

Brahms has often been called the last of the great classical masters, in a sense wider than that of his place in the long line of the great composers of Germany. Though only the most superficial observers could deny him the possession of qualities which distinguish the masters of the romantic school, it is as a classicist that he must be ranked among modern musicians. From the beginning of his career until its close, his ideas were clothed by preference in the forms which had sufficed for Beethoven, and the instances in which he departed from structural precedent are so rare that they might be disregarded, were they not of such high value that they must be considered as the signs of a logical development of musical form, and not as indicating a spirit of rebellion against existing modes of structure. His practice, more frequent in later than in earlier life, of welding together the "working-out" and the "recapitulation" sections of his movements in a closer union than any of his predecessors had attempted, is an innovation which cannot fail to have important results in the future; and if the skill of younger writers is not adequate to such a display of ingenuity as occurs in the finale of the fourth symphony, where the "passacaglia" form has been used with an effect that is almost bewildering to the ordinary listener, that at least stands as a monument of inventiveness finely subordinated to the emotional and intellectual purport of the thoughts expressed. His themes are always noble, and even from the point of view of emotional appeal their deep intensity of expression is of a kind which grows upon all who have once been awakened to their beauty, or have been at the pains to grasp the composer's characteristics of utterance. His vocal music, whether for one voice or many, is remarkable for its fidelity to natural inflection and accentuation of the words, and for its perfect reflection of the poet's mood. His songs, vocal quartets and choral works abound in passages that prove him a master of effects of sound; and throughout his chamber music, in his treatment of the piano, of the strings, or of the solo wind instruments he employs, there are numberless examples which sufficiently show the irrelevance of a charge sometimes brought against his music, that it is deficient in a sense of what is called "tone-colour." It is perfectly true that the mere acoustic effect of a passage was of far less importance to him than its inherent beauty, poetic import, or logical fitness in a definite scheme of development; and that often in his orchestral music the casual hearer receives an impression of complexity rather than of clearness, and is apt to imagine

that the “thickness” of instrumentation is the result of clumsiness or carelessness. Such instances as the introduction to the finale of the first symphony, the close of the first movement of the second, what may be called the epilogue of the third, or the whole of the variations on a theme of Haydn, are not only marvels of delicate workmanship in regard to structure, but are instinct with the sense of the peculiar beauty and characteristics of each instrument. The “Academic Festival” overture proves Brahms a master of musical humour, in his treatment of the student songs which serve as its themes; and the companion piece, the “Tragic” overture, reaches a height of sublimity which is in no way lessened because no particular tragedy has ever been named in conjunction with the work.

As with all creative artists of supreme rank, the work of Brahms took a considerable time before it was very generally appreciated. The change in public opinion is strikingly illustrated in regard to the songs, which, once voted ineffective and unvocal, have now taken a place in every eminent singer’s repertory. The outline in his greater works must be grasped with some definiteness before the separate ideas can be properly understood in their true relation to each other; and while it is his wonderful power of handling the recognized classical forms, so as to make them seem absolutely new, which stamps him as the greatest musical architect since Beethoven, the necessity for realizing in some degree what musical form signifies has undoubtedly been a bar to the rapid acceptance of his greater works by the uneducated lovers of music. These are of course far more easily moved by effects of colour than by the subtler beauties of organic structure, and Brahms’s attitude towards tone-colour was scarcely such as would endear him to the large number of musicians in whose view tone-colour is pre-eminent. His mastery of form, again, has been attacked as formalism by superficial critics, blind to the real inspiration and distinction of his ideas, and to their perfection in regard to style and the appropriateness of every theme to the exact emotional state to be expressed. In his larger vocal works there are some which treat of emotional conditions far removed from the usual stock of subjects taken by the average composer; to compare the ideas in the “German Requiem” with those of the “Schicksalslied” or “Nänie” is to learn a lesson in artistic style which can never be forgotten. In the songs, too, it is scarcely too much to say that the whole range of human emotion finds expression in noble lyrics that yield to none in actual musical beauty. The four “Ernste Gesänge,” Brahms’s last composition, must be considered as his supreme achievement in dignified utterance of noble thoughts in a style that perfectly fits them. The choice of words for these as well as for the “Requiem” and others of his serious works reveals a strong sense of the vanity and emptiness of human life, but at least as strong a confidence in the divine consolations.

It has been the misfortune of the musical world in Germany that every prominent musician is ranged by critics and amateurs in one of two hostile camps, and it was probably due in the main to the misrepresentations of the followers of Wagner that the idea was so generally held that Brahms was a man of narrow sympathies and hard, not to say brutal manners. The latter impression was fostered, no doubt, by the master’s natural detestation of the methods by which the average lionizer seeks to gain his object, and both alike are disproved in the *Recollections* of J.V. Widmann, an intimate friend for many years, which throw a new light on the master, revealing him as a man of the widest artistic sympathies, neither intolerant of excellence in a line opposed to his own, nor weakly enthusiastic over mediocre productions by composers whose views were in complete sympathy with him. His admiration for Verdi and Wagner is enough to show that the absence of any operatic work from his list of compositions was simply due to the difficulty of finding a libretto which appealed to him, not to any antagonism to the lyric stage in its modern developments. How far he stood from the prejudices of the typical pedant may be seen in the passionate love he showed throughout his life for national music, especially that of Hungary. Not only were his arrangements of Hungarian dances the first work by which his name was known outside his native land, but his first pianoforte quartet, op. 25 in G minor, incurred the wrath of the critics of the time by its introduction of some characteristics of Hungarian music into the finale. His arrangement of a number of children’s traditional songs was published without his name, and dedicated to the children of Robert and Clara Schumann in the earliest years of his creative life; and among the last of his publications was a collection of forty-nine German Volkslieder, arranged with the utmost skill, taste and simplicity. He had a great admiration for the waltzes of Strauss, and in many passages of his own works the *entrain* that is characteristic of the Viennese dance-writers is present in a striking degree.

See also W.H. Hadow, *Studies in Modern Music* (2nd series, 1908); and the articles MUSIC, SONG.

(J. A. F. M.)

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**BRAHUI,** a people of Baluchistan, inhabiting the Brahui mountains, which extend continuously from near the Bolan Pass to Cape Monze on the Arabian Sea. The khan of Kalat, the native ruler

of Baluchistan, is himself a Brahui, and a lineal descendant of Kumbar, former chief of the Kumbarini, a Brahui tribe. The origin of the Brahuis is an ethnological mystery. Bishop Robert Caldwell and other authorities declare them Dravidians, and regard them as the western borderers of Dravidian India. Others believe them to be Scythians,[1] and others again connect them with Tatar mountaineers who early settled in southern parts of Asia. The origin of the word itself is in doubt. It is variously derived as a corruption of the Persian *Ba Rohi* (literally "of the hills"); as an eponym from Braho, otherwise Brahin or Ibrahim, a legendary hero of alleged Arab descent who led his people "out of the west," while Dr Gustav Oppert believes that the name is in some way related to, if not identical with, that of the Baluchis. He recognizes in the name of the Paratas and Paradas, who dwelt in north-eastern Baluchistan, the origin of the modern Brahui. He gives reasons for regarding the *Bra* as a contraction of Bara and obtains "thus in Barahui a name whose resemblance to that of the ancient Barrhai (the modern Bhars), as well as to that of the Paratas and Paravar and their kindred the Maratha Paravari and Dravidian Parheyas of Palaman, is striking." The Brahuis declare themselves to be the aborigines of the country they now occupy, their ancestors coming from Aleppo. For this there seems little foundation, and their language, which has no affinities with Persian, Pushtu or Baluchi, must be, according to the most eminent scholars, classed among the Dravidian tongues of southern India. Probably the Brahuis are of Dravidian stock, a branch long isolated from their kindred and much Arabized, and thus exhibiting a marked hybridism.



Whatever their origin, the Brahuis are found in a position of considerable power in Baluchistan from earliest times. Their authentic history begins with Mir Ahmad, who was their chief in the 17th century. The title of "khan" was assumed by Nasir the Great in the middle of the 18th century. The Brahuis are a confederacy of tribes possessing common lands and uniting from time to time for purposes of offence or defence. At their head is the khan, who formerly seems to have been regarded as semi-divine, it being customary for the tribesmen on visiting Kalat to make offerings at the Ahmadzai gate before entering. The Brahuis are a nomadic race, who dwell in tents made of goats' hair, black or striped, and live chiefly on the products of their herds. They are Sunnite Mahommedans, but are not fanatical. In physique they are very easily distinguished from their neighbours, the Baluchis and Pathans, being a smaller, sturdier people with rounder faces characterized by the flat, blunt and coarse features of the Dravidian races. They are of a dark brown colour, their hair and beards being often brown not black. They are an active, hardy race, and though as avaricious as the Pathans, are more trustworthy and less turbulent. Their ordinary dress is a tunic or shirt, trousers gathered in at the ankles and a cloak usually of brown felt. A few wear turbans, but generally their headgear is a round skullcap with tassel or button. Their women are not strictly veiled. Sandals of deer or goat skin are worn by all classes. Their weapons are rifles, swords and shields. They do not use the Afghan knife or any spears. Some few Brahuis are enlisted in the Bombay Native Infantry.

See Dr Bellew, *Indus to Euphrates* (London, 1874); Gustav Oppert, *The Original Inhabitants of India* (1893); Dr Theodore Duka, *Essay on the Brahui Grammar* (after the German of Dr Trumpp of Munich University).

1 Compare Mountstuart Elphinstone's (*History of India*, 9th ed., 1905, p. 249) description of Scythians with physique of Brahuis. A relationship between the Jats (*q.v.*) and the Brahuis has been suggested, and it is generally held that the former were of Scythic stock. The Mengals, Bizanjos and Zehris, the three largest Brahui tribes, are called Jadgal or Jagdal, *i.e.* Jats, by some of their neighbours. The Zaghar Mengal, a superior division of the Mengal tribe, believe they themselves came from a district called Zughd, somewhere near Samarkand in central Asia. *Gal* appears to be a collective suffix in Baluchi, and *Men* or *Min* occurs on the lists of the Behistun inscriptions as the name of one of the Scythian tribes deported by Darius, the Achaemenian, for their turbulence (see *Kalat, A Memoir on the County and Family of the Ahmadzai Khans of Kalat*, by G.P. Tate). Sajdi, another Brahui tribal name, is Scythian, the principal clan of which tribe is the Saga, both names being identifiable with the Sagetae and Saki of ancient writers. Thus there seems some reason for believing that the former occupants of at least some portions of the Brahui domain were of Scythian blood.

**BRAID** (from the O. Eng. *bregdan*, to move quickly to and fro, hence to weave), a plait, especially a plait of hair, also a plaited tape woven of wool, silk, gold thread, &c., used for trimming or binding. A particular use is for the narrow bands, bordered with open work, used in making point lace.

**BRAIDWOOD, THOMAS** (1715-1806), British teacher of the deaf and dumb, was born in Scotland in 1715, and educated at Edinburgh University. He became a school teacher, and in 1760 opened in Edinburgh, with one pupil, the first school in Great Britain for the deaf and dumb, following the system of Dr John Wallis, described in *Philosophical Transactions* nearly a hundred years before. This school was the model for all of the early English institutions of the kind. Dr Johnson visited it in 1773, and describes it as “a subject of philosophical curiosity ... which no other city has to show,” and Braidwood’s dozen pupils as able “to hear with the eye.” In 1783 Braidwood moved to Hackney, where he died on the 24th of October 1806.

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**BRAILA** (in Rumanian *Braïla*, formerly Ibraila), the capital of the department of Braila, Rumania; situated amid flat and dreary country on the left bank of the river Danube, about 100 m. from its mouth at Sulina. Pop. (1900) 58,392, including 10,811 Jews. Southward, the Danube encircles a vast fen, tenanted only by waterfowl and herds of half-wild swine, while the plain which extends to the north-east and east only grows fertile at some distance inland. Braila itself is plainly built on a bank rising about 50 ft. above sea-level; but partly on a narrow strip of ground which separates this bank from the water’s edge. Along the crest of the bank a public park is laid out, commanding a view of the desolate Dobrudja hills, across the river.

On the landward side, Braila has the shape of a crescent, the curve of its outer streets following the line of the old fortifications, dismantled in 1829. Few houses, among the older quarters, exceed two storeys in height, but the main streets are paved, and there is a regular supply of filtered water. A wide avenue, the *Strada Bulivardului*, divides the town proper from the suburbs. The principal church, among many, is the cathedral of St Michael, a large, ungainly building of grey sandstone. Electric tramways intersect the town, and are continued for 3 m. to Lacul Sărat (Salt Lake), where there are mineral springs and mud-baths, owned by the state. The waters, which contain over 45% of salt, iodine and sulphur, are among the strongest of their kind in Europe; and are of high repute, being annually visited by more than a thousand patients. Braila is the seat of a chamber of commerce. It is the chief port of entry for Walachia, and the headquarters of the grain trade; for, besides its advantageous position on the river, it is connected with the central Walachian railways by a line to Buzeu, and with the Russian and Moldavian systems by a line to Galatz. Quays, where ships drawing 15 ft. of water can discharge, line the river front; and there are large docks, grain elevators and warehouses, besides paper mills, roperies, and soap and candle works. Over 20 steamers, maintained by the state, ply between Braila and Rotterdam. Among the vessels of all nations, the British are first in numbers and tonnage, the Greek second. Grain and timber form the chief articles of export; textiles, machinery, iron goods and coal being most largely imported.

Many events connected with the history of Walachia took place in the neighbourhood of Braila. In 1475 Stephen the Great, having dethroned the voivode Radu, burned the town. In 1573 another Moldavian prince took the city by storm, and massacred the Turkish garrison. In 1659 it was again burned by the Walachian prince Mircea, and for the time the Turks were expelled, but afterwards returned. In the latter part of the 18th century Braila was several times captured by the Russians, and in 1770 it was burned. By the peace of Bucharest (1812) the Turks retained the right of garrisoning Braila. In 1828 it was gallantly defended by Soliman Pasha, who, after holding out from the middle of May until the end of June, was allowed to march out with the honours of war. At the peace of Adrianople (1829) the place was definitely assigned to Walachia; but before giving it up, the grand-duke Michael of Russia razed the citadel, and in this ruinous condition it was handed over to the Walachians. Braila was the spot chosen by the Russian general Gorchakov for crossing the Danube with his division in 1854. On the banks of the Danube, a little above the city, are some remains of the piles of a bridge said by a very doubtful tradition to have been built by Darius (*c.* 500 B.C.).

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**BRAIN** (A.S. *braegen*), that part of the central nervous system which in vertebrate animals is contained within the cranium or skull; it is divided into the great brain or cerebrum, the hind brain or cerebellum, and the medulla oblongata, which is the transitional part between the spinal cord and the other two parts already named. Except where stated, we deal here primarily with the brain in man.

*Membranes of the Human Brain.*

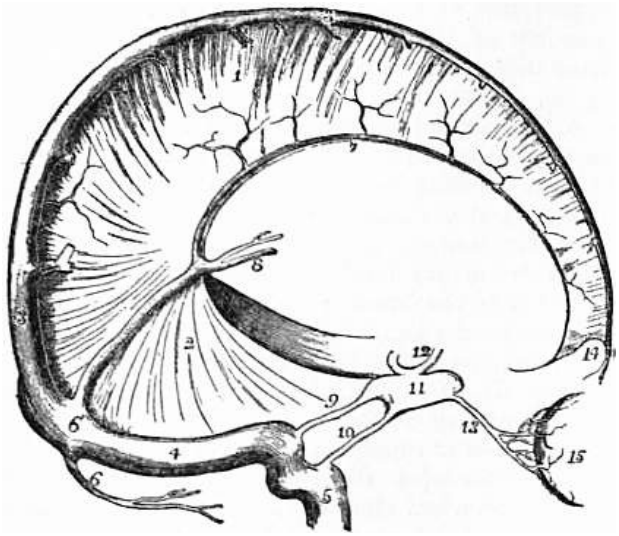


FIG. 1.—Dura Mater and Cranial Sinuses.

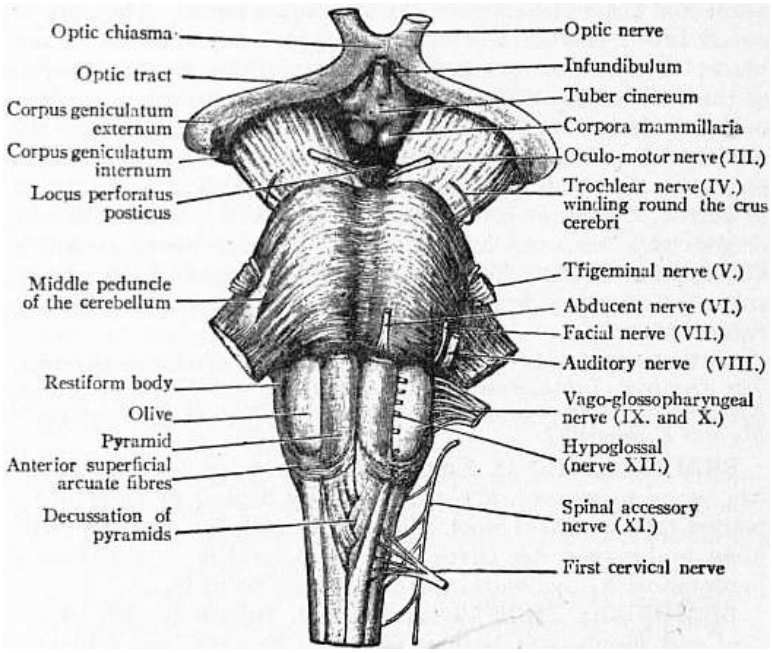
1. Falx cerebri.
2. Tentorium.
3,3. Superior longitudinal sinus.
4. Lateral sinus.
5. Internal jugular vein.
6. Occipital sinus.
6′. Torcular Herophili.
7. Inferior longitudinal sinus.
8. Veins of Galen.
9 and 10. Superior and inferior petrosal sinus.
11. Cavernous sinus.
12. Circular sinus which connects the two cavernous sinuses together.
13. Ophthalmic vein, from 15, the eyeball.
14. Crista galli of ethmoid bone.

Three membranes named the *dura mater, arachnoid* and *pia mater* cover the brain and lie between it and the cranial cavity. The most external of the three is the *dura mater*, which consists of a cranial and a spinal portion. The cranial part is in contact with the inner table of the skull, and is adherent along the lines of the sutures and to the margins of the foramina, which transmit the nerves, more especially to the foramen magnum. It forms, therefore, for these bones an internal periosteum, and the meningeal arteries which ramify in it are the nutrient arteries of the inner table. As the growth of bone is more active in infancy and youth than in the adult, the adhesion between the dura mater and the cranial bones is greater in early life than at maturity. From the inner surface of the dura mater strong bands pass into the cranial cavity, and form partitions between certain of the subdivisions of the brain. A vertical longitudinal mesial band, named, from its sickle shape, *falx cerebri*, dips between the two hemispheres of the cerebrum. A smaller sickle-shaped vertical mesial band, the *falx cerebelli*, attached to the internal occipital crest, passes between the two hemispheres of the cerebellum. A large band arches forward in the horizontal plane of the cavity, from the transverse groove in the occipital bone to the clinoid processes of the sphenoid, and is attached laterally to the upper border of the petrous part of each temporal bone. It separates the cerebrum from the cerebellum, and, as it forms a tent-like covering for the latter, is named *tentorium cerebelli*. Along certain lines the cranial dura mater splits into two layers to form tubular passages for the transmission of venous blood. These passages are named the *venous blood sinuses* of the dura mater, and they are lodged in the grooves on the inner surface of the skull referred to in the description of the cranial bones. Opening into these sinuses are numerous veins which convey from the brain the blood that has been circulating through it; and two of these sinuses, called *cavernous*, which lie at the sides of the body of the sphenoid bone, receive the ophthalmic veins from the eyeballs situated in the orbital cavities. These blood sinuses pass usually from before backwards: a *superior longitudinal* along the upper border of the falx cerebri as far as the internal occipital protuberance; an *inferior longitudinal* along its lower border as far as the tentorium, where it joins the *straight sinus*, which passes back as far as the same protuberance. One or two small *occipital sinuses*, which lie in the falx cerebelli, also pass to join the straight and longitudinal sinuses opposite this protuberance; several currents of blood meet, therefore, at this spot, and as Herophilus supposed that a sort of whirlpool was formed in the blood, the name *torcular Herophili* has been used to express the meeting of these sinuses. From the torcular the blood is drained away by two large sinuses, named *lateral*, which curve forward and downward to the jugular foramina to terminate in the internal jugular veins. In its course each lateral sinus receives two *petrosal* sinuses, which pass

from the cavernous sinus backwards along the upper and lower borders of the petrous part of the temporal bone. The dura mater consists of a tough, fibrous membrane, somewhat flocculent externally, but smooth, glistening, and free on its inner surface. The inner surface has the appearance of a serous membrane, and when examined microscopically is seen to consist of a layer of squamous endothelial cells. Hence the dura mater is sometimes called a fibro-serous membrane. The dura mater is well provided with lymph vessels, which in all probability open by stomata on the free inner surface. Between the dura mater and the subjacent arachnoid membrane is a fine space containing a minute quantity of limpid serum, which moistens the smooth inner surface of the dura and the corresponding smooth outer surface of the arachnoid. It is regarded as equivalent to the cavity of a serous membrane, and is named the *sub-dural space*.

*Arachnoid Mater*.—The arachnoid is a membrane of great delicacy and transparency, which loosely envelops both the brain and spinal cord. It is separated from these organs by the pia mater; but between it and the latter membrane is a distinct space, called *sub-arachnoid*. The sub-arachnoid space is more distinctly marked beneath the spinal than beneath the cerebral parts of the membrane, which forms a looser investment for the cord than for the brain. At the base of the brain, and opposite the fissures between the convolutions of the cerebrum, the interval between the arachnoid and the pia mater can, however, always be seen, for the arachnoid does not, like the pia mater, clothe the sides of the fissures, but passes directly across between the summits of adjacent convolutions. The sub-arachnoid space is subdivided into numerous freely-communicating loculi by bundles of delicate areolar tissue, which bundles are invested, as Key and Retzius have shown, by a layer of squamous endothelium. The space contains a limpid cerebro-spinal fluid, which varies in quantity from 2 drachms to 2 oz., and is most plentiful in the dilatations at the base of the brain known as *cisternae*. It should be clearly understood that there is no communication between the subdural and sub-arachnoid spaces, but that the latter communicates with the ventricles through openings in the roof of the fourth, and in the descending cornua of the lateral ventricles.

When the skull cap is removed, clusters of granular bodies are usually to be seen imbedded in the dura mater on each side of the superior longitudinal sinus; these are named the *Pacchionian bodies*. When traced through the dura mater they are found to spring from the arachnoid. The observations of Luschka and Cleland have proved that villous processes invariably grow from the free surface of that membrane, and that when these villi greatly increase in size they form the bodies in question. Sometimes the Pacchionian bodies greatly hypertrophy, occasioning absorption of the bones of the cranial vault and depressions on the upper surface of the brain.

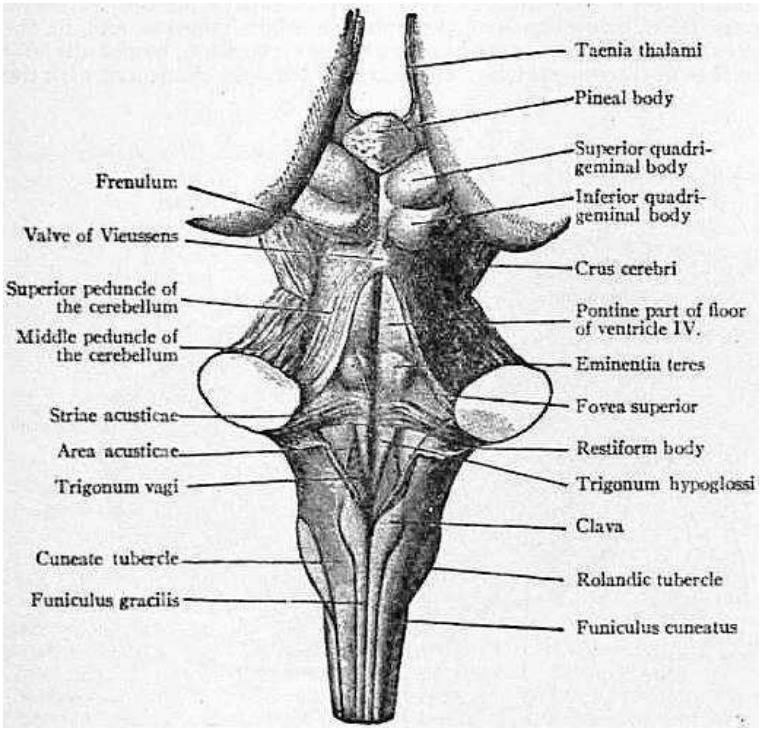



After D.J. Cunningham's *Text-book of Anatomy*.

FIG. 2.—Front View of the Medulla, Pons and Mesencephalon of a full-time Human Foetus.

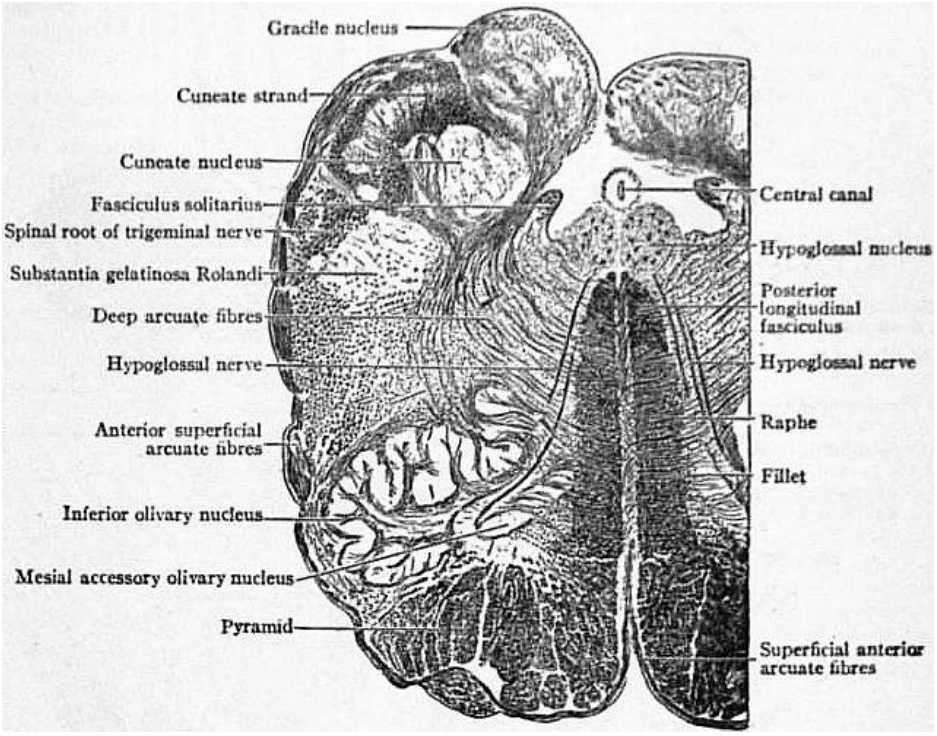
*Pia Mater*.—This membrane closely invests the whole outer surface of the brain. It dips into the fissures between the convolutions, and a wide prolongation, named *velum interpositum*, lies in the interior of the cerebrum. With a little care it can be stripped off the brain without causing injury to its substance. At the base of the brain the pia mater is prolonged on to the roots of the cranial nerves. This membrane consists of a delicate connective tissue, in which the arteries of the brain and spinal cord ramify and subdivide into small branches before they penetrate the nervous substance, and in which the veins conveying the blood from the nerve centres lie before they open into the blood sinuses of the cranial dura mater and the extradural venus plexus of the spinal canal.

The *Medulla Oblongata* rests upon the basi-occipital. It is somewhat pyramidal in form, about 1¼ in. long, and 1 in. broad in its widest part. It is a bilateral organ, and is divided into a right and a left half by shallow anterior and posterior median fissures, continuous with the corresponding fissures in the spinal cord; the posterior fissure ends above in the fourth ventricle. Each half is subdivided into elongated tracts of nervous matter. Next to, and parallel with the anterior fissure is the *anterior pyramid* (see fig. 2). This pyramid is continuous below with the cord, and the place of continuity is marked by the passage across the fissure of three or four bundles of nerve fibres, from each half of the cord to the opposite anterior pyramid; this crossing is called the *decussation of the pyramids*. To the side of the pyramid, and separated from it by a faint fissure, is the *olivary fasciculus*, which at its upper end is elevated into the projecting oval-shaped *olivary body*. Behind the olivary body in the lower half of the medulla are three tracts named from before backward the *funiculus of Rolando*, the *funiculus cuneatus* and the *funiculus gracilis* (see fig. 3). The two *funiculi graciles* of opposite sides are in contact in the mid dorsal line and have between them the *postero median* fissure. When the fourth ventricle is reached they diverge to form the lower limit of that diamond-shaped space and are slightly swollen to form the *clavae*. All these three bundles appear to be continued up into the cerebellum as the restiform bodies or inferior cerebellar peduncles, but really the continuity is very slight, as the restiform bodies are formed from the direct cerebellar tracts of the spinal cord joining with the superficial arcuate fibres which curve back just below the olivary bodies. The upper part of the fourth ventricle is bounded by the superior cerebellar peduncles which meet just before the inferior quadrigeminal bodies are reached. Stretching across between them is the superior medullary velum or valve of Vieussens, forming the upper part of the roof, while the inferior velum forms the lower part, and has an opening called the *foramen* of Majendie, through which the sub-arachnoid space communicates with the ventricle. The floor (see fig. 3) has two triangular depressions on each side of a median furrow; these are the superior and inferior *fovea*, the significance of which will be noticed in the development of the rhombencephalon. Running horizontally across the middle of the floor are the *striae acusticae* which are continued into the auditory nerve. The floor of the fourth ventricle is of special interest because a little way from the surface are the deep origins of all the cranial nerves from the fifth to the twelfth. (See NERVE, *cranial*). If a section is made transversely through the medulla about the apex of the fourth ventricle three important bundles of fibres are cut close to the mid line on each side (see fig. 4). The most anterior is the pyramid or motor tract, the decussation of which has been seen. Behind this is the mesial fillet or sensory tract, which has also decussated a little below the point of section, while farther back still is the posterior longitudinal bundle which is coming up from the anterior basis bundle of the cord. External to and behind the pyramid is the crenated section of the olivary nucleus, the surface bulging of which forms the olivary body.




From Cunningham, *Text-book of Anatomy.*

FIG. 3.—Back View of the Medulla, Pons and Mesencephalon of a full-time Human Foetus.

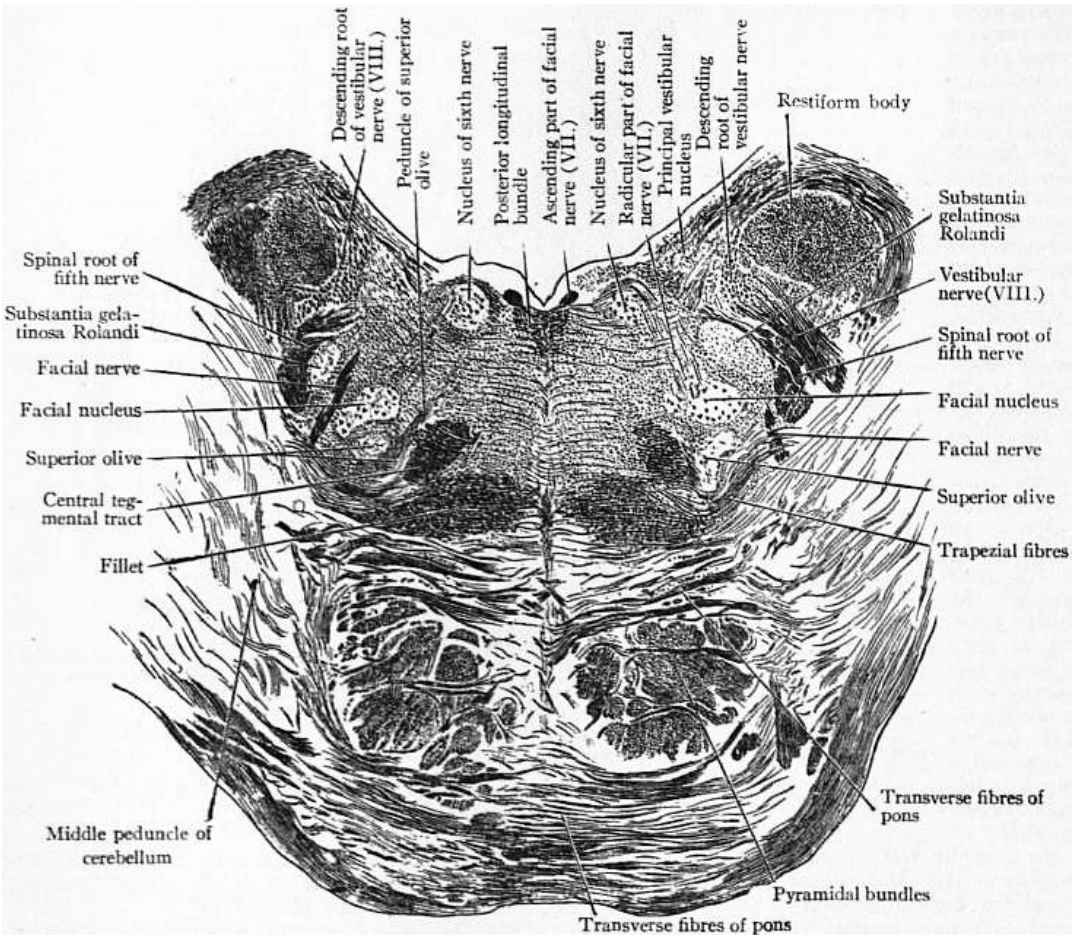



From Cunningham, *Text-book of Anatomy.*

FIG. 4.—Transverse Section through the Human Medulla in the Lower Olivary Region.

The grey matter of the medulla oblongata, which contains numerous multipolar nerve cells, is in part continuous with the grey matter of the spinal cord, and in part consists of independent masses. As the grey matter of the cord enters the medulla it loses its crescentic arrangement. The posterior cornua are thrown outwards towards the surface, lose their pointed form, and dilate into rounded masses named the grey tubercles of Rolando. The grey matter of the anterior cornua is cut off from the rest by the decussating pyramids and finally disappears. The *formatio reticularis* which is feebly developed in the cord becomes well developed in the medulla. In the lower part of the medulla a central canal continuous with that of the cord exists, but when the clavae on the opposite sides of the medulla diverge from each other, the central canal loses its posterior boundary, and dilates into the cavity of the fourth ventricle. The grey matter in the interior of the medulla appears, therefore, on the floor of the ventricle and is continuous with the grey matter near the central canal of the cord. This grey matter forms collections of nerve cells, which are the centres of origin of several cranial nerves. Crossing the anterior surface of the medulla oblongata, immediately below the pons, in the majority of mammals is a transverse arrangement of fibres forming the *trapezium*, which contains a grey nucleus, named by van der Kolk the *superior olive*. In the human brain the trapezium is concealed by the lower transverse fibres of the pons, but when sections are made through it, as L. Clarke pointed out, the grey matter of the superior olive can be seen. These fibres of the *trapezium* come from the cochlear nucleus of the auditory nerve, and run up as the lateral fillet.

The *Pons Varolii* or BRIDGE is cuboidal in form (see fig. 2): its anterior surface rests upon the dorsum sellae of the sphenoid, and is marked by a median longitudinal groove; its inferior surface receives the pyramidal and olivary tracts of the medulla oblongata; at its superior surface are the two crura cerebri; each lateral surface is in relation to a hemisphere of the cerebellum, and a peduncle passes from the pons into the interior of each hemisphere; the posterior surface forms in part the upper portion of the floor of the fourth ventricle, and in part is in contact with the corpora quadrigemina.




From Cunningham, *Text-book of Anatomy*.

FIG. 5.—Section through the Lower Part of the Human Pons Varolli immediately above the Medulla.

The pons consists of white and grey matter: the nerve fibres of the white matter pass through the substance of the pons, in either a transverse or a longitudinal direction. The transverse fibres go from one hemisphere of the cerebellum to that of the opposite side; some are situated on the anterior surface of the pons, and form its superficial transverse fibres, whilst others pass through its substance and form the deep transverse fibres. The longitudinal fibres ascend from the medulla oblongata and leave the pons by emerging from its upper surface as fibres of the two crura cerebri. The pons possesses a median raphe continuous with that of the medulla oblongata, and formed like it by a decussation of fibres in the mesial plane. In a horizontal section through the pons and upper part of the fourth ventricle the superficial transverse fibres are seen most anteriorly; then come the anterior pyramidal fibres, then the deep transverse pontine fibres, then the fillet, while most posteriorly and close to the floor of the fourth ventricle the posterior longitudinal bundle is seen (see fig. 5).

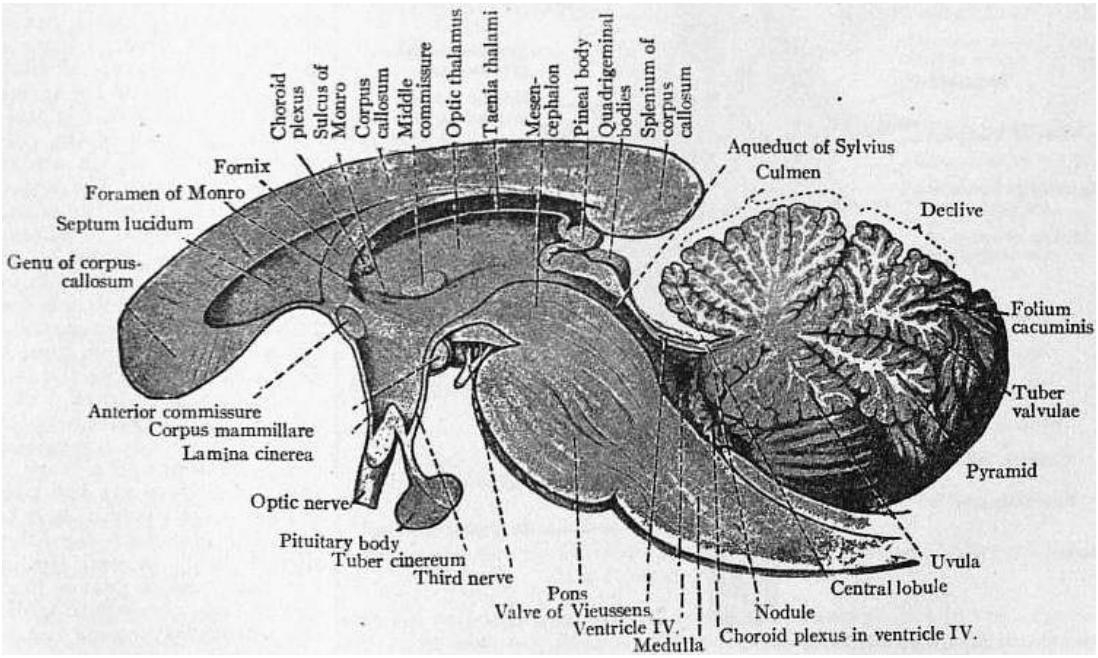


The grey matter of the pons is scattered irregularly through its substance, and appears on its posterior surface; but not on the anterior surface, composed exclusively of the superficial transverse fibres.

### *The Cerebellum.*

The *Cerebellum*, LITTLE BRAIN, or AFTER BRAIN occupies the inferior pair of occipital fossae, and lies below the plane of the tentorium cerebelli. It consists of two hemispheres or lateral lobes, and of a median or central lobe, which in human anatomy is called the vermis. It is connected below with the medulla oblongata by the two restiform bodies which form its *inferior peduncles*, and above with the corpora quadrigemina of the cerebrum by two bands, which form its *superior peduncles*; whilst the two hemispheres are connected together by the transverse fibres of the pons, which form the *middle peduncles* of the cerebellum. On the superior or tentorial surface of the cerebellum the median or vermiform lobe is a mere elevation, but on its inferior or occipital surface this lobe forms a well-defined process, which lies at the bottom of a deep fossa or *vallecula*; this fossa is prolonged to the posterior border of the cerebellum, and forms there a deep notch which separates the two hemispheres from each other; in this notch the falx cerebelli is lodged. Extending horizontally backwards from the middle cerebellar peduncle, along the outer border of each hemisphere is the *great horizontal fissure*, which divides the hemisphere into its tentorial and occipital surfaces. Each of these surfaces is again subdivided by fissures into smaller lobes, of which the most important are the *amygdala* or *tonsil*, which forms the lateral boundary of the anterior part of the vallecula, and the *flocculus*, which is situated immediately behind the middle peduncle of the cerebellum. The inferior vermiform process is subdivided into a

posterior part or *pyramid*; an elevation or *uvula*, situated between the two tonsils; and an anterior pointed process or *nodule*. Stretching between the two flocculi, and attached midway to the sides of the nodule, is a thin, white, semilunar-shaped plate of nervous matter, called the inferior *medullary velum*.



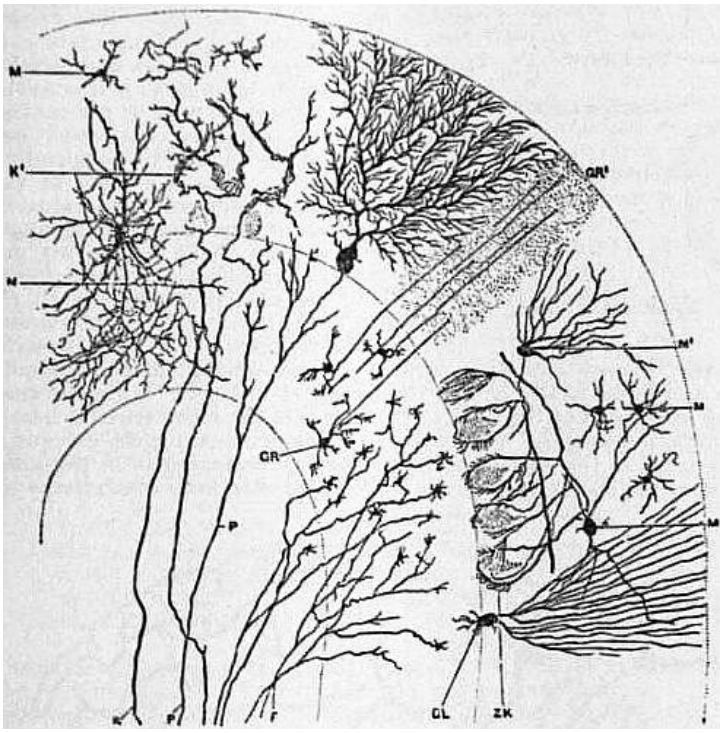

From Cunningham, *Text-book of Anatomy*.

Fig. 6.—Mesial section through the Corpus Callosum, the Mesencephalon, the Pons, Medulla and Cerebellum. Showing the third and fourth ventricles joined by the aqueduct of Sylvius.

The whole outer surface of the cerebellum possesses a characteristic foliated or laminated appearance, due to its subdivision into multitudes of thin plates or lamellae by numerous fissures. The cerebellum consists of both grey and white matter. The grey matter forms the exterior or cortex of the lamellae, and passes from one to the other across the bottoms of the several fissures. The white matter lies in the interior of the organ, and extends into the core of each lamella. When a vertical section is made through the organ, the prolongations of white matter branching off into the interior of the several lamellae give to the section an arborescent appearance, known by the fanciful name of *arbor vitae* (see fig. 6). Independent masses of grey matter are, however, found in the interior of the cerebellum. If the hemisphere be cut through a little to the outer side of the median lobe, a zigzag arrangement of grey matter, similar in appearance and structure to the nucleus of the olivary body in the medulla oblongata, and known as the *corpus dentatum* of the cerebellum, is seen; it lies in the midst of the white core of the hemisphere, and encloses white fibres, which leave the interior of the corpus at its inner and lower side. On the mesial side of this *corpus dentatum* lie three smaller nuclei. The white matter is more abundant in the hemispheres than in the median lobe, and is for the most part directly continuous with the fibres of the peduncles of the cerebellum. Thus the restiform or inferior peduncles pass from below upward through the white core, to end in the grey matter of the tentorial surface of the cerebellum, more especially in that of the central lobe; on their way they are connected with the grey matter of the corpus dentatum. The superior peduncles, which descend from the corpora quadrigemina of the cerebrum, form connexions mainly with the corpus dentatum. The middle peduncles form a large proportion of the white core, and their fibres terminate in the grey matter of the foliated cortex of the hemispheres. It has been noticed that those fibres which are lowest in the pons go to the upper surface of the cerebellum and vice versa.



*Histology of the Cerebellum.*—The white centre of the cerebellum is composed of numbers of medullated nerve fibres coursing to and from the grey matter of the cortex. These fibres are supported in a groundwork of neuroglial tissue, their nutrition being supplied by a small number of blood vessels.




From Cunningham, *Text-book of Anatomy*.

FIG. 7.—Transverse Section through a Cerebellar Folium (after Kölliker). Treated by the Golgi method.

P. Axon of cell of Purkinje.
F. Moss fibres.
K and $K^1$. Fibres from white core of folium ending in molecular layer in connexion with the dendrites of the cells of Purkinje.
M. Small cell of the molecular layer
GR. Granule cell.
$GR^1$. Axons of granule cells in molecular layer cut transversely.
$M^1$. Basket-cells.
ZK. Basket-work around the cells of Purkinje.
GL. Neuroglial cell.
N. Axon of an association cell.

The cortex (see fig. 7) consists of a thin layer of grey material forming an outer coat of somewhat varying thickness over the whole external surface of the laminae of the organ. When examined microscopically it is found to be made up of two layers, an outer “molecular” and an inner “granular” layer. Forming a layer lying at the junction of these two are a number of cells, the *cells of Purkinje*, which constitute the most characteristic feature of the cerebellum. The bodies of these cells are pear-shaped. Their inner ends taper and finally end in a nerve fibre which may be traced into the white centre. In their course through the granule layer they give off a number of branching collaterals, some turning back and passing between the cells of Purkinje into the molecular layer. Their inner ends terminate in one or sometimes two stout processes which repeatedly branch dichotomously, thus forming a very elaborate dendron in the molecular layer. The branchings of this dendron are also highly characteristic in that they are approximately restricted to a single plane like an espalier fruit tree, and those for neighbouring cells are all parallel to one another and at right angles to the general direction of the folium to which they belong. In the molecular layer are found two types of cells. The most abundant are the so-called *basket cells* which are distributed through the whole thickness of the layer. They have a rounded body giving off many branching dendrons to their immediate neighbourhood and one long neuraxon which runs parallel to the surface and to the long axis of the lamina. In its course, this gives off numerous collaterals which run downward to the bodies of Purkinje’s cells. Their terminal branchings together with similar terminals of other collaterals form the basket-work around the bodies of these cells.

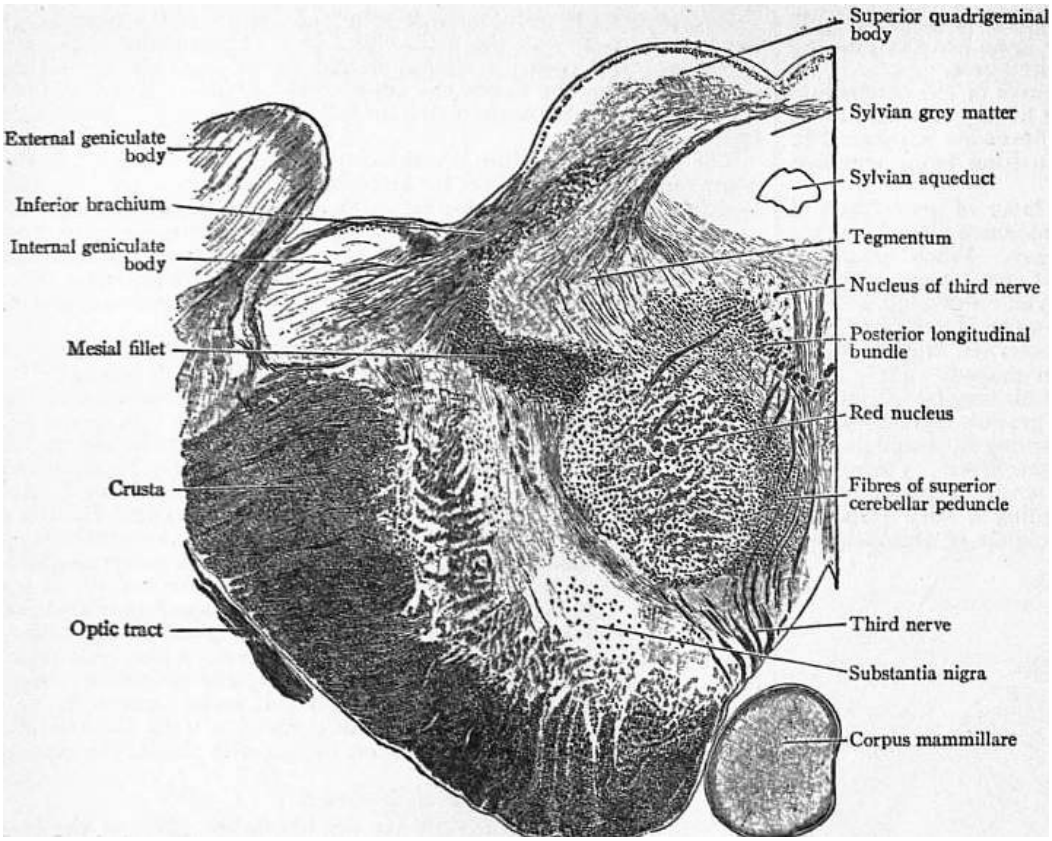
The granular layer is sometimes termed the rust-coloured layer from its appearance to the naked eye. It contains two types of nerve cells, the small granule cells and the large granule cells. The former are the more numerous. They give off a number of short dendrites with claw-like endings, and a fine non-medullated neuraxon process. This runs upward to the cortex, where it divides into two branches in the form of a T. The branches run for some distance parallel to the axis of the folium and terminate in unbranched ends. The large granule cells are multipolar cells, many of the branchings penetrating well into the molecular layer. The neuraxon process turns into the opposite direction and forms a richly branching system through the entire thickness of the granular layer. There is also an abundant plexus of fine medullated fibres within the granule layer.

The fibres of the white central matter are partly centrifugal, the neuraxons of the cells of Purkinje, and partly centripetal. The position of the cells of these latter fibres is not known. The fibres give rise to an abundant plexus of fibrils in the granular layer, and many reaching into the molecular layer ramify there, especially in the immediate neighbourhood of the dendrites of Purkinje's cells. From the appearance of their plexus of fibrils these are sometimes called *moss fibres*.

The *Fourth Ventricle* is the dilated upper end of the central canal of the medulla oblongata. Its shape is like an heraldic lozenge. Its floor is formed by the grey matter of the posterior surfaces of the medulla oblongata and pons, already described (see figs. 3 and 6); its roof partly by the inferior vermis of the cerebellum, the *nodule* of which projects into its cavity, and partly by a thin layer, called *valve of Vieussens*, or superior *medullary velum*; its lower lateral boundaries by the divergent clavae and restiform bodies; its upper lateral boundaries by the superior peduncles of the cerebellum. The *inferior medullary velum*, a reflection of the pia mater and epithelium from the back of the medulla to the inferior vermis, closes it in below. Above, it communicates with the *aqueduct of Sylvius*, which is tunnelled below the substance of the corpora quadrigemina. Along the centre of the floor is the median furrow, which terminates below in a pen-shaped form, the so-called *calamus scriptorius.* Situated on its floor are the fasciculi teretes, striae acusticae, and deposits of grey matter described in connexion with the medulla oblongata. Its epithelial lining is continuous with that of the central canal.

### *The Cerebrum.*

The *Cerebrum* or GREAT BRAIN lies above the plane of the tentorium, and forms much the largest division of the encephalon. It is customary in human anatomy to include under the name of cerebrum, not only the convolutions, the corpora striata, and the optic thalami, developed in the anterior cerebral vesicle, but also the corpora quadrigemina and crura cerebri developed in the mesencephalon or middle cerebral vesicle. The cerebrum is ovoid in shape, and presents superiorly, anteriorly and posteriorly a deep *median longitudinal fissure*, which subdivides it into two hemispheres. Inferiorly there is a continuity of structure between the two hemispheres across the mesial plane, and if the two hemispheres be drawn asunder by opening out the longitudinal fissure, a broad white band, the *corpus callosum*, may be seen at the bottom of the fissure passing across the mesial plane from one hemisphere to the other. The outer surface of each hemisphere is convex, and adapted in shape to the concavity of the inner table of the cranial bones; its inner surface, which bounds the longitudinal fissure, is flat and is separated from the opposite hemisphere by the falx cerebri; its under surface, where it rests on the tentorium, is concave, and is separated by that membrane from the cerebellum and pons. From the front of the pons two strong white bands, the *crura cerebri* or *cerebral peduncles*, pass forward and upward (see fig. 2). Winding round the outer side of each crus is a flat white band, the *optic tract*. These tracts converge in front, and join to form the *optic commissure*, from which the two *optic nerves* arise. The crura cerebri, optic tracts, and optic commissure enclose a lozenge-shaped space, which includes—(*a*) a grey layer, which, from being perforated by several small arteries, is called *locus perforatus posticus*; (*b*) two white mammillae, the *corpora albicantia*; (*c*) a grey nodule, the *tuber cinereum*, from which (*d*) the *infundibulum* projects to join the *pituitary body*. Immediately in front of the optic commissure is a grey layer, the *lamina cinerea* of the third ventricle; and between the optic commissure and the inner end of each Sylvian fissure is a grey spot perforated by small arteries, the *locus perforatus anticus*.




From Cunningham, *Text-book of Anatomy*.

FIG. 8.—Transverse Section through the Human Mesencephalon at the level of the superior Quadrigeminal Body.

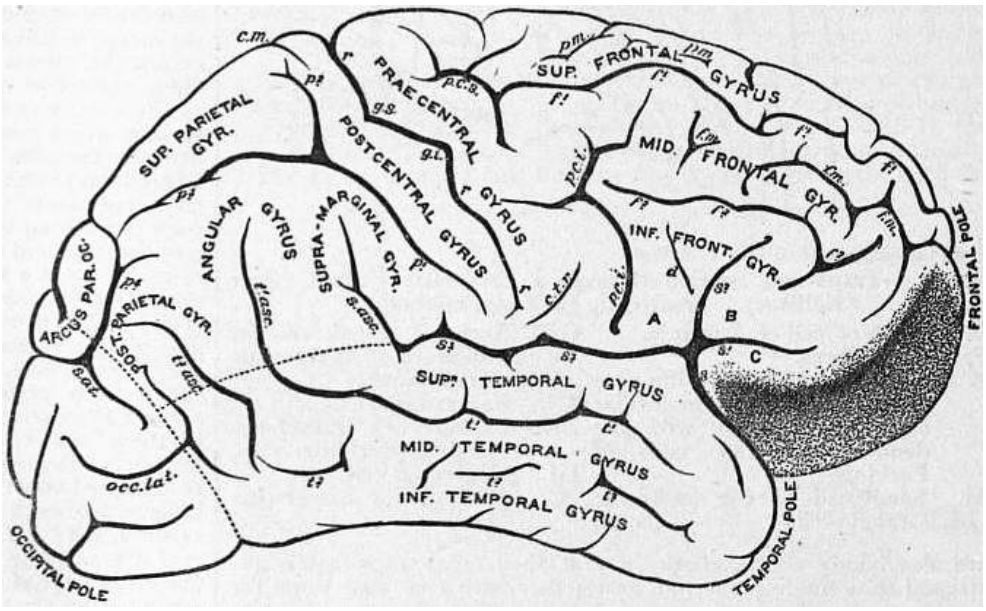
If a transverse section is made at right angles to the surface of the crura cerebri it will pass right through the mesencephalon and come out on the dorsal side through the corpora quadrigemina (see fig. 8). The ventral part of each crus forms the crusta, which is the continuation forward of the anterior pyramidal fibres of the medulla and pons, and is the great motor path from the brain to the cord. Dorsal to this is a layer of pigmented grey matter, called the *substantia nigra*, and dorsal to this again is the tegmentum, which is a continuation upward of the formatio reticularis of the medulla, and passing through it are seen three important nerve bundles. The superior cerebellar peduncle is the most internal of these and decussates with its fellow of the opposite side so that the two tegmenta are continuous across the middle line. More externally the mesial fillet is seen, while dorsal to the cerebellar peduncle is the posterior longitudinal bundle. If the section happens to pass through the superior corpus quadrigeminum a characteristic circular area appears between the cerebellar peduncle and the fillet, which, from its tint, is called the red nucleus. More dorsally still the section will pass through the Sylvian aqueduct or passage from the third to the fourth ventricle, and this is surrounded by a mass of grey matter in the ventral part of which are the nuclei of the third and fourth nerves. The third nerve is seen at the level of the superior corpus quadrigeminum running from its nucleus of origin, through the red nucleus, to a groove on the inner side of the crus called the *oculo-motor* groove, which marks the separation between the crusta and tegmentum. Dorsal to the Sylvian aqueduct is a layer called the *lamina quadrigemina* and on this the corpora quadrigemina rest. The superior pair of these bodies is overlapped by the pineal body and forms part of the lower visual centres. Connexions can be traced to the optic tract, the higher visual centre on the mesial surface of the occipital lobe, the deep origin of the third or oculo-motor nerve as well as to the mesial and lateral fillet. The inferior pair of quadrigeminal bodies are more closely in touch with the organs of hearing, and are connected by the lateral fillet with the cochlear nucleus of the auditory nerve.



*Surface of the Brain*.

The peripheral part of each hemisphere, which consists of grey matter, exhibits a characteristic folded appearance, known as gyri (or convolutions) of the cerebrum. These gyri are separated from each other by *fissures* and *sulci*, some of which are considered to subdivide the hemisphere into lobes, whilst others separate the gyri in each lobe from each other. In each hemisphere of the human brain five lobes are recognized: the temporo-sphenoidal, frontal, parietal, occipital, and the central lobe or Island of Reil; it should, however, be realized that these lobes do not exactly correspond to the outlines of the bones after which they are named. Passing obliquely on the outer face of the hemisphere from before, upward and backward, is the well marked *Sylvian fissure* (fig. 9, *s*), which is the first to appear in the development of the hemisphere. Below it lies the temporo-sphenoidal lobe, and above and in front of it, the parietal and frontal lobes. As soon

as it appears on the external surface of the brain the fissure divides into three limbs, anterior horizontal ($s^1$), ascending ($s^2$), and posterior horizontal ($s^3$), the latter being by far the longest. The place whence these diverge is the Sylvian point and corresponds to the pterion on the surface of the skull (see ANATOMY: *Superficial and Artistic*). Between these three limbs and the vallecula or main stem of the fissure are four triangular tongues or opercula; these are named, according to their position, orbital (fig. 9, C), frontal (pars triangularis) (B), fronto-parietal (pars basilaris) (A) and temporal. The frontal lobe is separated from the parietal by the *fissure of Rolando* (fig. 9, *r*) which extends on the outer face of the hemisphere from the longitudinal fissure obliquely downward and forward towards the Sylvian fissure. About 2 in. from the hinder end of the hemisphere is the *parieto-occipital fissure*, which, commencing at the longitudinal fissure, passes down the inner surface of the hemisphere, and transversely outwards for a short distance on the outer surface of the hemisphere; it separates the parietal and occipital lobes from each other.




From Cunningham, *Text-book of Anatomy*.

FIG. 9.—Gyri and Sulci, on the outer surface of the Cerebral Hemisphere.

$f^1$, Sulcus frontalis superior.
$f^2$, Sulcus frontalis inferior.
*f.m*, Sulcus frontalis medius.
*p.m*, Sulcus paramedialis.
A, Pars basilaris.
B, Pars triangularis.
C, Pars orbitalis.
S, Sylvian fissure.
$s^1$, Anterior horizontal limb (Sylvian fissure).
$s^2$, Ascending limb (Sylvian fissure).
$s^3$. Posterior horizontal limb (Sylvian fissure).
*s.asc*, Ascending terminal part of the posterior horizontal limb of the Sylvianfissure.
*p.c.i*, Inferior praecentral sulcus.
*p.c.s*, Superior praecentral sulcus.
*r*, Fissure of Rolando.
*g.s*, Superior genu.
*g.i*, Inferior genu.
*d*, Sulcus diagonalis.
$t^1$, Superior temporal sulcus (parallel sulcus).
$t^2$, Inferior temporal sulcus.
$p^1$, Inferior postcentral sulcus.
$p^2$, Superior postcentral sulcus.
$p^3$, Ramus horizontalis.
$p^4$, Ramus occipitalis.
*s.o.t*, Sulcus occipitalis transversus.
*occ*. lat, Sulcus occipitalis lateralis (the sulcus lunatus of Elliot Smith).
*c.m*, Calloso-marginal sulcus.
*c.t.r*, Inferior transverse furrow.

The *Temporo-Sphenoidal Lobe* presents on the outer surface of the hemisphere three convolutions, arranged in parallel *tiers* from above downward, and named *superior, middle and inferior temporal* gyri. The fissure which separates the superior and middle of these convolutions is called the *parallel fissure* (fig. 9, $t^1$). The *Occipital Lobe* also consists from above downwards of three parallel gyri, named *superior, middle and inferior occipital*. The *Frontal Lobe* is more complex; immediately in front of the fissure of Rolando, and forming indeed its anterior boundary, is a convolution named *ascending frontal* or pre-central, which ascends obliquely backward and upward from the Sylvian to the longitudinal fissure. Springing from the front of this gyrus, and passing forward

to the anterior end of the cerebrum, are three gyri, arranged in parallel *tiers* from above downwards, and named *superior, middle and inferior frontal* gyri, which are also prolonged on to the orbital face of the frontal lobe. The *Parietal Lobe* is also complex; its most anterior gyrus, named *ascending parietal* or post-central, ascends parallel to and immediately behind the fissure of Rolando. Springing from the upper end of the back of this gyrus is the supra-parietal lobule, which, forming the boundary of the longitudinal fissure, extends as far back as the parieto-occipital fissure; springing from the lower end of the back of this gyrus is the *supra-marginal*, which forms the upper boundary of the hinder part of the Sylvian fissure; as this gyrus occupies the hollow in the parietal bone, which corresponds to the eminence, it may appropriately be named the *gyrus* of the *parietal eminence*. Above and behind the gyrus of the parietal eminence is the *angular gyrus*, which bends round the posterior extremity of the parallel fissure, while arching over the hinder end of the inferior temporo-sphenoidal sulcus is the post-parietal gyrus. Lying in the parietal lobe is the *intra-parietal* fissure (fig. 9, $p^3$ and $p^4$), which separates the gyrus of the parietal eminence from the supra-parietal lobule.

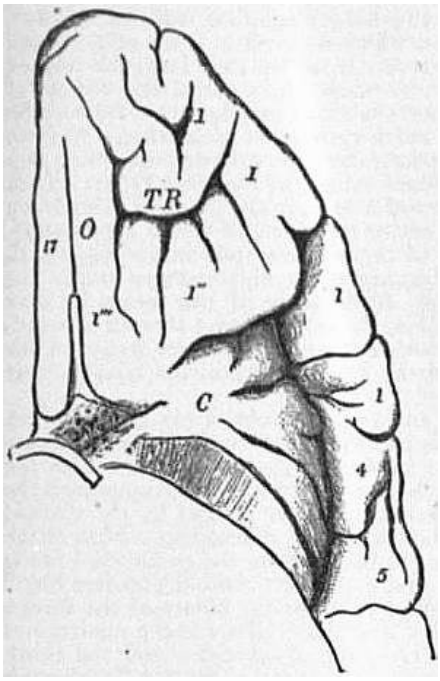



FIG. 10.—Orbital surface of the left frontal lobe and the island of Reil; the tip of the temporo-sphenoidal lobe has been removed to display the latter.

17. Convolution of the margin of the longitudinal fissure.
O. Olfactory fissure, over which the olfactory peduncle and lobe are situated.
TR. Orbital sulcus.
1″ 1‴. Convolutions on the orbital suface.
1,1,1,1. Under surface of infero-frontal convolution.
4. Under surface of ascending frontal; and 5, of ascending parietal convolutions.
C. Central lobe or insula.

The *Central Lobe* of the hemisphere, more usually called the *insula* or *island of Reil*, does not come to the surface of the hemisphere, but lies deeply within the Sylvian fissure, the opercula forming the margin of which, conceal it. It consists of four or five short gyri, which radiate from the *locus perforatus anticus*, situated at the inner end of the fissure. This lobe is almost entirely surrounded by a deep sulcus called the limiting sulcus of Reil, which insulates it from the adjacent gyri. It lies opposite the upper part of the ali-sphenoid, where it articulates with the parietal and squamous-temporal.

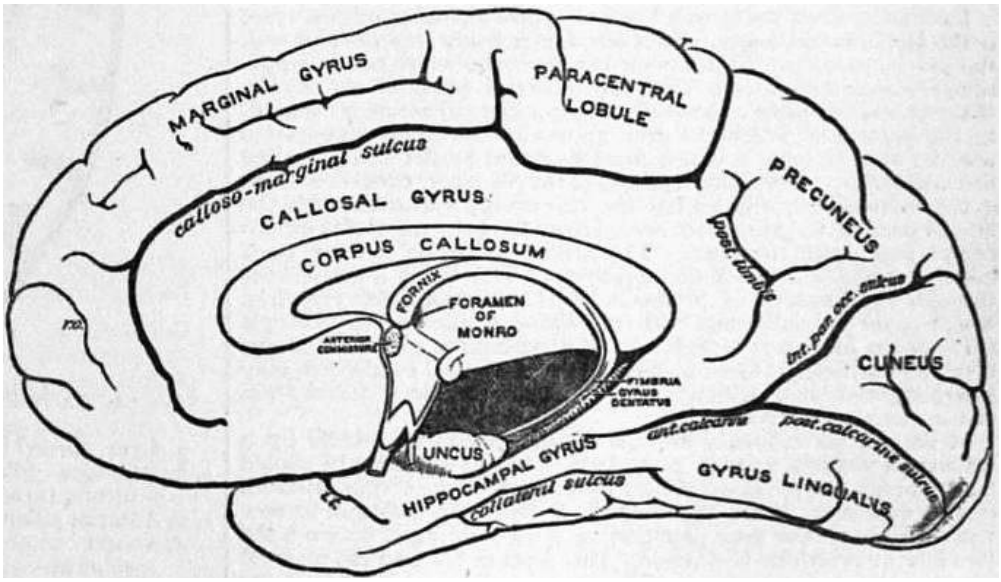
In front of the central lobe, on the base of the brain, are the *orbital gyri*, which are separated from one another by the *orbital sulcus*. This is usually H-shaped, and the gyri are therefore anterior, posterior, external and internal. Bisecting the internal orbital gyrus is an antero-posteripr sulcus (*s. rectus*), beneath which lies the olfactory lobe, bulbous in front, for the olfactory nerves to arise from.

On the mesial surface of the hemisphere, as seen when the brain is longitudinally bisected and the cerebellum and medulla removed by cutting through the crus cerebri (see fig. 11), the divided corpus callosum is the most central object, while below it are seen the fornix, septum lucidum and third ventricle, the description of which will follow. The cerebral surface, above and in front of the corpus callosum, is divided into two by a sulcus, the contour of which closely resembles that of the upper margin of the corpus callosum. This is the *calloso-marginal sulcus*, so called because it separates the callosal gyrus, which lies between it and the corpus callosum, from the marginal gyri nearer the margin of the brain. When the sulcus reaches a point vertically above the hind end of the corpus callosum it turns sharply upward and so forms the hinder limit of the marginal gyri, the posterior inch or two of which is more or less distinctly marked off to form the *paracentral lobule*, where the upper part of the central fissure of Rolando turns over the margin of the brain. The callosal gyrus, which is also called the gyrus fornicatus from its arched appearance, is continued backward round the posterior end of the corpus callosum, and so to the mesial surface of the temporal lobe. Behind the upturned end of the calloso-marginal sulcus there is a square area which is called the *precuneus* or *quadrate lobe*; it is bounded behind by the deeply cut internal parieto-occipital fissure and this runs from the margin of the brain downward and forward to join another fissure, the calcarine, at an acute angle, thus enclosing a wedge-shaped piece of brain called the *cuneus* between them. The *calcarine* fissure is fairly horizontal, and is joined about its middle by the internal parieto-occipital, so that the part in front of the junction is called the *pre-calcarine*, and that behind the *post-calcarine* fissure. The internal parieto-occipital and calcarine are real fissures, because they cause an elevation in the interior of the brain, known as the hippocampus minor. Just in front of the anterior end of the calcarine fissure the callosal gyrus is constricted to form the isthmus which connects it with the hippocampal or uncinate gyrus. Below the calcarine fissure is a gyrus called the *gyrus lingualis*, and this is bounded below

by another true fissure, the *collateral*, which runs parallel to the calcarine, but is continued much farther forward into the temporal lobe and so forms the lower boundary of the hippocampal gyrus. It will thus be seen that the hippocampal gyrus is continuous posteriorly with the callosal gyrus above by means of the isthmus, and with the gyrus lingualis below. The hippocampal gyrus is bounded above by the dentate or hippocampal fissure which causes the hippocampus major in the descending cornu and so is a complete fissure. If its lips are separated the fascia dentata or gyrus dentatus and the fimbria continued from the posterior pillar of the fornix are seen. Anteriorly the fissure is arrested by the recurved process of the upper part of the hippocampal gyrus, called the *uncus*, and in front of this a slight sulcus, the *incisura temporalis*, marks off the temporal pole or tip of the temporal lobe from the region of the uncus. It will be seen that the callosal gyrus, isthmus, and hippocampal gyrus form nearly a complete ring, and to this the name of *limbic lobe* is given.

*Interior of the Cerebrum*.

If a horizontal slice be removed from the upper part of each hemisphere (see fig. 12), the peripheral grey matter of the gyri will be seen to follow their various windings, whilst the core of each gyrus consists of white matter continuous with a mass of white matter in the interior of the hemisphere. If a deeper slice be now made down to the plane of the corpus callosum, the white matter of that structure will be seen to be continuous with the white centre of each hemisphere known as the centrum ovale. The *corpus callosum* does not equal the hemispheres in length, but approaches nearer to their anterior than their posterior ends. It terminates behind in a free rounded end, named the splenium (see fig. 11), whilst in front it forms a knee-shaped bend, and passes downwards and backwards as far as the lamina cinerea. If the dissection be performed on a brain which has been hardened in spirit, the corpus callosum is seen to consist almost entirely of bundles of nerve fibres, passing transversely across the mesial plane between the two hemispheres; these fibres may be traced into the white cores and grey matter of the gyri, and connect the gyri, though by no means always corresponding ones, in the opposite hemispheres. Hence the corpus callosum is a connecting or commissural structure, which brings the gyri of the two hemispheres into anatomical and physiological relation with each other. On the surface of the corpus callosum a few fibres, the *striae longitudinales*, run in the antero-posterior or longitudinal direction (see fig. 12, *b*). Their morphological interest is referred to in the section below on *Comparative Anatomy*. In the sulcus between the corpus callosum and the limbic lobe a narrow band of fibres called the *cingulum* is seen, most of its fibres only run a short distance in it and link together adjacent parts of the brain. If the corpus callosum be now cut through on each side of its mesial line, the large cavity or *lateral ventricle* in each hemisphere will be opened into.




From Cunningham, *Text-The book of Anatomy*.

FIG. 11.—The Gyri and Sulci on the Mesial Aspect of the Cerebral Hemisphere, *r*, Fissure of Rolando. *r*, *o*, Rostral sulcus. *i*, *t*, Incisura temporalis.

The lateral ventricle is subdivided into a *central space* or body, and three bent prolongations or *cornua*; the *anterior cornu* extends forward, outward and downward into the frontal lobe; the *posterior cornu* curves backward, outward and inward into the occipital lobe; the *descending cornu* curves backward, outward, downward, forward and inward, behind and below the optic thalamus into the temporo-sphenoidal lobe. On the floor of the central space may be seen from before backward the grey upper surface of the pear-shaped caudate nucleus of the *corpus striatum* (figs. 12 and 13, *f*), and to its inner and posterior part a small portion of the *optic thalamus*, whilst between the two is the curved flat band, the *taenia semicircularis* (figs. 12 and 13, *g*). Resting on the upper surface of the thalamus is the vascular fringe of the velum

interpositum, named *choroid plexus*, and immediately internal to this fringe is the free edge of the white *posterior pillar of the fornix*. The anterior cornu has the anterior end of the corpus striatum projecting into it. The posterior cornu has an elevation on its floor, the *hippocampus minor* (fig. 12, *n*), and between this cornu and the descending cornu is the elevation called *eminentia collateralis*, formed by the collateral fissure (fig. 12, *o*).

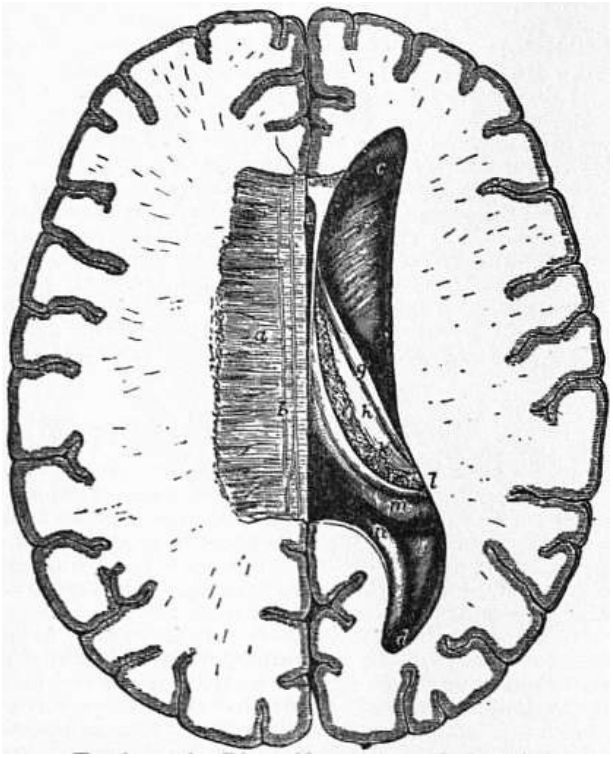



FIG. 12.—To show the Right Ventricle and the left half of the Corpus Callosum.

*a*, Transverse fibres, and
*b*, Longitudinal fibres of corpus callosum.
*c*, Anterior, and
*d*, Posterior cornua of lateral ventricle.
*e*, Septum lucidum.
*f*, Corpus striatum.
*g*, Taenia semicircularis.
*h*, Optic thalamus.
*k*, Choroid plexus.
*l*, Taenia hippocampi.
*m*, Hippocampus major.
*n*, Hippocampus minor.
*o*, Eminentia collateralis.

Extending down the descending cornu and following its curvature is the *hippocampus major*, which terminates below in a nodular end, the *pes hippocampi*; on its inner border is the white *taenia hippocampi*, continuous above with the posterior pillar of the fornix. If the taenia be drawn to one side the hippocampal fissure is exposed, at the bottom of which the grey matter of the gyrus hippocampi may be seen to form a well-defined dentated border (the so-called *fascia dentala*). The choroid plexus of the pia mater turns round the gyrus hippocampi, and enters the descending cornu through the lateral part of the great transverse fissure between the taenia hippocampi and optic thalamus. The lateral ventricle is lined by a ciliated epithelium called the *ependyma.* This lining is continuous through the foramen of Monro with that of the third ventricle, which again is continuous with the lining of the fourth ventricle through the aqueduct of Sylvius. A little fluid is contained in the cerebral ventricles, which, under some pathological conditions, may increase greatly in quantity, so as to occasion considerable dilatation of the ventricular cavities.

If the corpus callosum be now divided about its middle by a transverse incision, and the posterior half of this structure be turned back (see fig. 13), the body of the fornix on which the corpus callosum rests is exposed. If the anterior half of the corpus callosum be now turned forward, the grey partition, or *septum lucidum*, between the two lateral ventricles is exposed. This septum fits into the interval between the under surface of the corpus callosum and the upper surface of the anterior part of the fornix. It consists of two layers of grey matter, between which is a narrow vertical mesial space, the *fifth ventricle* (fig. 13, *e*), and this space does not communicate with the other ventricles nor is it lined with ependyma. If the septum be now removed, the anterior part of the fornix is brought into view.

The *fornix* is an arch-shaped band of nerve fibres extending in the antero-posterior direction. Its anterior end forms the *anterior* pillars of the arch, its posterior end the *posterior pillars*, whilst the intermediate *body* of the fornix forms the crown of the arch. It consists of two lateral halves, one belonging to each hemisphere. At the summit of the arch the two lateral halves are joined to

form the *body*; but in front the two halves separate from each other, and form two anterior pillars, which descend in front of the third ventricle to the base of the cerebrum, where they form the *corpora albicantia*, and from these some white fibres called the bundle of Vicq d'Azyr ascend to the optic thalamus (see fig. 11). Behind the body the two halves diverge much more from each other, and form the posterior pillars, in the triangular interval between which is a thin lamina of commissural fibres called the *lyra* (fig. 13, *a*). Each posterior pillar curves downward and outward into the descending cornu of the ventricle, and, under the name of *taenia hippocampi*, forms the mesial free border of the hippocampus major (fig. 13, *l*). Eventually it ends in the substance of the hippocampus and in the uncus of the temporal lobe. If the body of the fornix be now divided by a transverse incision, its anterior part thrown forward, and its posterior part backward, the great transverse fissure of the cerebrum is opened into, and the velum interpositum lying in that fissure is exposed.

The *velum interpositum* is an expanded fold of pia mater, which passes into the anterior of the hemispheres through the great transverse fissure. It is triangular in shape; its base is a line with the posterior end of the corpus callosum, where it is continuous with the external pia mater; its lateral margins are fringed by the choroid plexuses, which are seen in the bodies and descending cornua of the lateral ventricles, where they are invested by the endothelial lining of those cavities. Its apex, where the two choroid plexuses blend with each other, lies just behind the anterior pillars of the fornix. The interval between the apex and these pillars is the aperture of communication between the two lateral ventricles and the third, already referred to as the foramen of Monro. The choroid plexuses contain the small *choroidal arteries*; and the blood from these is returned by small veins, which join to form the *veins of Galen.* These veins pass along the centre of the velum, and, as is shown in fig. 1, open into the straight sinus. If the velum interpositum be now carefully raised from before backward, the optic thalami, third ventricle, pineal body and corpora quadrigemina are exposed.

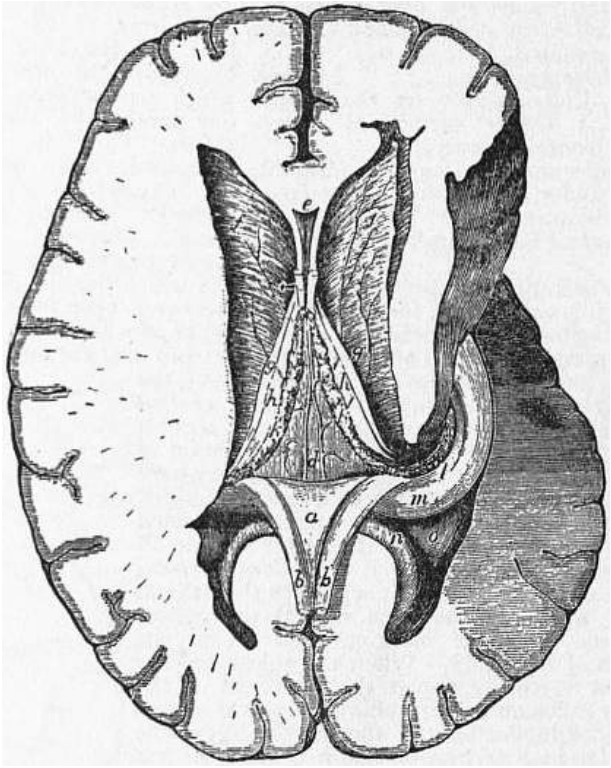



FIG. 13.—A deeper dissection of the Lateral Ventricle, and of the Velum Interpositum.

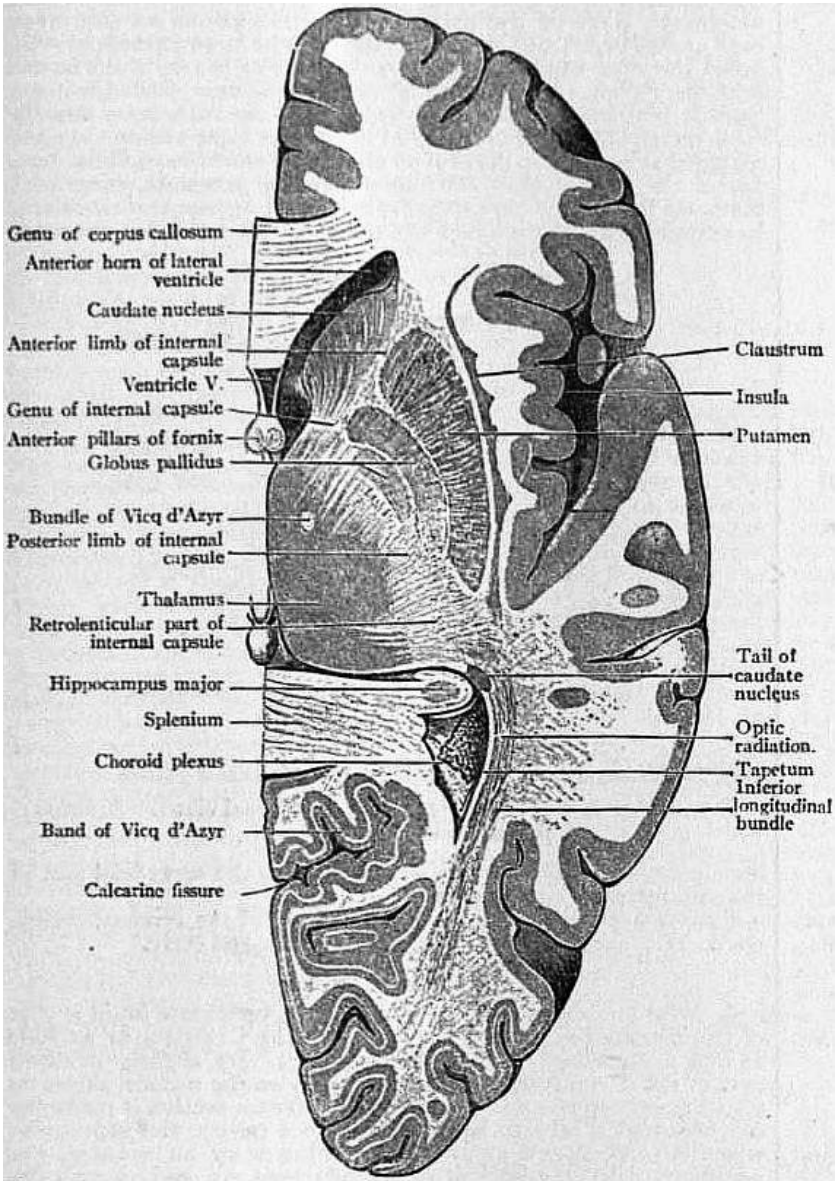
*a*, Lyra, turned back.
*b*, *b*, Posterior pillars of the fornix, turned back.
*c*, *c*, Anterior pillars of the fornix.
*d*, Velum interpositum and veins of Galen.
*e*, Fifth ventricle.
*f*, *f*, Corpus striatum.
*g*, *g*, Taenia semicircularis.
*h*, *h*, Optic thalamus.
*k*, Choroid plexus.
*l*, Taenia hippocampi.
*m*, Hippocampus major in descending cornu.
*n*, Hippocampus minor.
*o*, Eminentia collateralis.

The *optic thalamus* is a large, somewhat ovoid body situated behind the corpus striatum, and above the crus cerebri. Its upper surface is partly seen in the floor of the body of the lateral ventricle, but is for the most part covered by the fornix and velum interpositum. Its postero-inferior surface forms the roof of the descending cornu of the ventricle, whilst its inner surface forms the side wall of the third ventricle. At its outer and posterior part are two slight elevations, in close relation to the optic tract, and named respectively corpus geniculatum internum and

externum.

The posterior knob-like extremity of the thalamus is called the *pulvinar*; this, as well as the two corpora geniculata and the superior corpus quadrigeminum, is connected with the optic tract.

The *third ventricle* (see fig. 6) is a cavity situated in the mesial plane between the two optic thalami. Its roof is formed by the velum interpositum and body of the fornix; its floor by the posterior perforated space, corpora albicantia, tuber cinereum, infundibulum, and optic commissure; its anterior boundary by the anterior pillars of the fornix, anterior commissure and lamina cinerea; its posterior boundary by the corpora quadrigemina and posterior commissure. The cavity of this ventricle is of small size in the living head, for the inner surfaces of the two thalami are connected together by intermediate grey matter, named the *middle* or *soft commissure*. Immediately in front of the corpora quadrigemina, the white fibres of the *posterior commissure* pass across between the two optic thalami. If the anterior pillars of the fornix be separated from each other, the white fibres of the *anterior commissure* may be seen lying in front of them.




From Cunningham, *Text-book of Anatomy*.

FIG. 14.—Horizontal Section through the Right Cerebral Hemisphere at the Level of the Widest Part of the Lenticular Nucleus.

The *pineal body* is a reddish cone-shaped body situated upon the anterior pair of the corpora quadrigemina (see figs. 3 and 6). From its broad anterior end two white bands, the *peduncles* of the *pineal body*, pass forward, one on the inner side of each optic thalamus. Each peduncle joins, along with the taenia semicircularis, the anterior pillar of the fornix of its own side. In its structure this body consists of tubular gland tissue containing gritty calcareous particles, constituting the *brain sand*. Its morphology will be referred to later.

A general idea of the internal structure of the brain is best obtained by studying a horizontal section made just below the level of the Sylvian point and just above the great transverse fissure (see fig. 14). Such a section will cut the corpus callosum anteriorly at the genu and posteriorly at the splenium, but the body is above the plane of section. Behind the genu the fifth ventricle is cut,

and behind that the two pillars of the fornix which here form the anterior boundary of the third ventricle. At the posterior end of this is the pineal body, which the section has just escaped. To the outer side of the fornix is seen the foramen of Munro, leading into the front of the body and anterior horn of the lateral ventricle. It will be seen that the lateral boundary of this horn is the cut caudate nucleus of the corpus striatum, while the lateral boundary of the third ventricle is the cut optic thalamus, both of which bodies have been already described, but external to these is a third triangular grey mass, with its apex directed inward, which cannot be seen except in a section. This is the lenticular nucleus of the corpus striatum, the inner or apical half of which is of a light colour and is called the *globus pallidus*, while the basal half is reader and is known as the *putamen.* External to the putamen is a long narrow strip of grey matter called the *claustrum*, which is sometimes regarded as a third nucleus of the corpus striatum. These masses of grey matter, taken together, are the basal nuclei of the brain. Internal to the lenticular nucleus, and between it and the caudate nucleus in front and the thalamus behind, is the *internal capsule*, through which run most of the fibres connecting the cerebral cortex with the crus cerebri. The capsule adapts itself to the contour of the lenticular nucleus and has an anterior limb, a bend or genu, and a posterior limb. Just behind the genu of the internal capsule is a very important region, for here the great motor tract from the Rolandic region of the cortex passes on its way to the crusta and spinal cord. Besides this there are fibres passing from the cortex to the deep origins of the facial and hypo-glossal nerves. Behind the motor tracts are the sensory, including the fillet, the superior cerebellar peduncle and the inferior quadrigeminal tract, while quite at the back of the capsule are found the auditory and optic radiations linking up the higher (cortical) and lower auditory and visual centres. Between the putamen and the claustrum is the *external capsule*, which is smaller and of less importance than the internal, while on the lateral side of the claustrum is the white and then the grey matter of the central lobe. As the fibres of the internal capsule run up toward the cortex they decussate with the transverse fibres of the corpus callosum and spread out to form the *corona radiata.* It has only been possible to deal with a few of the more important bundles of fibres here, but it should be mentioned that much of the white matter of the brain is formed of association fibres which link up different cortical areas, and which become medullated and functional after birth.

### *Weight of the Brain.*

This has been the subject of a great deal of research, but the results are not altogether conclusive; it seems, however, that, although the male brain is 4 to 5 oz. heavier than that of the female, its relative weight to that of the body is about the same in the two sexes. An average male brain weighs about 48 oz. and a female 43½ oz. The greatest absolute weight is found between twenty-five and thirty-five years of age in the male and a little later in the female. At birth the brain weighs comparatively much more than it does later on, its proportion to the body weight being about 1 to 6. At the tenth year it is about 1 to 14, at the twentieth 1 to 30, and after that about 1 to 36.5. In old age there is a further slight decrease in proportion. In many men of great intellectual eminence the brain weight has been large—Cuvier’s brain weighed 64½ oz., Goodsir’s 57½, for instance—but the exceptions are numerous. Brains over 60 oz. in weight are frequently found in quite undistinguished people, and even in idiots 60 oz. has been recorded. On the other hand, microcephalic idiots may have a brain as low as 10 or even 8½ oz., but it is doubtful whether normal intelligence is possible with a brain weighing less than 32 oz. The taller the individual the greater is his brain weight, but short people have proportionally heavier brains than tall. The weight of the cerebellum is usually one-eighth of that of the entire brain. Attempts have been made to estimate the surface area of the grey matter by dissecting it off and measuring it, and also by covering it with gold leaf and measuring that. The results, however, have not been conclusive.

Further details of the brain, abundantly illustrated, will be found in the later editions of any of the standard text-books on anatomy, references to which will be found in the article on ANATOMY: *Modern Human. Das Menschenhirn*, by G. Retzius (Stockholm, 1896), and numerous recent memoirs by G. Elliot Smith and D.J. Cunningham in the *Journ. Anat. and Phys.* and *Anatomisch Anzeig.*, may be consulted.

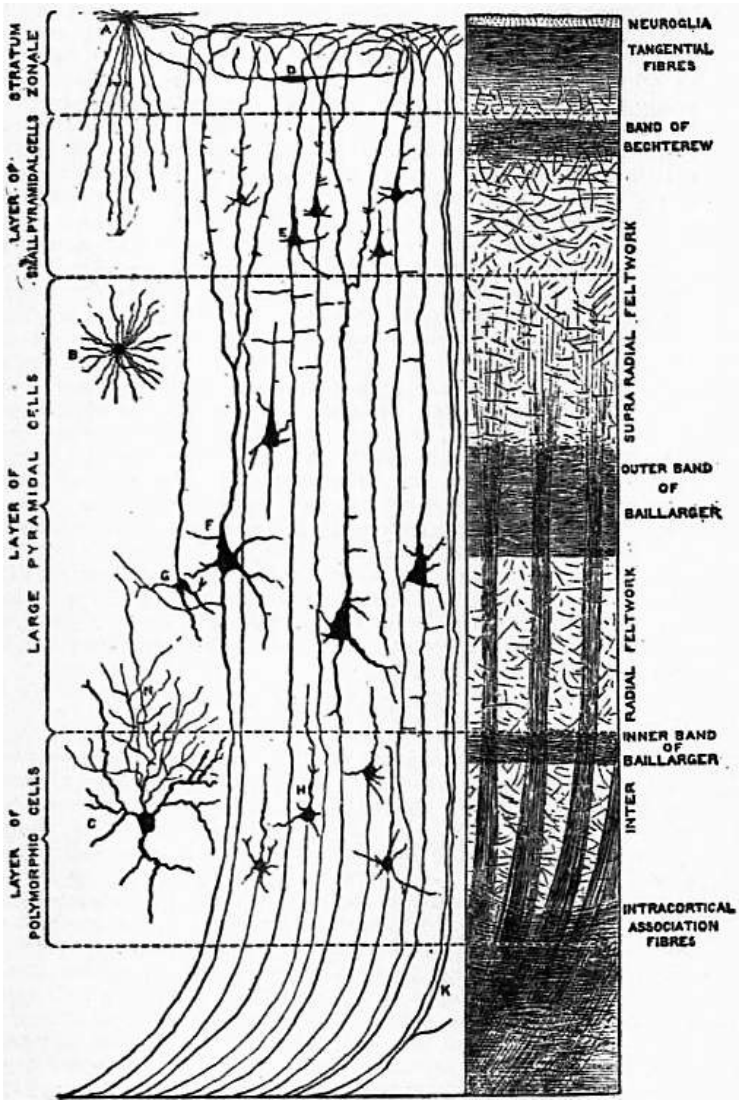
### *Histology of Cerebral Cortex.*

The cerebral cortex (see fig. 15) consists of a continuous sheet of grey matter completely enveloping the white matter of the hemispheres. It varies in thickness in different parts, and becomes thinner in old age, but all parts show a somewhat similar microscopic structure. Thus, in vertical section, the following layers may be made out:—

1. *The Molecular Layer (Stratum zonale).*—This is made up of a large number of fine nerve branchings both medullated and non-medullated. The whole forms a close network, the fibres of which run chiefly a tangential course. The cells of this layer are the so-called *cells of Cajal*. They possess an irregular body, giving off 4 or 5 dendrites, which terminate within the molecular layer and a long nerve fibre process or neuraxon which runs parallel to the surface of the convolution.

2. *The Layer of small Pyramidal Cells.*—The typical cells of this layer are pyramid-shaped, the

apices of the pyramids being directed towards the surface. The apex terminates in a dendron which reaches into the molecular layer, giving off several collateral horizontal branches in its course. The final branches in the molecular layer take a direction parallel to the surface. Smaller dendrites arise from the lateral and basal surfaces of these cells, but do not extend far from the body of the cell. The neuraxon always arises from the base of the cell and passes towards the central white matter, thus forming one of the nerve-fibres of that substance. In its path it gives off a number of collaterals at right angles, which are distributed to the adjacent grey matter.




From Cunningham, *Text-book of Anatomy*.

FIG. 15.—Diagram to illustrate Minute Structure of the Cerebral Cortex.

A. Neuroglia cells.
B. " "
C. Cell with short axon (N) which breaks up in a free arborization.
D. Spindle-shaped cell in stratum zonale.
E. Small pyramidal cell.
F. Large pyramidal cell.
G. Cell of Martinotti.
H. Polymorphic cell.
K. Corticipetal fibres.

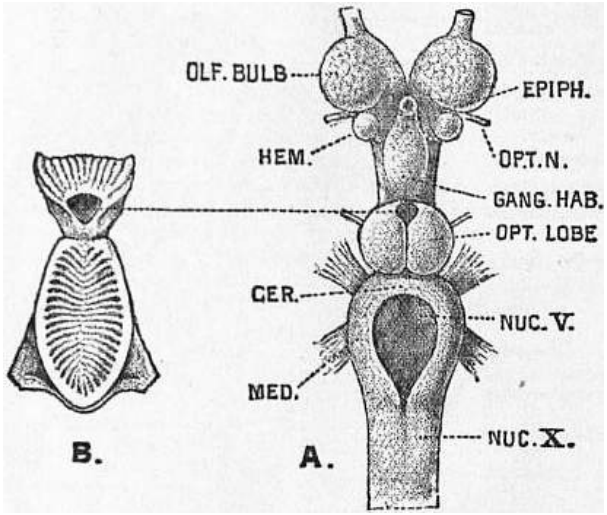
3. *The Layer of large Pyramidal Cells.*—This is characterized by the presence of numbers of cells of the same type as those of the preceding layer, but of larger size. The nerve-fibre process becomes a medullated fibre of the white matter.

4. *The Layer of Polymorphous Cells.*—The cells of this layer are irregular in outline, and give off several dendrites branching into the surrounding grey matter. The neuraxon gives off a number of collaterals, and then becomes a nerve-fibre of the central white matter.

Scattered through these three layers there are also a number of cells (*cells of Golgi*) whose neuraxon divides at once, the divisions terminating within the immediate vicinity of the cell-body. Some cells are also found in which the neuraxon, instead of running into the white matter of the brain, passes toward the surface; these are called *cells of Martinotti*.

The medullated nerve-fibres of the white matter when traced into the cortex are seen to enter in bundles set vertically to the surface. These bundles taper and are resolved into isolated fibres in the upper parts of the pyramidal layers. The fibres constituting the bundles form two sets. (a)

The centrifugal fibres consist as above described of the fibre processes of the pyramidal and polymorphous cells. (b) The centripetal fibres ascend through the cortex to terminate within the molecular layer by horizontally running branches. As they pass through they give off a number of collaterals. The position of the cells from which these fibres arise is not known. In addition to the radially arranged bundles of fibres, networks are formed by the interlacement with them of large numbers of fine medullated fibres running tangentially to the surface. These are derived chiefly from the collaterals of the pyramidal cells and of the centripetal fibres. They form two specially marked bundles, one within the layer of the polymorphous cells known as the *inner band of Baillarger*, and another in the layer of large pyramidal cells called the *outer band of Baillarger*. This latter is very thick in the calcarine region, and forms the *white stria of Gennin*, while the inner band is best seen in the precentral gyrus. As both these strands cross the already mentioned radial bundles at right angles, they are regarded as specialized parts of an *interradial reticulum* of fibres, but, nearer the surface than the radial bundles penetrate, tangential fibres are found, and here they are called the *supraradial reticulum*. In certain parts of the brain the fibres of this reticulum are more closely set, and form the *band of Bechterew* in the superficial part of the small pyramidal cell zone.




From *The Museum Catalogue of the Royal College of Surgeons of England.*

FIG. 16.—Brain of *Petromyzon marinus* (dorsal view). A, Brain; B, choroid plexus removed.

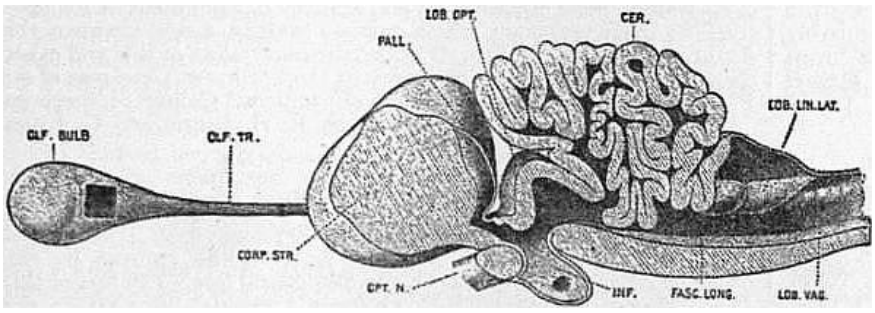
For further information on the structure of the cerebral cortex, see A.W. Campbell, *Proc. R. Soc.* vols. lxxii. and lxxiv.

*Comparative Anatomy.*

A useful introduction to the study of the vertebrate brain is that of the Amphioxus, one of the lowest of the Chordata or animals having a notochord. Here the brain is a very slightly modified part of the dorsal tubular nerve-cord, and, on the surface, shows no distinction from the rest of that cord. When a section is made the central canal is seen to be enlarged into a cavity, the neurocoele, which, in the young animal, communicates by an opening, the neuropore, with the bottom of the olfactory pit, and so with the exterior. More ventrally another slight diverticulum probably represents the infundibulum. The only trace of an eye is a patch of pigment at the anterior end of the brain, and there are no signs of any auditory apparatus. There are only two pairs of cerebral nerves, both of which are sensory (Willey, *Amphioxus*, 1894). In the Cyclostomata, of which the lamprey (Petromyzon) is an example, the minute brain is much more complex, though it is still only a very slight enlargement of the anterior end of the cord. The single cavity seen in Amphioxus is here subdivided into three: an anterior or prosencephalon, a middle or mesencephalon, and a hinder or rhombencephalon. The rhombencephalon has a very slight transverse thickening in the fore-part of its roof, this is the rudimentary cerebellum (*Cer.*); the rest of this part of the brain is taken up by the large medulla, the cavity of which is the *fossa rhomboidalis* or fourth ventricle. This fossa is roofed over by the epithelium lining the cavity of the ventricle, by pia mater and blood-vessels constituting a choroid plexus (fig. 16, B). The fourth ventricle communicates with the parts in front by means of a passage known as the aqueduct of Sylvius.

The mesencephalon or mid-brain, when looked at from the dorsal surface, shows a pair of large hollow swellings, the optic lobes or *corpora bigemina*. Their cavities open out from the aqueduct of Sylvius, and from the nervous tissue in their walls the optic nerves derive their fibres. From the front of the prosencephalon or anterior vesicle the olfactory nerves come off, and at the base of each of these are two hollow swellings; the larger and more anterior is the olfactory bulb, the smaller and more posterior the cerebral hemisphere. Both these swellings must be regarded as lateral outgrowths from the blind front end of the original single vesicle of the brain as seen in

Amphioxus, and from the anterior subdivision or prosencephalon in the lamprey. The anterior vesicle, however, is now again subdivided, and that part from which the cerebral hemispheres bud out, and the hemispheres themselves, is called the telencephalon, while the posterior part of the original prosencephalon is known as the thalamencephalon, or more rarely the diencephalon. On the dorsal surface of the thalamencephalon are two nervous masses called the ganglia habenulae; the right is much larger than the left, and from it a stalk runs forward and upward to end in the vestigial pineal body (or epiphysis), which contains rudiments of a pigmented retina and of a lens, and which is usually regarded as the remains of one of a pair of median eyes, though it has been suggested that it may be an organ for the appreciation of temperature. From the small left ganglion habenulae a still more rudimentary pineal stalk projects, and there are signs of a third outgrowth (paraphysis) in front of these. On the floor of the thalamencephalon the blind pouch-like infundibulum is in contact with the pituitary body, an outgrowth from the combined pituitary and olfactory pouch, which in the adult opens on to the top of the head just in front of the pineal area. The anterior closed end of the nerve-tube, in front of the foramina of Munro or openings from which the hemispheres have grown out, is known as the *lamina terminalis*, and in this is seen a little white commissure, connecting the hemispheres of opposite sides and belonging entirely to the telencephalon, known as the anterior commissure. The roof of the telencephalon is mainly epithelial, and contains no traces of cortical structure. In the posterior part of the roof of the thalamencephalon is the small posterior commissure (Ahlborn, *Zeits. wiss. Zool.* Bd. xxxix., 1883, p. 191). In the Elasmobranch Fish, such as the sharks and rays, the cerebellum (*Cer*. fig. 17) is very large and contains the layers found in all the higher vertebrates. In the mesencephalon fibres corresponding with those of the fillet of higher vertebrates can be seen, and there is a nucleus in the hinder part of the *corpora bigemina* foreshadowing the separation into corpora quadrigemina. There is only one pineal stalk in the roof of the thalamencephalon, and the ganglia habenulae—very constant structures in the vertebrate brain—are not so marked as in Petromyzon, but are, as usual, connected with the olfactory parts of the cerebrum, with the surface of the optic lobes (*tectum opticum*), and with the *corpus interpeduncular*e (Meynert's bundle). They are united across the middle line by a small *superior* or *habenular commissure*. In the floor of the thalamencephalon are two masses of ganglionic tissue, the optic thalami. The infundibulum dilates into two rounded bodies, the *lobi inferiores*, while the pituitary body or *hypophysis cerebri* has two lateral diverticula known as *sacci vasculosi*. Ganglia geniculata are found for the first time in connexion with the optic tracts in the lower part of the thalamus. The olfactory lobes (fig. 17, *Olf. Bulb*) are very large and often separated by long stalks from the cerebral hemispheres, which are comparatively much larger than those of the Cyclostomata; their roof or pallium is nervous, but devoid of cortical structure, while in the floor in some species large anterior basal ganglia or *corpora striata* are found (Miklucho-Maclay, *Beiträge z. vergl. Neurol.*, 1870; Edinger, *Arch. mikr. Anat.* Bd. lviii., 1901, p. 661, "Cerebellum"). The Teleostean Fish are chiefly remarkable for the great development of the optic lobes and suppression of the olfactory apparatus. The pallium is non-nervous, and the optic tracts merely cross one another instead of forming a commissure. A process of the cerebellum called *valvula cerebelli* projects into the cavity of each optic lobe (Rabl. Ruckhard, *Arch. Anat. u. Phys.*, 1898, p. 345 [Pallium]; Haller, *Morph. Jahrb.* Bd. xxvi., 1898, p. 632 [Histology and Bibliography]). The brain of the Dipnoi, or mud fish, shows no very important developments, except that the anterior pineal organ or paraphysis is large (Saunders, *Ann. and Mag. Nat. Hist.* ser. 6, vol. iii., 1889, p. 157; Burkhardt, *Centralnervensystem v. Protopterus*, Berlin, 1892).




From *Cat. R.C.S. England.*

FIG. 17.—Section of the Brain of Porbeagle Shark (*Lamna*).

In the Amphibia the brain is of a low type, the most marked advances on that of the fish being that the anterior commissure is divided into a dorsal and ventral part, of which the ventral is the true anterior commissure of higher vertebrates, while the dorsal is a hippocampal commissure and coincides in its appearance with the presence of a small mass of cells in the outer layer of the median wall of the pallium, which is probably the first indication of a hippocampal cortex or cortex of any kind (Osborn, *Journ. Morph.* vol. ii., 1889, p. 51).

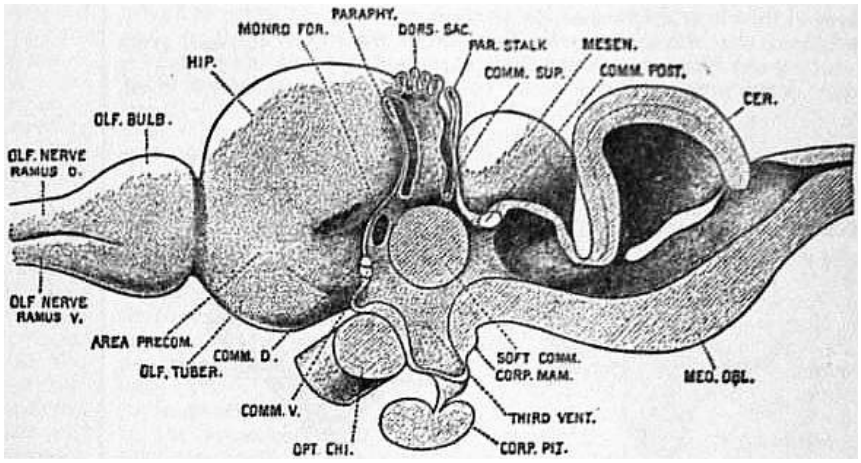



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FIG. 18.—Section of Brain of Turtle (*Chelone*).

In the Reptilia the medulla has a marked flexure with a ventral convexity, and an undoubted cerebral cortex for the first time makes its appearance. The mesial wall of the cerebral hemisphere is divided into a large dorsal hippocampal area (fig. 18, *Hip.*) and a smaller ventral olfactory tubercle. Between these two a narrow area of ganglionic matter runs forward from the side of the *lamina terminalis* and is known as the paraterminal or precommissural area (Elliot Smith, *Journ. Anat. and Phys.* vol. xxxii. p. 411). To the upper lateral part of the hemisphere Elliot Smith has given the name of *neopallium*, while the lower lateral part, imperfectly separated from it, is called the *pyriform lobe*. In the Lacertilia the pineal eye, if it be an eye, is better developed than in any existing vertebrate, though even in them there is no evidence of its being used for sight. Behind the so-called pineal eye and its stalk is the *epiphysis* or pineal body, and sometimes there is a dorsal sac between them (see fig. 18).[1] The middle or soft commissure appears in certain reptiles (*Crocodilia* and *Chelonia*), as does also the *corpus mammillare* (Edinger, Senckenberg, *Naturf. Gesell.* Bd. xix., 1896, and Bd. xxii., 1899; Haller, *Morph. Jahrb.* Bd. xxviii., 1900, p. 252). Among the birds there is great unity of type, the cerebellum is large and, by its forward projection, presses the optic lobes down toward the ventro-lateral part of the brain. The cerebral hemispheres are also large, owing chiefly to the great size of the *corpora striata*, which already show a differentiation into caudate nucleus, putamen and globus pallidus. The pallium is reptilian in character, though its cortical area is more extensive. The geniculate bodies are very large (Bumm, *Zeits. wiss. Zool.* Bd. xxxviii., 1883, p. 430; Brandis, *Arch. mikr. Anat.* Bd. xli., 1893, p. 623, and xliii., 1894, p. 96, and xliv., 1895, p. 534; Boyce and Warrington, *Phil. Trans.* vol. cxci., 1899, p. 293).

Among the Mammalia the Monotremata have a cerebellum which shows, in addition to the central lobe of the lower vertebrates, a flocculus on each side, and the two halves of the cerebellum are united by a ventral commissure, the *pons varolii*. The pallium is reptilian in its arrangement, but that part of it which Elliot Smith has named the neopallium is very large, both in the Ornithorynchus and Echidna, a fact very difficult to account for. In the latter animal the cortical area is so extensive as to be thrown into many and deep sulci, and yet the Echidna is one of the lowliest of mammals in other respects. A well-marked rhinal fissure separates the pyriform lobe from the neopallium, while, on the mesial surface, the hippocampal fissure separates the neopallium from the hippocampal area. Just below the hippocampal fissure a specially coloured tract indicates the first appearance of the fascia dentata (see fig. 20). The anterior commissure is  divided, as in reptiles, into dorsal and ventral parts, of which the latter is the larger (fig. 20, *Comm. V. and D.*), while just behind the dorsal part is the first appearance of the fimbria or fornix. In addition to the two fissures already named, there is, in the Echidna, one which in position and mode of formation corresponds with the Sylvian fissure of higher mammals. Elliot Smith, however, wisely refuses to homologize it absolutely with that fissure, and proposes the name of pseudosylvian for it. The pineal body is rudimentary, and the optic lobes are now, and throughout the Mammalia, subdivided into four *corpora quadrigemina*.

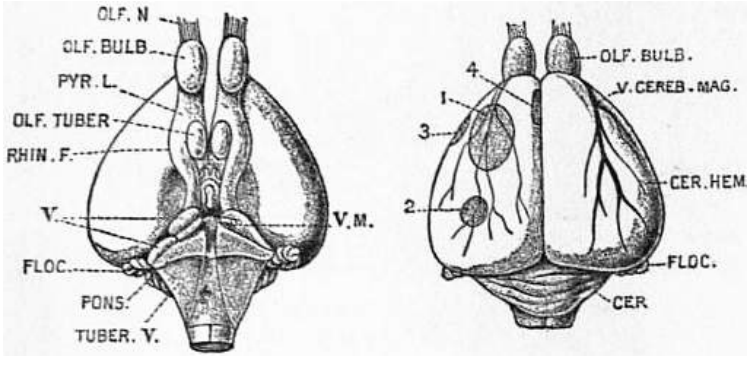

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FIG. 19.—Ventral and Dorsal Views of the Brain of Ornithorynchus.

Among the Marsupialia the Tasmanian devil (Sarcophilus) gives a very good idea of a generalized mammalian brain, and shows a large development of the parts concerned in the sense of smell. The most important advance on the monotreme brain is that the calcarine fissure has now appeared on the posterior part of the mesial surface and causes a bulging into the ventricle, called the *calcar avis* or hippocampus minor, just as the hippocampal fissure causes the *hippocampus major* (Gervais, *Nuov. Arch. Mus*. tom. v., 1869; Ziehen, *Jenaische Denkschr*. Bd. vi., 1897).

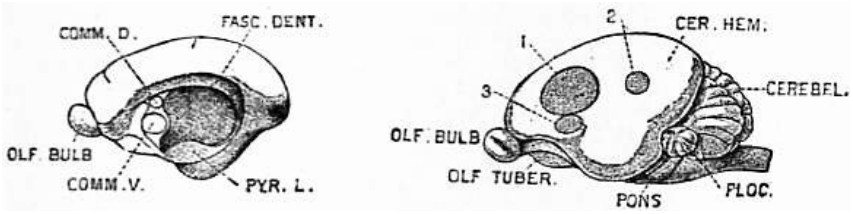


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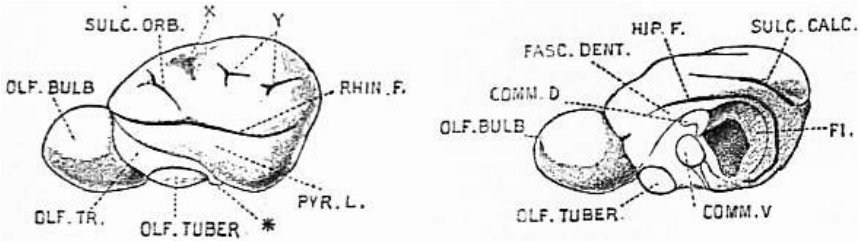
FIG. 20.—Mesial and Lateral Views of the Brain of Ornithorynchus.




From *Cat. R.C.S. England.*

FIG. 2l.—Mesial and Lateral Views of the Brain of the Tasmanian Devil (*Sarcophilus*).

In the Eutheria or mammals above the marsupials, the cerebellum gradually becomes more complex, owing to the appearance of lateral lobes between the flocculus and the vermis, as well as the paraflocculus on the outer side of the flocculus. The corpus callosum now first appears as a bridge between the neopallia, and its development leads to the stretching of the hippocampal formation, so that in the higher mammals the hippocampus is only found in the lower and back part of the ventricle, while the rudiments of the dorsal part remain as the *striae longitudinals* on the corpus callosum. The dorsal part of the original anterior commissure becomes the fornix, and the paraterminal area is modified to form the septum lucidum. The first appearance of the fissure of Rolando is probably in some of the Carnivora, in which, as the *sulcus crucialis*, it forms the posterior boundary of the "ursine lozenge" described by Mivart (*Journ. Linn. Soc*. vol. xix., 1886) (see fig. 22, *Sulc. Cru.*). In the higher apes or Anthropoidea the human fissures and sulci are largely recognizable, so that a gibbon's brain, apart from all question of comparative anatomy, forms a useful means of demonstrating to a junior class the main gyri and sulci of Man in a simple and diagrammatic way. The main points of difference, apart from greater simplicity, are that the central lobe or island of Reil is exposed on the surface of the brain, as it is in the human foetus, and that the anterior part of the occipital lobe has a well-marked vertical sulcus, called the simian sulcus or *Affenspalte*; this often has a semilunar shape with its convexity forward, and is then called the *sulcus lunatus*. It is usually concealed in European brains by the overgrowth of the surrounding gyri, but it occasionally remains, though less frequently than in the brains of Egyptian fellaheen. Its relation to the *white stria of Gennari* is especially interesting, and is recorded by Elliot Smith in the *Anatomischer Anzeiger*, Bd. xxiv., 1904, p. 436. The rhinal fissure, which is so characteristic a feature of the lower mammals, almost disappears in Man, and is only represented by the *incisura temporalis* (see fig. 11, *i.t*). The hippocampal fissure persists with little modification all through the mammalian class. The calcarine fissure remains with many modifications from the marsupials to man, and in view of the famous controversy of 1864, in which Owen, Huxley and the then bishop of Oxford took part, it is interesting to note that its hippocampus minor can now be clearly demonstrated, even in the Marsupialia. Another very ancient and stable sulcus is the *orbital*, which is a simple antero-posterior line until Man is reached (see fig. 23, *Sulc. Orb.*). The great point of importance, however, in the evolution of the mammalian brain is the gradual suppression of the olfactory region, and the development of the neopallium, a development which takes a sudden stride between the Anthropoid apes and Man. (For further particulars of this and other points in the comparative anatomy of the brain, see *Catalogue of the Physiological Series* of the Museum of the Royal College of Surgeons of England, vol. ii. 2nd ed., by R.H. Burne and G. Elliot Smith, London, 1902.)

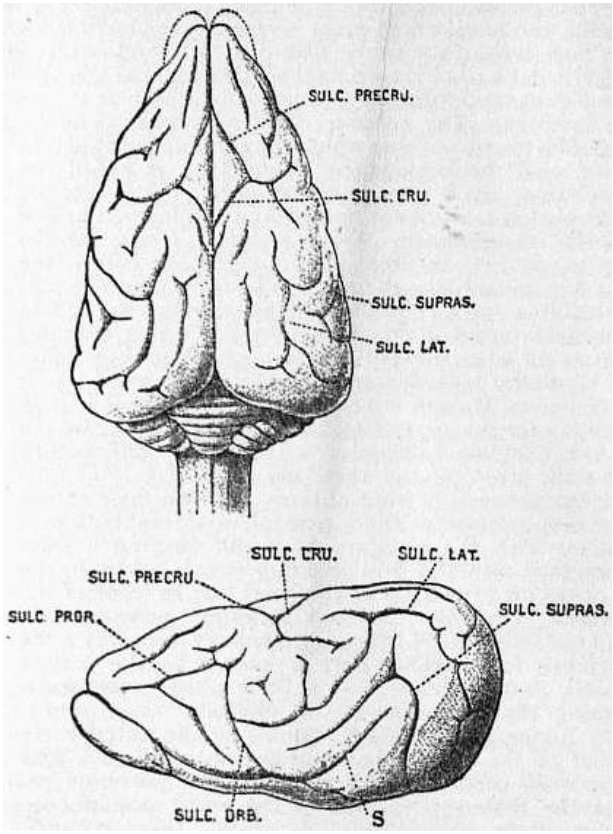



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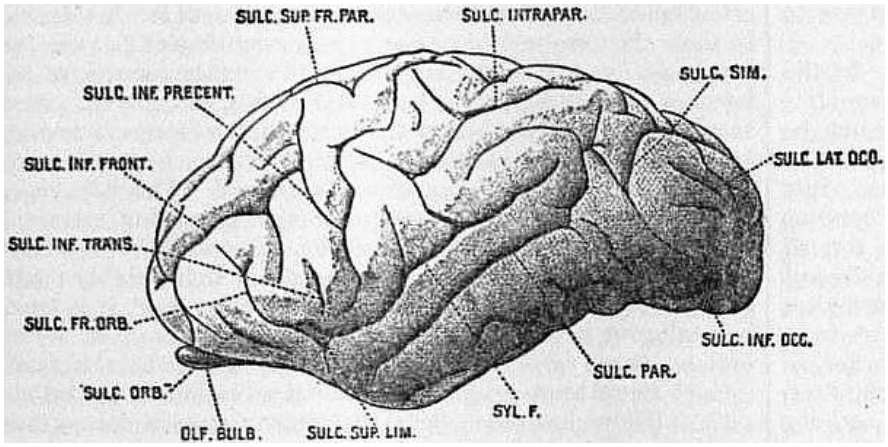
FIG. 22.—Dorsal and Lateral Views of the Brain of a Ratel (*Mellivora indica*).

*Embryology.*

The brain, like the rest of the nervous system, is developed from the ectoderm or outer layer of the embryo by the formation of a groove in the mid-dorsal line. The lips of this *medullary groove* unite to form a canal beginning at the place where the neck of the embryo is to be. The part of the neural canal in front of the earliest union forms the brain and very early becomes constricted into three vesicles, to which the names of *prosencephalon*, *mesencephalon* and *rhombencephalon* are now usually given. The simple tubular brain we have seen as a permanent arrangement in Amphioxus, but the stage of the three vesicles is a transitory one, and is not found in the adult of any existing animal. From the sides of the prosencephalon, the optic vesicles grow out before the neural tube is completely closed, and eventually form the optic nerves and retinae, while, soon after this, the cerebral hemispheres bulge from the antero-dorsal part of the first primary vesicle, their points of evagination being the *foramina of Munro*. From the ventral parts of these cerebral hemispheres the olfactory lobes are constricted off, while just behind the openings of the foramina of Munro a constriction occurs which divides the prosencephalon into two secondary vesicles, the anterior of which, containing the foramina of Munro, is called the *telencephalon*, while the posterior is the *thalamencephalon* or *diencephalon*. A constriction also occurs in the hind vesicle or *rhombencephalon*, dividing it into an anterior part, the *metencephalon*, from which the cerebellum is developed, and a posterior or *myelencephalon*, the primitive *medulla oblongata*. At this stage the general resemblance of the brain to that of the lamprey is striking.



Before the secondary constrictions occur three vertical flexures begin to form. The first is known as the *cephalic*, and is caused by the prosencephalon bending sharply downward, below and in front of the mesencephalon. The second is the *cervical*, and marks the place where the brain ends and the spinal cord begins; the concavity of this flexure is ventral. The third to appear has a ventral convexity and is known as the *pontine*, since it marks the site of the future *pons Varolii*; it resembles the permanent flexure in the reptilian brain.




From *Cat. R.C.S. England.*

FIG. 23.—Lateral view of cerebral hemisphere of Gorilla (*Anthropopithecus gorilla*).

It will now be seen that the original neural canal, which is lined by ciliated epithelium, forms the ventricles of the brain, while superficial to this epithelium (*ependyma*) the grey and white matter is subsequently formed. It has been shown by His that the whole neural tube may be divided into *dorsal* or *alar*, and *ventral* or *basal* laminae, and, as the cerebral hemispheres bud out from the dorsal part of the anterior primary vesicle, they consist entirely of alar laminae. The most characteristic feature of the human and anthropoid brain is the rapid and great expansion of these hemispheres, especially in a backward direction, so that the mesencephalon and metencephalon are hidden by them from above at the seventh month of intra-uterine life. At first the foramina of Munro form a communication not only between the third and lateral ventricles, but between the two lateral ventricles, so that the cavity of each hemisphere is continuous with that of the other; soon, however, a median longitudinal fissure forms, into which the mesoderm grows to form the falx, and so the foramina of Munro are constricted into a V-shaped canal. In the floor of the hemispheres the corpora striata are developed at an early date by a multiplication of nerve cells, and on the external surface a depression, called the *Sylvian fossa*, marks the position of the future central lobe, which is afterwards hidden as the lips of the fossa (*opercula*) gradually close in on it to form the Sylvian fissure. The real fissures are complete infoldings of the whole thickness of the vesicular wall and produce swellings in the cavity. Some of them, like the choroidal on the mesial surface, are developed very early, while the vesicle is little more than epithelial, and contain between their walls an inpushing of mesoderm to form the choroid plexus. Others, like the hippocampal and calcarine, appear in the second and third months and correspond to invaginations of the nervous tissue, the hippocampus major and minor. The sulci appear later than the fissures and do not affect the internal cavity; they are due to the rapid growth of the cortex in certain areas. The corpus callosum and fornix appear about the third month and their development is somewhat doubtful; they are probably modifications of the lamina terminalis, but they may be secondary adhesions between the adjacent surfaces of the cerebral hemispheres where the cortical grey matter has not covered the white. They begin at their antero-ventral part near the genu of the corpus callosum and the anterior pillars of the fornix, and these are the parts which first appear in the lower mammals. The original anterior vesicle from which the hemispheres evaginate is composed, as already shown, of an anterior part or telencephalon and a posterior or thalamencephalon; the whole forming the third ventricle in the adult. Here the alar and basal laminae are both found, but the former is the more important; from it the optic thalami are derived, and more posteriorly the geniculate bodies. The anterior wall, of course, is the lamina terminalis, and from it are formed the *lamina cinerea*, the *corpus callosum*, *fornix* and *septum lucidum*. The roof largely remains epithelial and is invaginated into the ventricle by the mesoderm to form the *choroid plexuses* of the third ventricle, but at the posterior part it develops the *ganglia habenulae* and the pineal body, from a structure just in front of which both a lens and retinal elements are derived in the lower forms. This is one great difference between the development of this organ and that of the true eyes; indeed it has been suggested that the pineal is an organ of thermal sense and not the remains of a median eye at all. The floor of the third ventricle is developed from the basal laminae, which here are not very important and from which the *tuber cinereum* and, until the fourth month, single *corpus mammillare* are developed. The *infundibulum* or stalk of the posterior part of the pituitary body at first grows down in front of the *tuber cinereum* and, according to Gaskel's theory, represents an ancestral mouth to which the ventricles of the brain and the central canal of the cord acted as the stomach and intestine (*Quart. Journ. of Mic. Sci.* 31, p. 379; and *Journ. of Phys.* v. 10, p. 153). The reason why the basal lamina is here small is because it contains the nuclei of no cranial nerves. The anterior and posterior commissures appear before the middle and the middle before the *corpus callosum*, as they do in phylogeny. In connexion with the thalamencephalon, though not really belonging to it, may be mentioned the anterior lobes of the pituitary body; these begin as an upward *diverticulum* from the posterior wall of the primitive pharynx or *stomatodaeum* about the fourth week. This *pouch of Rathke*, as it is called, becomes nipped off by the developing base of the skull, and its bifid blind end meets and becomes applied to the posterior part of the body,

which comes down from the brain. In the mesencephalon the alar laminae form the *corpora quadrigemina*; these at first are bigeminal and hollow as they are in the lower vertebrates. The basal laminae thicken to form the *crura cerebri*. In the rhombencephalon the division into basal and alar laminae is better marked than in any other part; there is a definite groove inside the fourth ventricle, which remains in the adult as the superior and inferior *fovea* and which marks the separation between the two laminae. In the basal laminae are found the deep origins of most of the motor cranial nerves, while those of the sensory are situated in the alar laminae. The roof of the fourth ventricle widens out very much and remains largely epithelial as the superior and inferior medullary vela. The cerebellum develops in the anterior part of the roof of the rhombencephalon as two lateral rudiments which unite in the mid line and so form a transverse bar similar to that seen in the adult lamprey; at the end of the second month the flocculus and paraflocculus become marked, and later on a series of transverse fissures occur dividing the various lobes. Of the cerebellar peduncles the inferior develops first (third month), then the middle forming the *pons* (fourth month), and lastly the *superior* (fifth month) (Elliot Smith, *Review of Neurology and Psychiatry*, October 1903; W. Kuithan, "Die Entwicklung des Kleinhirns bei Säugetieren," *Munchener Med. Abhandl.*, 1895; B. Stroud, "Mammalian cerebellum," *Journ. of Comp. Neurology*, 1895). Much of our knowledge of the tracts of fibres in the brain is due to the fact that they acquire their white sheaths at different stages of development, some long after birth.

For further details and references see Quain's *Anat*. vol. i. (1908); Minot's *Human Embryology* (New York); W. His, *Anat. menschlicher Embryonen* (Leipzig, 1881); Marshall's *Vertebrate Embryology*; Kölliker, *Grundriss der Entwickelungsgeschichte* (Leipzig, 1880); A. Keith, *Human Embryology and Morphology* (London, 1904); O. Hertwig, *Handbuch der vergleichenden und experimentellen Entwickelungslehre der Wirbeltiere*, Bd. 2, part 3 (Jena, 1902-1906); *Development of the Human Body*, J.P. McMurrich (1906).

(F. G. P.)

## 2. Physiology

The nervous system has as its function the co-ordinating of the activities of the organs one with another. It puts the organs into such mutual relation that the animal reacts as a whole with speed, accuracy and self-advantage, in response to the environmental agencies which stimulate it. For this office of the nervous system there are two fundamental conditions. The system must be thrown into action by agencies at work in the environment. Light, gravity, mechanical impacts, and so on, which are conditions significant for animal existence, must find the system responsive and through it evoke appropriate activity in the animal organs. And in fact there have been evolved in the animal a number of structures called receptive organs which are selectively excitable by different environmental agencies. Connected with these receptive organs lies that division of the nervous system which is termed *afferent* because it conducts impulses inwards towards the nervous centres. This division consists of elongated nerve-cells, in man some two 404
million in number for each half of the body. These are living threads of microscopic tenuity, each extending from a receptive organ to a central nervous mass. These central nervous masses are in vertebrates all fused into one, of which the part which lies in the head is especially large and complex, because directly connected with particularly important and delicate receptive organs. The part of the central nervous organ which lies in the head has, in consequence of its connexion with the most important receptive organs, evolved a dominant importance in the nervous system, and this is especially true of the higher animal forms. This head part of the central nervous organ is sufficiently different from the rest, even to anatomical examination, to have received a separate name, the *brain*. But the fact of its having received a separate name ought not to obscure the singleness and solidarity of the whole central nervous organ as one entity. The functions of the whole central nervous organ from region to region are essentially similar throughout. One of its essential functions is reception, via afferent nerves, of nervous impulses generated in the receptive organs by environmental agents as stimuli. In other words, whatever the nature of the agent, its result on the receptive organs enters the central nervous organ as a nervous impulse, and all segments of the central nervous organ receive impulses so generated. Further, it is not known that nervous impulses present qualitative differences among themselves. It is with these impulses that the central nervous organ whether spinal cord or brain has to deal.

*Material and Psychical Signs of Cerebral Activity.*—In the central nervous organ the action resulting from entrant impulses has issue in three kinds of ways. The reaction may die out, be suppressed, and so far as discoverable lead to nothing; or the impulses may evoke effect in either or both of two forms. Just as from the receptive organs, nerves lead into the central nervous organ, so conversely from the central organ other nerves, termed *efferent*, lead to various organs of the body, especially glands and muscles. The reaction of the central nervous organ to impulses poured into it commonly leads to a discharge of impulses from it into glands and muscles. These centrifugal impulses are, so far as is known, qualitatively like the centripetal impulses. On reaching the glands and muscles they influence the activity of those organs. Since those organs are therefore the mechanisms in which the ultimate effect of the nervous reaction takes place, they are often termed from this point of view *effector organs*. A change ensuing in effector

organs is often the only sign an observer has that a nervous reaction has occurred, unless the nervous system under observation be the observer's own.

If the observer turns to his own nervous system for evidence of reaction, he meets at once in numberless instances with *sensation* as an outcome or sign of its reaction. This effect he cannot show to any being beside himself. He can only describe it, and in describing it he cannot strictly translate it into any term of material existence. The unbridged gulf between sensation and the changes produced in effector organs necessitates a separate handling of the functions of the nervous system according as their office under consideration is sensation or material effect. This holds especially in the case of the brain, and for the following reasons.

*Psychosis and the Fore-Brain.*—Hippocrates wrote, "It is through the brain that we become mad, that delirium seizes us, that fears and terrors assail us." "We know that pleasure and joy on the one hand and pain and grief on the other are referable to the brain. It is in virtue of it that we think, understand, see, hear, know ugliness and beauty, evil and good, the agreeable and the disagreeable." Similarly and more precisely Descartes indicated the brain, and the brain alone, as the seat of consciousness. Finally, it was Flourens who perhaps first definitely insisted on the restriction of the seat of consciousness in higher animals to that part of the brain which is the fore-brain. A functional distinction between the fore-brain and the remainder of the nervous system seems, in fact, that consciousness and physical reactions are adjunct to the fore-brain in a way in which they are not to the rest of the system. After transection of the spinal cord, or of the brain behind the fore-brain, psychical phenomena do not belong to the reactions of the nervous arcs posterior to the transection, whereas they do still accompany reactions of the nervous arcs in front and still connected with the fore-brain. A man after severance of the spinal cord does not possess in the strict sense consciousness of the limbs whose afferent nerves lie behind the place of spinal severance. He can see them with his eyes, and if the severance lie between the arms and the legs, can feel the latter with his hands. He knows them to be a part of his body. But they are detached from his consciousness. Sensations derived from them through all other channels of sense than their own do not suffice to restore them in any adequate measure to his consciousness. He must have the sensations so called "resident" in them, that is, referred to them, without need of any logical inference. These can be yielded only by the receptive organs resident in the part itself, its skin, its joints, its muscles, &c., and can only be yielded by those receptive organs so long as the nerve impulses from them have access to the fore-brain. Consciousness, therefore, does not seem to attach to any portion of the nervous system of higher animals from which the fore-brain has been cut off. In the dog it has been found that no sign of memory, let alone intelligence, has been forthcoming after removal of the greater part of the fore-brain.

In lower vertebrates it is not clear that consciousness in primitive form requires always the co-operation of the fore-brain. In them the fore-brain does not seem a *conditio sine qua non* for psychosis—so far as we may trust the rather hazardous inferences which study of the behaviour of fish, &c., allows. And the difference between higher and lowlier animal forms in respect of the fore-brain as a condition for psychosis becomes more marked when the Arthropoda are examined. The behaviour of some Insecta points strongly to their possessing memory, rudimentary in kind though it may be. But in them no homologue of the fore-brain of vertebrates can be indisputably made out. The head ganglia in these Invertebrates may, it is true, be analogous in function in certain ways to the brain of vertebrates. Some experiments, not plentiful, indicate that destruction of these head ganglia induces deterioration of behaviour such as follows loss of psychical functions in cases of destruction of the fore-brain in vertebrates. Though, therefore, we cannot be clear that the head ganglia of these Invertebrates are the same structure morphologically as the brain of vertebrates, they seem to hold a similar office, exercising analogous functions, including psychosis of a rudimentary kind. We can, therefore, speak of the head ganglia of Arthropods as a brain, and in doing so must remember that we define by physiological evidence rather than by morphological.

*Cerebral Control over Lower Nervous Centres.*—There accrues to the brain, especially to the fore-brain of higher Vertebrates, another function besides that of grafting psychical qualities upon the reactions of the nervous system. This function is exhibited as power to control in greater or less measure the pure reflexes enacted by the system. These pure reflexes have the character of fatality, in the sense that, given a particular stimulus, a particular reaction unvaryingly follows; the same group of muscles or the same gland is invariably thrown into action in the same way. Removal of the fore-brain, *i.e.* of that portion of the central nervous organ to which psychosis is adjunct, renders the nervous reactions of the animal more predictable and less variable. The animal, for instance, a dog, is given over more completely to simple reflexes. Its skin is touched and it scratches the spot, its jaw is stroked and it yawns, its rump is rubbed and it shakes itself, like a dog coming out of water; and these reactions occur fatally and inopportunely, for instance, when food is being offered to it, when the dog normally would allow no such insignificant skin stimuli as the above to defer his appropriate reaction. Goltz relates the behaviour of a dog from which almost the whole fore-brain had been removed. The animal lived healthily under the careful treatment accorded it. At feeding time a little quinine (bitter) added to

its sop of meat and milk led to the morsels, after being taken into the mouth, being at once and regularly rejected. None was ever swallowed, nor was the slightest hesitation in their rejection ever obtained by any coaxing or command, or encouragement of the animal by the attendant who constantly had charge of it. On the other hand, directly an undoctored piece had entered the mouth it was swallowed at once. Goltz threw to his own house-dog a piece of the same doctored meat. The creature wagged its tail and took it eagerly, then after receiving it into its mouth pulled a wry face and hesitated, astonished. But on encouragement to go on eating it the dog did so. Perhaps it deemed it unseemly to appear ungrateful to the giver and reject the gift. It overcame its reflex of rejection, and by its self-control gave proof of the intact cerebrum it possessed.

There seems a connexion between consciousness and the power to modify reflex action to meet the exigencies of the occasion. Pure reflexes are admirably adapted to certain ends. They are reactions which have long proved advantageous to the phylum of which the existent animal is the representative embodiment. But the reflexes have a machine-like fatality, and conscious aim does not forerun their execution. The subject as active agent does not direct them. Yet they lie under the control of higher centres. The cough, the eye-closure, the impulse to smile, all these can be suppressed. The innate respiratory rhythm can be modified to meet the requirements of vocal utterance. In other words, the reaction of reflex arcs is controllable by the mechanism to whose activity consciousness is adjunct. The reflexes controlled are often reactions but slightly affecting consciousness, but consciousness is very distinctly operative with the centres which exert the control. It may be that the primary aim, object and purpose of consciousness is control. “Consciousness in a mere automaton,” writes Professor Lloyd Morgan, “is a useless and unnecessary epiphenomenon.” As to *how* this conscious control is operative on reflexes, how it intrudes its influence on the running of the reflex machinery, little is known.

*The Cerebrum an Organ giving Adaptation and Readjustment of Motor Acts.*—The exercise of this control and the acquirement of skilled actions have obviously elements in common. By skilled actions, we understand actions not innately given, actions acquired by training in individual experience. The controlling centres pick out from an ancestral motor action some part, and isolate and enhance that until it becomes a skilled act. The motor co-ordination ancestrally provided for the ring finger gives an extending of it only in company with extension of the fingers on either side of it. The isolated lifting of the ring finger can, however, soon be acquired by training. In such cases the higher centre with conscious effort is able to dissociate a part from an ancestral co-ordination, and in that way to add a skilled adapted act to the powers of the individual.

The nervous organs of control form, therefore, a special instrument of adaptation and of readjustment of reaction, for better accommodation to requirements which may be new. The attainment of more precision and speed in the use of a tool, or the handling of a weapon, means a process in which nervous organs of control modify activities of reflex centres themselves already perfected ancestrally for other though kindred actions. This process of learning is accompanied by conscious effort. The effort consists not so much in any course of reasoning but rather in the acquiring of new sensorimotor experience. To learn swimming or skating by simple cogitation or mere visual observation is of course impossible. The new ideas requisite cannot be constructed without motor experience, and the training must include that motor experience. Hence the training for a new skilled motor manoeuvre must be simply *ad hoc*, and is of itself no training for another motor co-ordination.

The more complex an organism the more points of contact does it have with its environment, and the more does it need readjustment amid an environment of shifting relationships. Hence the organs of consciousness and control, being organs of adaptation and readjustment of reaction, will be more pronounced the farther the animal scale is followed upward to its crowning species, man. The cerebrum and especially the cerebral cortex may be regarded as the highest expression of the nervous organ of individual adaptation of reactions. Its high development in man makes him the most successful animal on earth’s surface at the present epoch. The most important part of all this adjustment in his case, as he stands now, consists doubtless in that nervous activity which is intellectual. The mentality attached to his cerebrum includes reason in higher measure than is possessed by the mentality of other animals. He, therefore, more than they, can profitably forecast the future and act suitably to meet it from memory of the past. The cerebrum has proved itself by his case the most potent weapon existent for extending animal dominance over the environment.

*Means and Present Aims of Physiological Study of the Brain.*—The aspects of cerebral activity are therefore twofold. There is the contribution which it makes to the behaviour of the animal as seen in the creature’s doings. On the other hand there is its product in the psychical life of the animal. The former of these is subject matter for physiology; the latter is especially the province of psychology. Physiology does, however, concern itself with the psychical aspect of cerebral functions. Its scope, embracing the study of the bodily organs in regard to function, includes the psychic as well as the material, because as just shown the former inextricably interlace with the

latter. But the relation between the psychic phenomena and the working of the brain in regard to any data of fundamental or intimate character connecting the two remains practically as unknown to us as to the Greek philosophers. What physiology has at present to be content with in this respect is the mere assigning of certain kinds of psychic events to certain local regions of the cerebrum. This primitive quest constitutes the greater part of the "neurology" of our day, and some advance has been made along its lines. Yet how meagre are really significant facts will be clear from the brief survey that follows. Before passing finally from these general considerations, we may note that it becomes more and more clear that the brain, although an organ than can be treated as a whole, is complex in the sense that separable functions belong in some measure to its several parts.

The means principally adopted in studying the functions of the brain—and it must be remembered that this study in its present phase is almost exclusively a mere search for localization—are four. These are the physiological, the clinico-pathological, the histological and the zoological. The first named proceeds by observing the effects of artificial excitation, chiefly electric, of various parts of the brain, and the defects produced by destruction or removal of circumscribed portions. The clinico-pathological proceeds by observing the disturbances of body and mind occurring in disease or injury, and ascertaining the extent of the disease or injury, for the most part *post mortem*. The histological method examines the microscopic structure of the various regions of the brain and the characters and arrangement of the nerve-cells composing it. The zoological follows and compares the general features of the brain, as represented in the various types of animal creation.

It is on the functions of the fore-brain that interest now mainly focuses, for the reasons mentioned above. And the interest in the fore-brain itself chiefly attaches to the functions of its cortex. This is due to several causes. In man and the animals nearest him the cortex forms by far the larger part of the whole cerebral hemisphere. More than any other part it constitutes the distinctively human feature. It lies accessible to various experimental observations, as also to traumatic lesions and to the surgeon's art. It is composed of a great unbroken sheet of grey matter; for that reason it is a structure wherein processes of peculiar interest for the investigation in view are likely to occur. To make this last inference more clear a reference to the histology of nervous tissue must be made. The whole physiological function of the nervous system may be summed up in the one word "conduction." This "conduction" may be defined as the transmission of states of excitement (nerve-impulses) along the neural arcs composing the system. The whole nervous system is built up of chains of nerve-cells (neurones) which are nervous conductors, the chains often being termed arcs. Each neurone is an elongated cell which  transmits nerve-impulses from its one end to its other, without so far as is known modifying the impulses in transit, unless in that part of the nerve-cell where the nucleus lies. That part of the neurone or nerve-cell is called the perikaryon or cell-body, and from that part usually many branches of the cell (each branch being a nerve-fibre) ramify. There is no evidence that impulses are modified in transit along a branch of a nerve-cell, but there is clear evidence of manifold modification of nerve-impulses in transit along the nerve-arcs of the nervous system. These nerve-arcs are neurone-chains. In them one neurone continues the line of conduction where the immediately foregoing neurone left it. That is, the neurones are laid in conductive series, the far end of one apposed to the near end of its precursor. The place of juxtaposition of the end of one neurone against the beginning of another is called the *synapse*. At it the conduction which has so far been wholly intra-neuronic is replaced by an inter-neuronic process, in which the nerve impulse passes from one neurone to the next. The process there, it is natural to think, must be physiologically different from that conductive process that serves for transmission merely within the neurone itself. It may be that to this inter-neuronic conduction are due the differences between conduction in nerve-*arcs* and nerve-*trunks* (nerve-fibres) respectively. Significant of the former are changes in rhythm, intensity, excitability and modifications by summation and inhibition; in fact a number of the main features of nervous reaction. These characters impressed upon conduction in nerve arcs (neurone-chains) would therefore be traceable to the intercalation of perikarya and synapses, for both these structures are absent from nerve-trunks. It is therefore probably to perikarya and synapses that the greater part of the co-ordination, elaboration and differentiation of nervous reactions is due. Now, perikarya and synapses are not present in the *white* matter of the central nervous organ, any more than they are in nerve-trunks. They are confined exclusively to those portions of the central organ which consist of *grey* matter (so called from its naked-eye appearance). Hence it is to the great sheet of grey matter which enfolds the cerebrum that the physiologist turns, as to a field where he would expect to find evidences of the processes of cerebral co-ordination at work. It is therefore to items regarding the functions of the great sheet of cerebral cortex that we may now pass.

*The Cerebral Cortex and its Functions.*—The main question which vexed the study of the physiology of the cerebral hemispheres in the 19th century was whether differences of function are detectible in the different regions of the hemisphere and especially in those of its cortex. One camp of experimenters and observers held that the cortex was identical in function throughout its extent. These authorities taught that the various faculties and senses suffer damage in proportion

to the amount of cortex removed or injured, and that it is a matter of indifference what may be the particular region wherein the destruction takes place. Against this an opposed set of observers held that different regions perform different functions, and this latter "differential" view was raised in two wholly dissimilar forms in the first and last quarters of the 19th century respectively. In the first quarter of the century, a school, with which the name of Gall is prominently associated, held that each faculty of a set of particular so-called "faculties," which it assumed constituted intelligence, has in the brain a spatially separate organ proper to itself. Gall's doctrine had two fundamental propositions. The first was that intelligence resides exclusively in the brain: the second, that intelligence consists of twenty-seven "faculties," each with a separate local seat in the brain. The first proposition was not new. It is met with in Hippocrates, and it had been elaborated by Descartes and others. But Bichat in his *Anatomie generale* had partly wandered from the gradually established truth and referred the emotions to the visceral organs, returning to a naive view popularly prevalent. Gall's first proposition was probably raised especially in reaction against Bichat. But Gall's proposition was retrograde from the true position of the science of his time. Flourens and others of his contemporaries had already shown not only that intelligence was resident exclusively in the brain, but that it was resident exclusively in that part of the brain which is the fore-brain. Now Gall placed certain of his twenty-seven intellectual faculties in the cerebellum, which is part of the hind-brain.

*Phrenology.*—As to Gall's second proposition, the set of faculties into which he analysed intelligence shows his power of psychological analysis to have been so weak that it is matter of surprise his doctrine could obtain even the ephemeral vogue it actually did. Among his twenty-seven faculties are, for instance, "*l'amour de la progéniture, l'instinct carnassier, l'amitié, la ruse, la sagacité comparative, l'esprit métaphysique, le talent poétique, la mimique*," &c. Such crudity of speculation is remarkable in one who had undoubtedly considerable insight into human character. Each of the twenty-seven faculties had its seat in a part of the brain, and that part of the brain was called its "organ." The mere spatial juxtaposition or remoteness of these organs one from another in the brain had, according to Gall, an influence on the constitution of the mind. "*Comme l'organe des arts est placé loin de l'organe du sens des couleurs, cette circonstance explique pourquoi les peintres d'histoire ont été rarement coloristes*." All these "faculty-organs" were placed by Gall at the surface of the brain. "This explains the correspondence which exists between craniology and the doctrine of the functions of the brain (cerebral physiology), the single aim of my researches." Gall wrote that he found the bump of pride (*la bosse de l'orgueil*) as far down in the animal series as the goat. Broussais traced the "organ" of veneration as far down as the sheep. Gall found the bump of murder (*bosse du meurtre*) in the carnivora. Later it was traced also in herbivora. Broussais added apologetically that "the herbivora cause a real destruction of plants."

Gall's doctrine enjoyed enormous vogue. He himself had the gifts and the demerits of quackery. His doctrine possessed, apart from its falsity, certain other mischievous qualities. "*Que ces hommes si glorieux, qui font égorger les nations par millions, sachent qu'ils n'agissent point de leur propre chef, que c'est la nature qui a placé dans leur coeur la rage de la destruction*." One of his scientific opponents rejoined, "Nay, it is not that which they should know. What they should know is that if providence has allowed to man the possibility of doing evil, it has also endowed him with the power to do good." The main cause of the success of phrenology (*q.v.*) has been no doubt the common desire of men to read the characters and hidden thoughts of others by external signs. Each bump or "bosse" on the cranium was supposed to indicate the existence and degree of development of one or other of the twenty-seven "faculties." One such "bosse" showed the development of the organ of "goodness," and another the development of the organ of "murder." Such an easy means to arrive at information so curious delighted many persons, and they were not willingly undeceived.

*Modern Localization Doctrines.*—The crude localization of the phrenologists is therefore too clumsy to possess an interest it might otherwise have had as an early expression of belief in cerebral localization, a belief which other labours have subsequently justified, although on facts and lines quite different from these imagined by Gall and his followers. Patient scientific toil by the hands of E. Hitzig and D. Ferrier and their followers has slowly succeeded in obtaining certain facts about the *cortex cerebri* which not only show that different regions of it are concerned with different functions, but, for some regions at least, outline to some extent the kind of function exercised. It is true that the greater part of the cortex remains still *terra incognita* unless we are content with mere descriptive features concerning its coarse anatomy. For several scattered regions some knowledge of their function has been gained by physiological investigation. These scattered regions are the *visual*, the *auditory*, the *olfactory* and the *precentral*.

The grey matter of the cerebral cortex is broadly characterized histologically by the perikarya (nerve-cells bodies) which lie in it possessing a special shape; they are pyramidal. The dendrite fibres of these cells—that is, their fibres which conduct *towards* the perikarya—are branches from the apex and corners of the pyramid. From the base often near its middle arises one large fibre—the axone fibre, which conducts impulses away from the perikaryon. The general

appearance and arrangement of the neurones in a particle of cortical grey matter are shown in fig. 15, above. The apices of the pyramidal perikarya are turned towards the free surface of the cortex. The figure as interpreted in terms of functional conduction means that the cortex is beset with conductors, each of which collects nerve-impulses, from a minute but relatively wide field by its branched dendrites, and that these nerve-impulses converge through its perikaryon, issue by its axone, and are carried whithersoever the axone runs. In some few cells the axone breaks up into branches in the immediate neighbourhood of its own perikaryon in the cortex. In most cases, however, the axone runs off into the subjacent white matter, leaving the cortex altogether. On reaching the subjacent white matter it mingles with other fibres and takes one of the following courses:—(1) to the grey matter of the cortex of the same hemisphere, (2) to the grey matter of the cortex of the opposite hemisphere, (3) to the grey matter of the pons, (4) to the grey matter of the bulb or spinal cord. It is noteworthy that the dendrite fibres of these cortical neurones do not transgress the limits of the grey cortex and the immediate neighbourhood of the perikaryon to which they belong; whereas the discharging or axone fibre does in the vast majority of cases transgress the limits of the grey matter wherein its perikaryon lies. The cortical neurone therefore collects impulses in the region of cortex just about its perikaryon and discharges them to other regions, some not cortical or even cerebral, but spinal, &c. One question which naturally arises is, do these cells spontaneously generate their impulses or are they stirred to activity by impulses which reach them from without? The tendency of physiology is to regard the actions of the cortex as reactions to impulses communicated to the cortical cells by nerve-channels reaching them from the sense organs. The neurone conductors in the cortex are in so far considered to resemble those of reflex centres, though their reactions are more variable and complex than in the use of the spinal. The chains of neurones passing through the cortex are more complex and connected with greater numbers of associate complex chains than are those of the spinal centres. But just as the reflex centres of the cord are each attached to afferent channels arriving from this or that receptive-organ, for instance, tactile-organs of the skin, or spindles of muscle-sense, &c., so the regions of cortex whose function is to-day with some certainty localized seem to be severally related each to some particular sense-organ. The localization, so far as ascertained, is a localization which attaches separate areas of cortex to the several species of sense, namely the visual, the auditory, the olfactory, and so on. This being so, we should expect to find the sensual representation in the cortex especially marked for the organs of the great distance-receptors, the organs which—considered as *sense* organs—initiate sensations having the quality of projicience into the sensible environment. The organs of distance-receptors are the olfactory, the visual and the auditory. The environmental agent which acts as stimulus in the case of the first named is chemical, in the second is radiant, and in the last is mechanical.

*Olfactory Region of Cortex.*—There is phylogenetic evidence that the development of the *cortex cerebri* first occurred in connexion with the distance-receptors for chemical stimuli—that is, expressed with reference to psychosis, in connexion with olfaction. The olfactory apparatus even in mammals still exhibits a neural architecture of primitive pattern. The cell which conducts impulses to the brain from the olfactory membrane in the nose resembles cells in the skin of the earthworm, in that its cell-body lies actually amid the epithelium of the skin-surface and is not deeply buried near or in the central nervous organ. Further, it has at its external end tiny hairlets such as occur in specially receptive-cells but not usually in purely nervous cells. Hence we must think that one and the same cell by its external end receives the environmental stimulus and by its deep end excites the central nervous organ. The cell under the stimulation of the environmental agent will therefore generate in itself a nervous impulse. This is the clearest instance we have of a neurone being actually excited under natural circumstances by an agent of the environment *directly*, not indirectly. The deep ends of these olfactory neurones having entered the central nervous organ come into contact with the dendrites of large neurones, called, from their shape, mitral. In the dog, an animal with high olfactory sense, the axone of each olfactory neurone is connected with five or six mitral cells. In man each olfactory neurone is connected with a single mitral cell only. We may suppose that the former arrangement conduces to intensification of the central reaction by summation. At the same time it is an arrangement which could tend to smother sharp differentiation of the central reaction in respect to locality of stimulus at the receptive surface. Considering the diffuse way in which olfactory stimuli are applied in comparison, for instance, with visual, the exact localization of the former can obviously yield little information of use for locating the exact position of their source. On the other hand, in the case of visual stimuli the locus of incidence, owing to the rectilinear propagation of light, can serve with extraordinary exactitude for inferences as to the position of their source. The adaptation of the neural connexions of the two organs in this respect is therefore in accord with expectation.

The earliest cerebral cortex is formed in connexion with the neurone-chains coming into the central nervous organ from the patch of olfactory cells on the surface of the head. The region of cerebrum thus developed is the so-called olfactory lobe and hippocampal formation. The greater part of the cerebral hemisphere is often termed the *pallium*, because as its development extends it folds cloak-wise over the older structures at the base of the brain. The olfactory lobe, from its position, is sometimes called the *pallium basale*, and the hippocampal formation the *pallium*

*marginale*; and these two parts of the pallium form what, on account of their phylogenetic history, Elliott Smith well terms the *archipallium*. A fissure, the limbic fissure, marks off more or less distinctly this archipallium from the rest of the pallium, a remainder which is of later development and therefore designated by Elliott Smith the *neopallium*. Of the archipallium, the portion which constitutes the olfactory lobe is well formed in the selachian fish. In the reptilian cerebrum the hippocampal region, the pallium marginale, coexists in addition. These are both of them olfactory in function. Even so high up in the animal scale as the lowest mammals they still form one half of the entire pallium. But in the higher apes and in man the olfactory portion of the pallium is but a small fraction of the pallium as a whole. It is indeed so relatively dwarfed and obscured as to be invisible when the brain is regarded from the side or above. The olfactory part of the pallium exhibits little variation in form as traced up through the higher animals. It is of course small in such animals as Cetaceans, which are *anosmatic*. In highly osmatic such as the dog it is large. The *uncus*, and *subiculum cornu ammonis* of the human brain, belong to it. Disease of these parts has been accompanied by disturbance of the sense of smell. When stimulated electrically (in the rabbit) the olfactory pallium occasions peculiar torsion of the nose and lips (Ferrier), and change, often slowing or arrested, of the respiratory rhythm. P.E. Flechsig has shown that the nerve-fibres of this part of the pallium attain the final stage of their growth, that is to say, acquire their sheaths of myelin, early in the ontogenetic development of the brain. In the human brain they are myelinate before birth. This is significant from the point of view of function, for reasons which have been made clear especially by the researches of Flechsig himself.

The completion of the growth of the nerve-fibres entering and leaving the cortex occurs at very various periods in the growth of the brain. Study of the development of the fibres entering and leaving the various regions of the pallium in the human brain, discovers that the regions may be conveniently grouped into those whose fibres are perfected before birth and those whose fibres are perfected during the first post-natal month, and those whose fibres are perfected after the first but before the end of the fourth post-natal month. The regions thus marked out by completion before birth are five in number, and are each connected, as also shown by collateral evidence, with one or other particular species of sense-organ. And these regions have another character in common recognizable in the nerve-fibres entering and leaving them, namely, they possess fibres projected to or from parts of the nervous system altogether outside the cortex itself. These fibres are termed “projection” fibres. Other regions of the cortex possess fibres coming from or going to various regions of the cortex itself, but do not possess in addition, as do the five primitive cortical fields, the fibres of projection. So that the facts established by Flechsig for the regions of pallium, which other evidence already indicated as connected with the sense-organ of smell, support that evidence and bring the olfactory region of cortex into line with certain other regions of cortex similarly primarily connected with organs of sense.



It will be noted that what has been achieved by these various means of study in regard to the region of the cortex to which olfactory functions are attributed amounts at present to little more than the bare ascertainment of the existence there of nervous mechanisms connected with olfaction, and to the delimiting roughly of their extent and of their ability to influence certain movements, and in man sensations, habitually associated with exercise of the olfactory organ. As to what part the cortical mechanism has in the elaboration or association of mental processes to which olfaction contributes, no evidence worth the name seems as yet forthcoming. In this respect our knowledge, or rather our want of knowledge, of the functions of the olfactory region of the cortex, is fairly typical of that to which we have to confess in regard to the other regions of the cortex, even the best known.

*Visual Region of the Cortex.*—There is a region of the cortex especially connected with vision. The *optic nerve* and *tract* constitute the second link in the chain of neurones joining the retina to the brain. They may therefore be regarded as the equivalent of an intraspinal tract connecting the deep ends of the afferent neurones from the skin with higher nervous centres. In the bony fishes the optic tract reaches the grey matter of the optic lobe, a part of the mid-brain, to which the so-called anterior colliculus is equivalent in the mammalian brain. In the optic lobe the axones of the neurones of the optic tract meet neurones whose axones pass in turn to the motor neurones of the muscles moving the eyeballs, and also to other motor neurones. But in these fish the optic tract has no obvious connexion with the fore-brain or with any cerebral pallium. Ascending, however, to the reptilian brain is found an additional arrangement: a small portion of the optic tract passes to grey matter in front of the optic lobe. This grey matter is the lateral geniculate body. From this geniculate body a number of neurones extend to the pallial portion of the cerebrum, for in the reptilian brain the pallium is present. The portion of pallium connected with the lateral geniculate body lies above and behind the olfactory or archipallium. It is a part of what was mentioned above as neopallium.

In the mammalian brain the portion of the optic tract which goes to the optic lobe (*ant. colliculus* of the mammal) is dwarfed by great development of the part which goes to the geniculate body and an adjoining grey mass, the pulvinar (part of the optic thalamus). From these latter pass large bands of fibres to the occipital region of the neopallium. In mammals this visual

region of the cortex is distinguished in its microscopic features from the cortex elsewhere by a layer of myelinate nerve-fibres, many of which are the axones of neurones of the geniculate body and pulvinar. Thus, whereas in the bony fishes all the third links of the conductive chain from the retina lead exclusively to the final neurones of motor centres for muscles, in the mammal the majority of the third links conduct to grey matter of the cortex cerebri.

The application of electric stimuli to the surface of the cortex does not for the greater part of the extent of the cortex evoke in higher mammalian brains any obvious effect; no muscular act is provoked. But from certain limited regions of the cortex such stimulation does evoke muscular acts, and one of these regions is that to which the neurones forming the third link of the conductive chain from the retina pass. The muscular acts thus provoked from that region are movements of the eyeballs and of the neck turning the head. In the monkey the movement is the turning of both eyeballs and the head away from the side stimulated. In short, the gaze is directed as to an object on the opposite side. The newer conductive chain traceable through the cortex does therefore, after all, like the older one through the optic lobe, lead ultimately to the motor neurones of the eye muscles and the neck, only it takes a longer course thither and is undoubtedly much more complex. What gain is effected by this new and as it were alternative and longer route, which takes a path up to the cerebral cortex and down again, we can only conjecture, but of one point we may rest well assured, namely, that a much richer inter-connexion with other arcs of the nervous system is obtained by the path that passes via the cortex. The functional difference between the old conductive circuit and the new can at present hardly indeed be stated even in outline. A natural inference might be that the phylogenetically older and less complex path is concerned with functions purely reflex-motor, not possessing sensation as an attribute. But fish, which possess only the older path, can be trained to seize bait of one colour and not of another colour, even against what appeared to be an original colour-preference in them. Such discrimination individually acquired seems to involve memory, though it may be rudimentary in kind. Where motor reaction to visual stimuli appears to involve memory—and without memory the training could hardly be effective—some germ of consciousness can hardly be denied to the visual reactions, although the reactions occurred in complete absence of a cortical path and indeed of a visual cortex altogether.

Removal of the visual pallium in the tortoise produces little or no obvious defect in vision; but in the bird such a lesion greatly impairs the vision of the eye of the side opposite to the lesion. The impairment does not, however, amount to absolute blindness. Schrader’s hawk, after removal of the pallium, reacted to movements of the mice with which it was caged. But the reactions were impaired: they lacked the sustained purpose of the normal reactions. The bird saw the mice; that was certain, for their movements across its field of vision made it turn its gaze towards them. But on their ceasing to move, the reaction on the part of the bird lapsed. Neither did their continuing to move excite the attack upon them which would have been the natural reaction on the part of the bird of prey towards its food. The bird apparently did not recognize them as prey, but saw them merely as moving objects. It saw them perhaps as things to which mental association gave no significance. Similarly, a dog after ablation of the occipital lobes of the cortex is able to see, for it avoids obstacles in its path; but if food is offered to it or the whip held up to it, it does not turn towards the food or away from the whip. It sees these things as if it saw them for the first time, but without curiosity, and as if it had no experience of their meaning. It gives no hint that it any longer understands the meaning of even familiar objects so long as these are presented to it through the sense of vision. Destruction of the visual cortex of one hemisphere alone produces in the dog impairment of vision, not as in the bird practically exclusively in the opposite eye, but in one lateral half of each eye, and that half the half opposite the hemisphere injured. Thus when the cortex destroyed is of the right cerebral hemisphere, the resultant visual defect is in the left half of the field of vision of both eyes. And this is so in man also.

In man disturbances of sensation can be better studied because it is possible to obtain from him his description of his condition. The relation of the *cortex cerebri* to human vision can be summarized briefly as follows. The visual cortex is distinguishable in higher mammals by a thin white stripe, the stripe of Gennari, seen in its grey matter when that is sectioned. This stripe results from a layer of nerve-fibres, many of which are axones from the neurones of the lateral geniculate body and the pulvinar, the grey masses directly connected with the optic nerve-fibres. In the dog, and in such monkeys as the Macaque, the region of cortex containing this stripe traceable to optic fibres forms practically the whole occipital lobe. But in the man-like apes and in man this kind of cortex is confined to one region of the occipital lobe, namely, that of the calcarine fissure and the *cuneus* behind that. This region of cortex thus delimited in man is one of Flechsig’s areas of earlier myelinization. It is also one of his areas possessing projection fibres; and this last fact agrees with the yielding by this area, when under electrical stimulation, of movements indicating that impulses have been discharged from it into the motor neurones of the muscles of the eyes and neck. Evidence from cases of disease show that destruction of the cortex of the upper lip of the calcarine fissure, say in the right half of the brain, causes in man impairment in the upper right-hand quadrant of both retinae: destruction of the lower lip of the fissure causes impairment in the lower right-hand quadrants. Destruction of the calcarine region

of one hemisphere produces therefore “crossed hemianopia,” that is, loss of the opposite half of the field of vision. But in this hemianopia the region of central vision is always spared. That is, the piece of visual field which corresponds with the yellow spot of the retina is not affected in either eye, unless the calcarine regions of both hemispheres are destroyed. This central point of vision is connected therefore not with one side of the brain only but with both.

The impairment of sight is more severe in men than in lower animals. Where the destruction of the visuo-sensory cortex in one calcarine region is complete, a candle-flame offered in the hemianopic field cannot even be perceived. It may hardly excite a reflex contraction of the pupil. In such cases the visual defect amounts to blindness. But this is a greater defect than is found in the dog even after entire removal of both occipital lobes. The dog still avoids obstacles as it walks. Its defect is rather, as said above, a complete loss of interest in the visual images of things. But a dog or monkey after loss of the visual cortex hesitates more and avoids obstacles less well in a familiar place than it does when entirely blind from loss of the peripheral organ of vision. In man extensive destruction of the visual cortex has as one of its symptoms loss of memory of localities, thus, of the paths of a garden, of the position of furniture, and of accustomed objects in the patient’s own room. This loss of memory of position does not extend to spatial relations ordinarily appreciated by touch, such as parts of the patient’s own person or clothing. There is nothing like this in the symptoms following blindness by loss of the eye itself. Those who lose their sight by disease of the retina retain good memorial pictures of positions and directions appreciated primarily by vision.

Cases of disease are on record in which loss of visual memory has occurred without hemianopia. Visual hallucinations referred to the hemianopic side have been observed. This suggests that the function of visual memory in regard to certain kinds of percepts must belong to localities of cortex different from those pertaining to other visual percepts. The area of cortex characterized by the stripe of Gennari occupies in man, as mentioned, the calcarine and cuneate region. It is surrounded by a cortical field which, though intimately connected with it by manifold conducting fibres, &c., is yet on various grounds distinct from it. This field of cortex surrounding the visuo-sensory of the calcarine-cuneate region is a far newer part of the neopallium than the region it surrounds. Both in the individual (Flechsig) and in the phylum (Bolton, Campbell, Mott) its development occurs far later than that of the visuo-sensory which it surrounds. Flechsig finds that it has no “projection” fibres, that is, that it receives none of the optic radiations from the lower visual centres and gives no centrifugal fibres in the reverse direction. This field encompassing the visuo-sensory region differs from the latter in its microscopic structure by absence of the lower layer of stellate cells and by the presence in it of a third or deep layer of pyramidal cells (Mott). Its fibres are on the average smaller than are those of the visuo-sensory (W.A. Campbell). This zonal field is small in the lower apes, and hardly discoverable in the dog. In the anthropoid apes it is much larger. In man it is relatively much larger still. The impairment of visual memory and visual understanding in regard to direction and locality is said to be observed in man only when the injury of the cortex includes not only the calcarine-cuneate region but a wide area of the occipital lobe. From this it is argued that the zonal field is concerned with memories and recognitions of a kind based on visual perceptions. It has therefore been termed the *visuo-psychic* area. It is one of Flechsig’s “association-areas” of the cortex.

Adjoining the antero-lateral border of the just-described *visuo-psychic area* lies another region separate from it and yet related to it. This area is even later in its course of development than is the visuo-psychic. It is one of Flechsig’s “terminal fields,” and its fibres are among the last to ripen in the whole cortex. This terminal field is large in man. It runs forward in the parietal lobe above and in the temporal lobe below. Its wide extent explains, in the opinion of Mott, the displacement of the visuo-sensory field from the outer aspect of the hemisphere in the lower monkeys to the median aspect in man. To this terminal field all the more interest attaches because it includes the angular gyrus, which authorities hold to be concerned with the visual memory of words. Study of diseased conditions of speech has shown that the power to understand *written* words may be lost or severely impaired although the words may be perfectly distinct to the sight and although the power to understand *heard* words remains good. This condition is asserted by many physicians to be referable to destruction of part of the angular gyrus. Close beneath the cortex of the angular gyrus runs a large tract of long fibres which pass from the visual cortex (see above) to the auditory cortex (see below) in the superior temporal gyrus and to the lower part of the frontal lobe. This lower part of the frontal lobe is believed—and has long been believed—to be concerned intimately with the production of the movements of speech. A difficulty besetting the investigation of the function of the angular gyrus is the fact that lesion of the cortex there is likely to implicate the underlying tract of fibres in its damage. It cannot be considered to have been as yet clearly ascertained whether the condition of want of recognition of seen words—”word-blindness”—is due to cortical injury apart from subcortical, to the angular gyrus itself apart from the underlying tract. Word-blindness seems, in the right-handed, to resemble the aphasia believed to be connected with the lower part of the frontal lobe, in that it ensues upon lesions of the left hemisphere, not of the right. In left-handed persons, on the contrary, it seems to attach to the right hemisphere.

*Auditory Region of the Cortex.*—Besides the two great organs of distance-receptors, namely, the nose and eye, whose cerebral apparatus for sensation has just been mentioned, those of a third great distance-receptor have to be considered. The agents of stimulation of the two former are respectively chemical (olfactory) and radiant (visual); the mode of stimulation of the third is mechanical, and the sensations obtained by it are termed auditory. Their cerebral localization is very imperfectly ascertained. Electric stimuli applied to a part of the uppermost temporal gyrus excites movements of the ears and eyes in the dog. Destruction of the same region when executed on both hemispheres is argued by several observers to impair the sense of hearing. To this region of cortex fibres have been traced from the lower centres connected with the nerve-fibres coming from the cochlea of the ear. From each cochlear nerve a path has been traced which passes to the *insulae* and the above-mentioned *temporal* region of cortex of both the cerebral hemispheres. The insula is a deeper-seated area of cortex adjoining the uppermost temporal convolution. To it Flechsig's chronological studies also impute a connexion with the nerves of the ear. Early myelinization of fibres, presence of ascending and descending "projection" tracts to and from lower centres outside the cortex, calibre of fibres, microscopic characters of its cortical cells, all those kinds of indirect items of evidence that obtain for the visual cortex likewise mark out this insular-temporal area as connected fairly directly with a special sense-organ, as in fact a sensory field of the cortex; and the suspicion is that it is auditory. Clinical observation supports the view in a striking way, but one requiring, in the opinion of some, further confirmation. It is widely believed that destruction of the upper and middle part of the uppermost temporal convolution produces "word-deafness," that is, an inability to recognize familiar words when heard, although the words are recognized when seen.



More precise information regarding this auditory region of the cortex has recently been obtained by the experiments of Kalischer. These show that after removal of this region from both sides of the brain in the dog the animal shows great defect in answering to the call of its master. Whereas prior to the operation the animal will prick its ears and attend at once to the lightest call, it requires after the removal of the auditory regions great loudness and insistence of calling to make it attend and react as it did. This is the more striking in view of other experimental results obtained. Kalischer trained a number of his dogs not to take meat offered them except at the sound of a particular note given by an organ pipe or a harmonium. The dogs rapidly learned not to take the food on the sounding of notes of other pitch than the one taught them as the permissive signal. This reaction on the part of the animal was not impaired by the removal of the so-called auditory regions of the cortex. Kalischer suggests that this reaction taught by training is not destroyed by the operation which so greatly impairs the common reaction to the master's call, because the former is a simpler process more allied to reflex action. In it the attention of the dog is already fastened upon the object, namely the food, and the stimulus given by the note excites a reaction which simply allows the act of seizing the food to take place, or on the other hand stops it. In the case of answering the call of the master the stimulus has to excite attention, to produce perception of the locality whence it comes, and to invoke a complicated series of movements of response. He finds that destruction of the posterior colliculi of the mid-brain, which have long been known to be in some way connected with hearing, likewise destroys the response to the call of the master, but did not destroy the trick taught to his dogs of taking meat offered at the sound of a note of one particular pitch but not at notes of other pitch given by the same instrument.

*Other Senses and Localization in the Cortex Cerebri.*—Turning now to the connexion between the function of the cortex and the senses other than those of the great distance-receptors just dealt with, even less is known. Disturbance and impairment of skin sensations are observable both in experiments on the cerebrum of animals and in cases of cerebral disease in man. But the localization in the cortex of regions specially or mainly concerned with cutaneous sensation has not been made sufficiently clear to warrant statement here. Still less is there satisfactory knowledge regarding the existence of cortical areas concerned with sensations originated in the alimentary canal. The least equivocal of such evidence regards the sense of taste. There is some slight evidence of a connexion between this sense and a region of the hippocampal gyrus near to but behind that related to smell.

As to the sensations excited by the numerous receptors which lie not in any of the surface membranes of the body but embedded in the masses of the organs and between them, the *proprioceptors*, buried in muscles, tendons and joints, there is little doubt that these sensations may be disturbed or impaired by injury of the *cortex cerebri*. They may probably also be excited by cortical stimulation. But evidence of localization of their seat in, and their details of connexion with, the cortex, is at present uncertain. Many authorities consider it probable that sensations of touch and the sensations initiated by the proprioceptors of muscles and joints (the organs of the so-called muscular sense) are specially related to the post-central gyrus and perhaps to the pre-central gyrus also. The clearest items on this point are perhaps the following.

Besides the regions instanced above, in the limbic (olfactory), occipital (visual), and temporal (auditory) lobes, as exhibiting precocity of development, there is a region showing similar precocity in the fronto-parietal portion of the hemisphere. This is the region which in the Primates includes the large *central fissure* (sometimes called the fissure of Rolando). To it fibres

are traced which seem to continue a path of conduction that began with afferent tracts belonging to the spinal cord, and tracts which there is reason to think conduct impulses from the receptor-organs of skin and muscles. The part of the cortex immediately behind the *central fissure* seems to be the main cortical goal for these upward-conducting paths. That *post-central* strip of cortex would in this view bear to these paths a relation similar to that which the occipital and temporal regions bear to afferent tracts from the retina and the cochlea. There are observations which associate impaired tactual sense and impaired perception of posture and movement of a limb with injury of the *central region* of the cortex. But there are a number also which show that the motor defect which is a well-ascertained result of injury of the *pre-central* gyrus is sometimes unaccompanied by any obvious defect either of touch or of muscular sense. It seems then that the motor centres of this region are closely connected with the centres for cutaneous and muscular sense, yet are not so closely interwoven with them that mechanical damage inflicted on the one of necessity heavily damages the other as well. There is evidence that the sensory cortex in this region lies posterior to that which has been conveniently termed the "motor." These latter in the monkey and the man-like apes and man lie in front of the central fissure: the sensory lie probably behind it. A.W. Campbell has found changes in the cortex of the post-central convolution ensuing in the essentially sensory disease, *tabes dorsalis*, a disease in which degeneration of sensory nerve-fibres of the muscular sense and of the skin senses is prominent. He considers that in man and the man-like apes the part of the post-central gyrus which lies next to and enters into the *central fissure* is concerned with simpler sensual recognitions, while the adjoining part of that convolution farther back is a "psychic region" concerned with more complex psychosis connected with the senses of skin and muscle. His subdivision of the post-central gyrus is based on histological differences which he discovers between its anterior and its posterior parts and on the above-described analogous differentiation of a "sensory" from a "psychic" part in the visual region of cortex.

It will be noted that although certain regions of the cortex are found connected closely with certain of the main sense organs, there are important receptive organs which do not appear to have any special region of cortex assigned to their sensual products. Thus, there is the "vestibular labyrinth" of the ear. This great receptive organ, so closely connected in function with the movements and adjustment of the postures of the head and eyes, and indeed of the whole body, is prominent in the co-ordination necessary for the equilibrium of the body, an essential part of the fundamental acts of progression, standing, &c. Yet neither structural nor functional connexion with any special region of the cortex has been traced as yet for the labyrinthine receptors. Perceptions of the position of the head and of the body are of course part of our habitual and everyday experience. It may perhaps be that these perceptions are almost entirely obtained through sense organs which are not labyrinthine, but visual, muscular, tactual, and so on. The labyrinth may, though it controls and adjusts the muscular activities which maintain the balance of the body, operate reflexly without in its operation exciting of itself sensations. The results of the unconscious reflexes it initiated and guided would be perceptible through other organs of sense. But against this purely unconscious functioning of the labyrinth and its nervous apparatus stands the fact that galvanic stimulation of the labyrinth is accompanied by well-known distinctive sensations—including giddiness, &c. Moreover, the prominent factor in sea-sickness, a disorder richly suffused with sensations, is probably the labyrinth. Yet there is marked absence of evidence of any special and direct connexion between the *cortex cerebri* and the labyrinth organs.

Also there is curiously little evidence of connexion of the cortex with the nervous paths of conduction concerned with pain. As far as the present writer can find from reference to books and from the clinical experience of others, "pain" is unknown as an *aura* in cortical epilepsy, or at most is of equivocal occurrence.



The preceding brief exposition of some of the main features of the localization of function in the *cortex cerebri*, gradually deciphered by patient inquiry, shows that the scheme of partition of function so far perceptible does not follow the quaint lines of analysis of the phrenologists with their supposed mental entities, so-called "faculties." On the contrary it is based, as some of those who early favoured a differential arrangement of function in the cerebrum had surmised, on the *separateness of the incoming channels from peripheral organs of sense*. These organs fall into groups separate one from another not only by reason of their spatial differentiation at the surface and in the thickness of the body, but also because each group generates sensations which introspection tells us are of a species unbridgeably separate from those generated by the other groups. Between sensations of hearing and sensations of sight there is a dissimilarity across which no intermediate series of sensual phenomena extend. The two species of sensations are wholly disparate. Similarly there is a total and impassable gap between sensations of touch and sensations of sight and sound. In other words the sensations fall into groups which are wholly disparate and are hence termed species. But within each species there exist multifold varieties of the specific sensation, *e.g.* sensations of red, of yellow, &c. We should expect, therefore, that the conducting paths from the receptive organs which in their function as sense-organs yield wholly disparate sensations would in so far as subserving sensation diverge and pass to separate neural

mechanisms. That these sense-organs should in fact be found to possess in the cortex of the cerebrum separate fields for their sensual nervous apparatus is, therefore, in harmony with what would be the *a priori* supposition.

But, as emphasized at the beginning of this article, the receptive organs belonging to the surfaces and the depths of the body and forming the starting-points for the whole system of the afferent nerves, have two functions more or less separate. One of these functions is to excite sensations and the other is to excite movements, by reflex action, especially in glands and muscles. In this latter function, namely the reflexifacient, all that the receptive organs effect is effected by means of the efferent nerves. They all have to use the efferent, especially the motor, nerves of the body. So rich is the connexion of the receptive organs with the efferent nerves that it is not improbable that, through the central nervous organ, each receptive organ is connected with every motor nerve of the whole nervous system,—the facts of strychnine poisoning show that if this is not literally true it is at least approximately so. Hence one of the goals to which each afferent fibre from a receptive organ leads is a number of motor nerves. Their conducting paths must, therefore, converge in passing to the starting-points of the motor nerves; because these latter are instruments common to the use of a number of different receptive organs in so far as they excite reflex actions. On the other hand those of their conducting paths which are concerned in the genesis of sensation, instead of converging, diverge, at least as far as the *cortex cerebri*, or if not divergent, remain separate. These considerations would make it appear likely that the conducting path from each receptive organ divides in the central nervous system into two main lines, one of which goes off to its own particular region of the *cortex cerebri* whither run conductors only of similar sensual species to itself, while the other main line passes with many others to a great motor station where, as at a telephone exchange, coordinate use of the outgoing lines is assured to them all. Now there is in fact a portion of the cortex in mammals the functions of which are so pre-eminently motor, as judged by our present methods, that it is commonly designated the *motor cortex* (see fig. 24). This region of the cortex occupies in the Primates, including Man, the pre-central gyrus. Among the items of evidence which reveal its motor capabilities are the following.

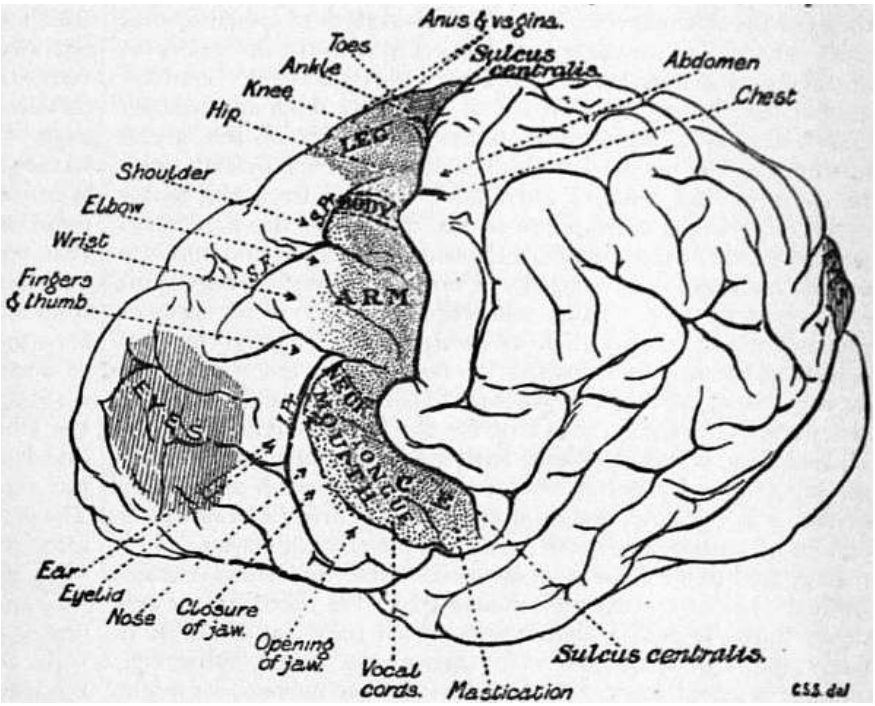



FIG. 24.—Diagram of the Topography of the Main Groups of Foci in the Motor Field of Chimpanzee.

*The Precentral or Motor Region of the Cortex.*—The application to it of electric currents excites movements in the skeletal muscles. The movements occur in the half of the body of the side crossed from that of the hemisphere excited. The "motor representation," as it is termed, is in the cortex better described as a representation of definite actions than of particular muscles. The actions "represented" in the top part of the gyrus, namely next the great longitudinal fissure, move the leg; those in the lowest part of the gyrus belong to the tongue and mouth. The topical distribution along the length of the gyrus may be described in a general way as following a sequence resembling that of the motor representation in the spinal cord, the top of the gyrus being taken as corresponding with the caudal end of the spinal cord. The sequence as the gyrus is followed downwards runs: perineum, foot, knee, hip, abdomen, chest, shoulder, elbow, wrist, hand, eyelids and ear, nose, mouth and tongue. The nature of the movement is very fairly constant for separate points of this motor cortex as observed both in the same and in similar experiments. Thus flexion of the arm will be excitable from one set of points, and extension of the arm from another set of points; opening of the jaw from one set and closure from another, and so

on. These various movements if excited strongly tend to have characters like those of the movements seen in an epileptic convulsion. Strong stimulation excites in fact a convulsion like that of epilepsy, beginning with the movement usual for the point stimulated and spreading so as to assume the proportions of a convulsion affecting the entire skeletal musculature of one half or even of the whole body. The resemblance to an epileptic seizure is the closer because the movement before it subsides becomes clonic (rhythmic) as in epilepsy. The determination of the exact spots of cortex in which are represented the various movements of the body has served a useful practical purpose in indicating the particular places in the cortex which are the seat of disease. These the physician can localize more exactly by reason of this knowledge. Hence the surgeon, if the nature of the disease is such as can be dealt with by surgical means, can without unnecessarily damaging the skull and brain, proceed directly to the point which is the seat of the mischief.

The motor representation of certain parts of the body is much more liberal than is that of others. There is little correspondence between the mere mass of musculature involved and the area of the cortex devoted to its representation. Variety of movement rather than force or energy of movement seems to demand extent of cortex. The cortical area for the thumb is larger than those for the whole abdomen and chest combined. The cortical area for the tongue is larger than that for the neck. Different movements of one and the same part are very unequally represented in the cortex. Thus, flexion of the leg is more extensively represented than is extension, opening of the jaw has a much larger cortical area than has closure of the jaws. It is interesting that certain agents, for instance strychnine, and the poison of the bacilli which cause the disease known as tetanus or lock-jaw, upset this normal topography, and replace in the cortex flexion of the limb by extension of the limb, and opening of the jaw by closure of the jaw. There is, however, no evidence that they do this by changing in any way the cortical mechanisms themselves. It is more likely that their action is confined to the lower centres, bulbar and spinal, upon which the discharge excited from the cortex plays. The change thus induced in the movement excited by the cortex does, however, show that the point of cortex which causes for instance opening of the mouth is connected with the motor nerves to the closing muscles as well as with those of the opening muscles. This is an item of evidence that the “centres” of the cortex are connected with the motor nerves of antagonistic muscles in such a way that when the “centre” excites one set of the muscles to contract, it simultaneously under normal circumstances causes inhibition of the motor neurones of the opposed set of muscles (reciprocal innervation). In the great majority of movements excited from the motor cortex of a single hemisphere of the cerebrum, the movement evoked is confined to one side of the body, namely to that opposite to the hemisphere stimulated. There are, however, important exceptions to this. Thus, adduction of both vocal cords is excited from the cortex of either hemisphere. The movement of closure of the eyelids is usually bilateral, unless the stimulation be very weak; then the movement is of the eyelids of the opposite side only. The same holds true for the movements of the jaw. It, therefore, seems clear that with many movements which are usually bilaterally performed in ordinary life, such as opening of the jaw, blinking, &c., the symmetrical areas of the motor regions of both hemispheres are simultaneously in action.



In regard to all these movements elicitable by artificial stimuli from the motor cortex it is obvious that were there clearer evidence that the pallial region from which they are elicitable is fairly directly connected with corticopetal paths subserving cutaneous sensation or “muscular sense,” the movements might be regarded as falling into the category of higher reflexes connected with the organs of touch, muscular sense, &c., just as the movements of the eyeball excitable from the visual cortex may be regarded as higher reflexes connected with vision. The evidence of the connexion of the reactions of the motor cortex with cutaneous and muscular senses appears, however, scarcely sufficient to countenance at present this otherwise plausible view, which has on general grounds much to commend it.

It is remarkable that movements of the eyeball itself, *i.e.* apart from movement of the lids, are not in the category of movements elicitable from the precentral gyrus, the “motor” cortex. They are found represented in a region farther forward, namely in front of the precentral gyrus altogether, and occupying a scattered set of points in the direction frontal from the areas for movements of arm and face. This frontal area yields on excitation conjugate movements of both eyeballs extremely like if not exactly similar to those yielded by excitation of the occipital (visual) region of the cortex. It is supposed by some that this frontal area yielding eye-movements has its function in this respect based upon afferent conductors from other parts of the eyeball than the retina, for instance upon kinaesthetic (Bastian) impressions or upon sensual impressions derived from the cornea and the coats of the eyeball including the ciliary and iris muscles. The ocular muscles are certainly a source of centripetal impulses, but their connexion with the cortex is not clear as to either their nature or their seat. The question seems for the present to allow no clearer answer. It is certain, however, that the frontal area of eye movements has corticofugal paths descending from it to the lower motor centres of the eyeballs quite independent of those descending from the occipital (visual) area of eye-movements. Further, it seems clear that in many animals there is another cortical region, a third region, the region which we saw above

might be considered auditory, where movements of the eyeball similar to those elicitable in the occipital and frontal cortex can be provoked. A. Tschermak is inclined to give the eyeball movements of the frontal region the significance of reflex movements which carry the visual field in various directions in answer to demands made by sensory data derived from touch, &c., as for instance from the hand. The movements of the eyeballs elicitable from the occipital region of the cortex he regards as probably concerned with directing the gaze toward something seen, for instance, in the peripheral field of vision. The occipital movement would, therefore, be excited through the retina, and would result in bringing the yellow spot region of the retinae of both eyes to bear upon the object. This view has much to justify it. The movements of the eyeballs excited from the cortex of the auditory region would in a similar way be explicable as bringing the gaze to bear upon a direction in which a sound had been located, auditory initiation replacing the visual and tactual of the occipital and the frontal regions respectively.

Turning from these still speculative matters to others less suggestive but of actual ascertainment, we find that the motor nature of the precentral cortex as ascertained by electric stimuli is further certified by the occurrence of disturbance and impairment of motor power and adjustment following destruction of that region of the cortex. The movements which such a part as a limb executes are of course manifold in purpose. The hind limb of a dog is used for standing, for stepping, for scratching, for squatting, and, where a dog, for instance, has been trained to stand or walk on its hind legs alone, for skilled acts requiring a special training for their acquisition. It is found that when the motor area of the brain has been destroyed, the limb is at first paralysed for all these movements, but after a time the limb recovers the ability to execute some of them, though not all. The scratching movement suffers little, and rapid improvement after cerebral injury soon effaces the impairment, at first somewhat pronounced, in the use of the limb for walking, running, &c., and ordinary movements of progression. Even when both hemispheres have been destroyed the dog can still stand and walk and run. Destruction of the motor region of the cortex renders the fore limbs of the dog unable to execute such skilled movements as the steadying of a bone for gnawing or the trained act of offering the paw in answer to the command of the master. Skilled acts of the limb, apart from conjoined movements in which it, together with all the other limbs, takes part, assume of course a larger share of the office of the limb in the Primates than in the dog; and this is especially true for the fore limb. It is when the fore-foot becomes a hand that opportunity is given for its more skilled individual use and for its training in movements as a tool, or for the handling of tools and weapons. It is these movements which suffer most heavily and for the longest period after injury of the motor region of the cortex. Hence the disablement ensuing upon injury to the cortex would be expected to be most apparent in the Primates; and it is so, and most of all in Man. Further, in Man there ensues a condition called “contracture,” which is not so apparent or frequent a result in other animals,—indeed, does not occur at all in other animals except the monkey. In contracture the muscles of the paretic limb are not flaccid, as they are usually in paralysis, but they are tense and the limb is more or less rigidly fixed by them in a certain position, usually one of flexion at elbow and wrist. This condition does not occur at first, but gradually supervenes in the course of a number of weeks. In Man the destruction of the motor area of the cortex cripples the limb even for the part it should play in the combined limb movements of walking, &c., and cripples it to an extent markedly contrasting with the slight disturbances seen in the lower mammals, *e.g.* the dog.

As regards the recovery of motor power after lesions of the motor cortex, two processes seem 413
at work which are termed respectively *restitution* and *compensation*. By the former is understood the recovery obtained when a part of a “centre” is destroyed, and the rest of the centre, although thrown out of function at first, recovers and supplements the deficiency later. An example of restitution would be the recovery from temporary hemianopia caused by a small injury in one occipital lobe. By compensation is understood the improvement of an impaired nervous function, traceable to other centres different from those destroyed supplying means to compass the reaction originally dependent on the centres subsequently destroyed. Instances of such compensation are the recovery of taxis for equilibrium subsequent to destruction of the labyrinth of the ear, where the recovery is traceable to assistance obtained through the eye. It will be noted that these instances of recovery by restitution and by compensation respectively are taken, from cases of injury inflicted on receptive rather than on motor centres. It is doubtful how far they really apply to the undoubted improvement that does within certain limits progress and succeed in partially effacing the paresis immediately consequent on lesions of the motor area. It has to be remembered that in all cases of traumatic injury to the nervous system, especially where the trauma implicates the central nervous organ, the first effects and impairment of function resulting are due to a mixed cause, namely on the one hand the mechanical rupture of conducting paths actually broken by solution of their continuity, and on the other hand the temporary interruption of conducting paths by “shock.” Shock effects are not permanent: they pass off. They are supposed to be due to a change at the synapses connecting neurone with neurone in the grey matter. They amount in effect to a long-lasting and gradually subsiding inhibition.

For diseases of the brain see Neuropathology, Insanity, Skull (*Surgery*), &c.

(C. S. S.)

1 The literature of the pineal region is enormous. Studnicka (in *Oppels Vergleichende mikrosk. Anat.* Teile 4-5, 1904, 1905) gives 285 references. The present conception of the generalized arrangement is: (α) A single glandular median organ from the fore-brain called the paraphysis. (β) A pouch of the ependymal roof of the ventricle called the dorsal sac. (γ) A right and left epiphysis, one of which may be wholly or partially suppressed. These may change their position to anterior and posterior in some animals.

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**BRAINERD, DAVID** (1718-1747), American missionary among the Indians, was born at Haddam, Connecticut, on the 20th of April 1718. He was orphaned at fourteen, and studied for nearly three years (1739-1742) at Yale. He then prepared for the ministry, being licensed to preach in 1742, and early in 1743 decided to devote himself to missionary work among the Indians. Supported by the Scottish "Society for Promoting Christian Knowledge," he worked first at Kaunaumeek, an Indian settlement about 20 m. from Stockbridge, Massachusetts, and subsequently, until his death, among the Delaware Indians in Pennsylvania (near Easton) and New Jersey (near Cranbury). His heroic and self-denying labours, both for the spiritual and for the temporal welfare of the Indians, wore out a naturally feeble constitution, and on the 19th of October 1747 he died at the house of his friend, Jonathan Edwards, in Northampton, Massachusetts.

His *Journal* was published in two parts in 1746 by the Scottish Society for Promoting Christian Knowledge; and in 1749, at Boston, Jonathan Edwards published *An Account of the Life of the Late Rev. David Brainerd, chiefly taken from his own Diary and other Private Writings*, which has become a missionary classic. A new edition, with the *Journal* and Brainerd's letters embodied, was published by Sereno E. Dwight at New Haven in 1822; and in 1884 was published what is substantially another edition, *The Memoirs of David Brainerd*, edited by James M. Sherwood.

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**BRAINERD,** a city and the county-seat of Crow Wing county, Minnesota, U.S.A., on the E. bank of the Mississippi river, about 127 m. N.W. of Minneapolis. Pop. (1890) 5703; (1900) 7524, of whom 2193 were foreign-born; (1905) 8133; (1910) 8526. It is served by the Minnesota & International and the Northern Pacific railways. The latter maintains here large car and repair shops, and a sanatorium for its employees. There are also the Sisters of St Joseph hospital, a county court house, a public library and a Y.M.C.A. building. A dam across the Mississippi provides water power (about 60,000 H.P.) which is utilized extensively for manufacturing purposes. Lumbering is an important industry, and there are saw mills and planing mills, and an extensive creosote plant for treating railway ties and timber. There are also flour mills, paper and pulp mills, cigar factories, a brewery, a large foundry and a grain elevator. In 1906 large quantities of iron ore were discovered in the vicinity, the new range, the Cuyuna, running through the city from north-east to south-west. Brainerd, named in honour of David Brainerd, was settled in 1870, and chartered as a city in 1883.

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**BRAINTREE,** a market town in the Maldon parliamentary division of Essex, England; 45 m. N.E. of London by a branch line from Witham of the Great Eastern railway. Pop. of urban district, 5330. The parish church of St Michael is a fine edifice of Early English work with later additions. A corn exchange, mechanics' institute and public hall may also be mentioned. The bishops of London had formerly a palace in the town, but there are no remains of the building. The manufactures of silk and crape have superseded that of woollen cloth, which was introduced by the Flemings who fled to England to escape the persecution of the duke of Alva. Matting and brushes are also made. On the north lies the large village of BOCKING, with the Perpendicular parish church of St Mary, similar industries, and a population of 3347.

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**BRAINTREE,** a township of Norfolk county, Massachusetts, U.S.A., on the Monatiquot river about 10 m. S. of Boston. Pop. (1890) 4848; (1900) 598l, including 1250 foreign-born; (1905, state census) 6879; (1910) 8066. The New York, New Haven & Hartford railway crosses the town and has stations at its villages of Braintree, South Braintree and East Braintree, which are also served by suburban electric railways. In South Braintree are the Thayer Academy (co-educational; opened 1877) and the Thayer public library, both founded by and named in honour of General Sylvanus Thayer (1785-1872), a well-known military engineer born in Braintree, who was superintendent of the United States Military Academy in 1817-1833 and has been called the "father of West Point." There are large shoe factories and other manufactories. Bog iron was early found in Braintree, and iron-works, among the first in America, were established here in 1644. Braintree was first incorporated in 1640 from land belonging to Boston and called Mount Wollaston, and was named from the town in England. At Merry Mount, in that part of Braintree which is now Quincy, a settlement was established by Thomas Morton in 1625, but the gay life of the settlers and their selling rum and firearms to the Indians greatly offended the Pilgrims of Plymouth, who in 1627 arrested Morton; soon afterward Governor John Endecott of Massachusetts Bay visited Merry Mount, rebuked the inhabitants and cut down their Maypole. Later the place was abandoned, and in 1634 a Puritan settlement was made here. In 1708 the town was divided into the North Precinct and the South Precinct, and it was in the former, now Quincy, that John Adams, John Hancock and John Quincy Adams were born. Quincy was separated from Braintree in 1792 (there were further additions to Quincy from Braintree in 1856), and Randolph in 1793.

See D.M. Wilson, *Quincy, Old Braintree and Merry Mount* (Boston, 1906); C.F. Adams, Jr., *Three Episodes of Massachusetts History* (Boston, 1892 and 1896); W.S. Pattee, *History of Old Braintree and Quincy* (Quincy, 1878).

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**BRAKE,** a town of Germany, in the grand duchy of Oldenburg, on the left bank of the Weser, about halfway between Bremen and the mouth of the river. Pop. 5000. It was for centuries the port of Bremen; and though, since the founding of Bremerhaven, it no longer possesses a monopoly of the river traffic as before, it still continues to flourish. Large docks have been constructed, and the place has a considerable import trade in English coal. Shipbuilding and weaving are carried on to some extent.

Brake in Oldenburg must be distinguished from the village of the same name in the principality of Lippe, known as Brake bei Limgo, which gave its name to the cadet line of the counts of Lippe-Brake (1621-1709).

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**BRAKE.** (1) A term for rough-tangled undergrowth, connected, according to the *New English Dictionary*, with "break," to separate. The "brake-fern" (*Pteris aquilina*) is the common "bracken," and is a shortened form of that northern Eng. word, derived from a Scand. word for "fern" (cf. Swed. *bräken*), though often confused with "brake," undergrowth. (2) A term applied to many implements and mechanical and other appliances, often spelled "break." Here there are probably several words, difficult to separate in origin, connected either with "break," to separate, and its derived meanings, or with the Fr. *braquer* (appearing in such expressions as *braquer un canon*, to turn or point a gun), from O. Fr. *brac*, modern *bras*, an arm, Lat. *bracchium*. The word is thus used of a toothed instrument for separating the fibre of flax and hemp; of the "break-rolls" employed in flour manufacture; of a heavy wheeled vehicle used for "breaking in" horses, and hence of a large carriage of the wagonette type; of an arm or lever, and so of the winch of a crossbow and of a pump handle, cf. "brake-pump"; of a curb or bridle for a horse; and of a mechanical appliance for checking the speed of moving vehicles, &c. It is noteworthy that the two last meanings are also possessed by the Fr. *frein* and the Ger. *Bremse*.



Brakes, in engineering, are instruments by means of which mechanical energy may be expended in overcoming friction. They are used for two main classes of purpose: (1) to limit or decrease the velocity of a moving body, or to bring it completely to rest; and (2) to measure directly the amount of frictional resistance between two bodies, or indirectly the amount of energy given out by a body or bodies in motion. Machines in which brakes are employed for purposes of the second class are commonly known as dynamometers (*q.v.*). The other class is exemplified in the brakes used on wheeled vehicles and on cranes, lifts, &c. Here a body, or

system of bodies, originally at rest, has been set in motion and has received acceleration up to a certain velocity, the work which has been done in that acceleration being stored up as “actual energy” in the body itself. Before the body can be brought to rest it must part with this energy, expending it in overcoming some external resistance. If the energy be great in proportion to the usual resistance tending to stop the body, the motion will continue for a long time, or through a long distance, before the energy has been completely expended and the body brought to rest. But in certain cases considerations of safety or convenience require that this time or distance be greatly shortened, and this is done by artificially increasing the external resistance for the time being, by means of a brake.

A simple method of obtaining this increased resistance is by pressing a block or shoe of metal or wood against the rim of a moving wheel, or by tightening a flexible strap or band on a rotating pulley or drum. In wheeled road vehicles, a wheel may be prevented from rotating by a chain passed through its spokes and attached to the body of the vehicle, when the resistance is increased by the substitution of a rubbing for a rolling action; or the same effect may be produced by fixing a slipper or skid under the wheel. Other forms of brake depend, not on the friction between two solid bodies, but on the frictional resistance of a fluid, as in “fan” and “pump” brakes. Thus the motion of revolving blades may be opposed by the resistance of the air or of a liquid in which they are made to work, or the motion of a plunger fitting tightly in a cylinder filled with a fluid may be checked by the fluid being prevented from escape except through a narrow orifice. The fly used to regulate the speed of the striking train in a clock is an example of a fan brake, while a pump brake is utilized for controlling the recoil of guns and in the hydraulic buffers sometimes fitted at terminal railway stations to stop trains that enter at excessive speed. On electric tramcars a braking effect is sometimes obtained by arranging the connexions of the motors so that they act as generators driven by the moving car. In this way a counter-torque is exerted on the axles. The current produced is expended by some means, as by being made to operate some frictional braking device, or to magnetize iron shoes carried on the car just over, but clear of, the running rails, to which they are then magnetically attracted (see TRACTION).

The simplest way of applying a brake is by muscular force, exerted through a hand or foot lever or through a screw, by which the brake block is pressed against the rim of the wheel or the band brake tightened on its drum. This method is sufficient in the case of most road vehicles, and is largely used on railway vehicles. But the power thus available is limited, and becomes inadequate for heavy vehicles moving at high speeds. Moreover, on a train consisting of a number of vehicles, the hand brakes on each of which are independent of all others, either a brakesman must be carried on each, or a number of the brakes must be left unused, with consequent loss of stopping power; while even if there is a brakesman on every vehicle it is impossible to secure that all the brakes throughout the train are applied with the promptness that is necessary in case of emergency.

Considerations of this sort led to the development of power brakes for railway trains. Of these there are five main classes:—

***Railway power brakes.***

(1) Mechanical brakes, worked by springs, friction wheels on the axle, chains wound on drums, or other mechanical devices, or by the force produced when, by reason of a sudden checking of the speed of the locomotive, the momentum of the cars causes pressure on the draw-bars or buffing devices. (2) Hydraulic brakes, worked by means of water forced through pipes into proper mechanism for transmitting its force to the brake-shoes. (3) Electric brakes. (4) Air and vacuum brakes, worked by compressed air or by air at atmospheric pressure operating on a vacuum. (5) Brakes worked by steam or water from the boiler of the engine, operating by means of a cylinder; the use of these is generally limited to the locomotive. Of this kind is the counter-pressure or water brake of L. le Chatelier. If the valve gear of a locomotive in motion be reversed and the steam regulator be left open, the cylinders act as compressors, pumping air from the exhaust pipe into the boiler against the steam pressure. A retarding effect is thus exercised, but at the cost of certain inconveniences due to the passage of hot air and cinders from the smoke box through the cylinders. To remedy these, le Chatelier arranged that a jet of hot water from the boiler should be delivered into the exhaust pipe, so that steam and not the hot flue gases should be pumped back.

Power brakes may be either continuous or independent—continuous if connected throughout the train and with the locomotive by pipes, wires, &c., as the compressed air, vacuum and electric brakes; independent if not so connected, as the buffer-brakes and hand-brakes. Continuous brakes may be divided into two other great classes—automatic and non-automatic. The former are so arranged that they are applied automatically on all the coaches of the train if any important part of the apparatus is broken, or the couplings between cars are ruptured; in an emergency they can be put on by the guard, or (in some cases) by a passenger. Non-automatic brakes can be applied only by the person (usually the engine-driver) to whom the management of them is given; they may become inoperative on all the coaches, and always on those which have

become detached, if a coupling or other important and generally essential part is broken. Many mechanical and several hydraulic and electrical continuous brakes have been invented and tried; but experience has shown them so inadequate in practice that they have all practically disappeared, leaving the field to the air and the vacuum brakes. At first these were non-automatic, but in 1872 the automatic air-brake was invented by George Westinghouse, and the automatic vacuum-brake was developed a few years later.

Those respects in which non-automatic brakes are inadequate will be understood from the following summary of the requirements most important in a train-braking apparatus: (1) It must be capable of application to every wheel throughout the train. (2) It must be so prompt in action that the shortest possible time shall elapse between its first application and the moment when the full power can be exerted throughout the train. (3) It must be capable of being applied by the engine-driver or by any of the officials in charge of the train, either in concert or independently. (4) The motion of the train must be arrested in the shortest possible distance. (5) The failure of a vital part must declare itself by causing the brake to be applied and to remain applied until the cause of failure is removed. (6) The breaking of the train in two or more parts must cause immediate automatic application of the brakes on all the coaches. (7) When used in ordinary service stops it must be capable of gradual and uniform application (followed, if necessary, by a full emergency application at any part of the service application) and of prompt release under all conditions of application. (8) It must be simple in operation and construction, not liable to derangement, and inexpensive in maintenance.



***Simple air-brake.***

The Westinghouse non-automatic or “straight” air-brake, patented in 1869, consists in its simplest form of a direct-acting, steam-driven air-pump, carried on the locomotive, which forces compressed air into a reservoir, usually placed under the foot-plate of the locomotive. From this reservoir a pipe is led through the engine cab, where it is fitted with a three-way cock, to the rear of the locomotive tender, where it terminates in a flexible hose, on the end of which is a coupling. The coaches are furnished with a similar pipe, having hose and coupling at each end, which communicates with one end of a cylinder containing a piston, to the rod of which the brake-rods and levers are connected. The application of the brakes is effected by the engine-driver turning the three-way cock, so that compressed air flows through the pipe and, acting against one side of the brake-cylinder piston, applies the brake-shoes to the wheels by the movement of this piston and the rods and levers connected to it. To release the brakes the three-way cock is turned to cut off communication between the main reservoir and the train-pipe, and to open a port permitting the escape of the compressed air in the train-pipe and brake-cylinders. This brake was soon found defective and inadequate in many ways. An appreciable time was required for the air to flow through the pipes from the locomotive to the car-cylinders, and this time increased quickly with the length of the trains. Still more objectionable, however, was the fact that on detached coaches the air-brakes could not be applied, the result being sometimes serious collisions between the front and rear portions of the train.

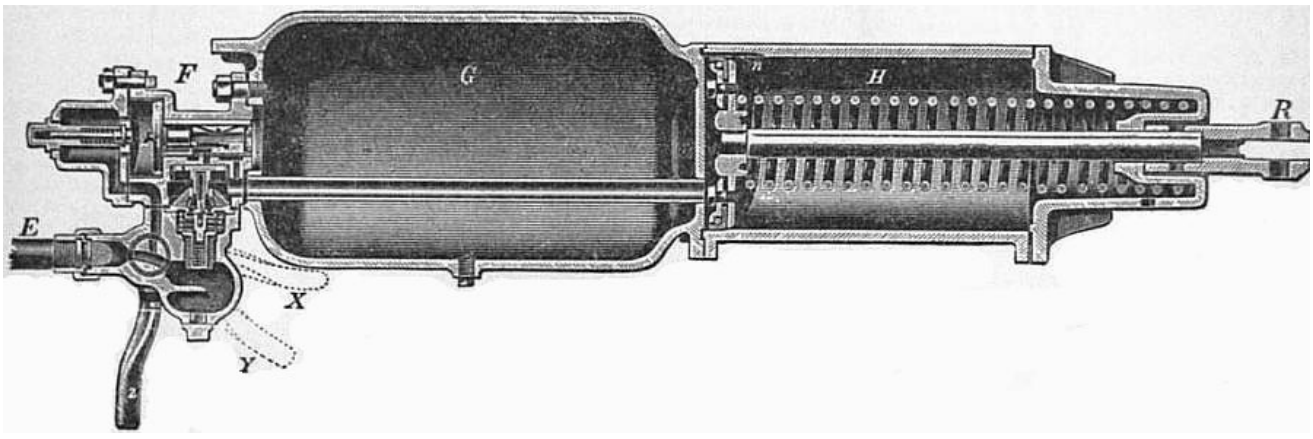


Fig. 1.—Westinghouse Air-Brake.
Section through Triple-Valve and Brake-Cylinder.

***Automatic air-brake.***

In the Westinghouse “ordinary” automatic air-brake a main air reservoir on the engine is kept charged with compressed air at 80 lb. per sq. in. by means of the steam-pump, which may be controlled by an automatic governor. On electric railways a pump, driven by an electric motor, is generally employed; but occasionally, on trains which run short distances, no pump is carried, the main reservoir being charged at the terminal points with sufficient compressed air for the journey. Conveniently placed to the driver’s hand is the driver’s valve, by means of which he controls the flow of air from the main reservoir to the train-pipe, or from the train-pipe to the atmosphere. A reducing-valve is attached to the driver’s valve, and in the normal or running position of the latter reduces the pressure of the air flowing from the main reservoir to the train-pipe by 10 or 15 lb. per sq. in. From the engine a train-pipe runs the whole length of the train, being rendered continuous

between each vehicle and between the engine and the rest of the train by flexible hose couplings. Each vehicle is provided with a brake-cylinder H (fig. 1), containing a piston, the movement of which applies the brake blocks to the wheels, an “auxiliary air-reservoir” G, and an automatic “triple-valve” F. The auxiliary reservoir receives compressed air from the train-pipe and stores it for use in the brake-cylinder of its own vehicle, and both the auxiliary reservoir and the triple-valve are connected directly or indirectly with the train-pipe through the pipe E. The automatic action of the brake is due to the construction of the triple-valve, the principal parts of which are a piston and slide-valve, so arranged that the air in the auxiliary reservoir acts at all times on the side of the piston to which the slide-valve is attached, while the air in the train-pipe exerts its pressure on the opposite side. So long as the brakes are not in operation, the pressures in the train-pipe, triple-valve and auxiliary reservoir are all equal, and there is no compressed air in the brake-cylinder. But when, in order to apply the brake, the driver discharges air from the train-pipe, this equilibrium is destroyed, and the greater pressure in the auxiliary reservoir forces the triple-valve to a position which allows air from the auxiliary reservoir to pass directly into the brake-cylinder. This air forces out the piston of the brake-cylinder and applies the brakes, connexion being made with the brake-rigging at R. The purpose of the small groove *n* which establishes communication between the two sides of the piston when the brakes are off, is to prevent their unintended application through slight leakage from the train-pipe. To release the brakes, the driver, by moving the handle of his valve to the release position, admits air from the main reservoir to the train-pipe, the pressure in which thus becomes greater than that in the auxiliary reservoir; the piston and slide-valve of the triple-valve are thereby forced back to their normal position, the compressed air in the brake-cylinder is discharged, and the piston is brought back by the coiled spring, thus releasing the brakes. At the same time the auxiliary reservoir is recharged.

***Quick-acting air-brake.***

With this “ordinary” brake, since an appreciable time is required for the reduction of pressure to travel along the train-pipe from the engine, the brakes are applied sensibly sooner at the front than at the end of the train, and with long trains this difference in the time of application becomes a matter of importance. The “quick-acting” brake was introduced to remedy this defect. For it the triple valve is provided with a supplementary mechanism, which, when the air pressure in the train-pipe is suddenly or violently reduced, opens a passage whereby air from the train-pipe is permitted to enter the brake-cylinder directly. The result is twofold: not only is the pressure from the auxiliary reservoir acting in the brake-cylinder reinforced by the pressure in the train-pipe, but the pressure in the train-pipe is reduced locally in every vehicle in extremely rapid succession instead of at the engine only, and in consequence all the brakes are applied almost simultaneously throughout the train. The same effect is produced should the train break in two, or a hose or any part of the train-pipe burst; but during ordinary or “service” stops the triple-valve acts exactly as in the ordinary brake, the quick-acting portion, that is, the vertical piston and valve seen in fig. 1, not coming into operation. When the handle Z is turned to the position X the quick-acting mechanism is rendered inoperative, and when it is at Y the brake on the vehicle concerned is wholly cut out of action.

A further improvement introduced in the Westinghouse brake in 1906 was designed to give quick action for service as well as emergency stops. In this the triple-valve is substantially the same as in the ordinary brake. The additional mechanism of the quick-acting portion is dispensed with, but instead, a small chamber, normally containing air at atmospheric pressure, is provided on each vehicle, and is so arranged that it is put into communication with the train-pipe by the first movement of the triple-valve. As soon, therefore, as the driver, by lowering the pressure in the train-pipe, causes the triple-valve in the foremost vehicle of the train to operate, a certain quantity of air rushes out of the train-pipe into the small chamber; a further local reduction in the pressure of the train-pipe in that vehicle is thereby effected, and this almost instantaneously actuates the triple-valve of the succeeding vehicle, and so on throughout the train. In this way, on a train 1800 ft. long, consisting of sixty 30-ft. vehicles, the brake-blocks may be applied, with equal force, on the last vehicle about 2½ seconds later than on the first.

***High-speed air-brake.***

Brake-blocks can be applied, without skidding the wheels, with greater pressure at high speeds than at low. Advantage is taken of this fact in the design of the Westinghouse “high-speed” brake, invented in 1894, which consists of attachments enabling the pressure in the train-pipe and reservoirs to be increased at the will of the driver. The increased pressure acting in the brake-cylinder increases in the same proportion the pressure of the brake-shoes against the wheels. Attached to the brake cylinder is a valve for automatically reducing the pressure therein proportionately to the reduction in speed, until the maximum pressure under which the brakes are operated in making ordinary stops is reached, when this valve closes and the maximum safe pressure for operating the brakes at ordinary speeds is retained until a stop is made.

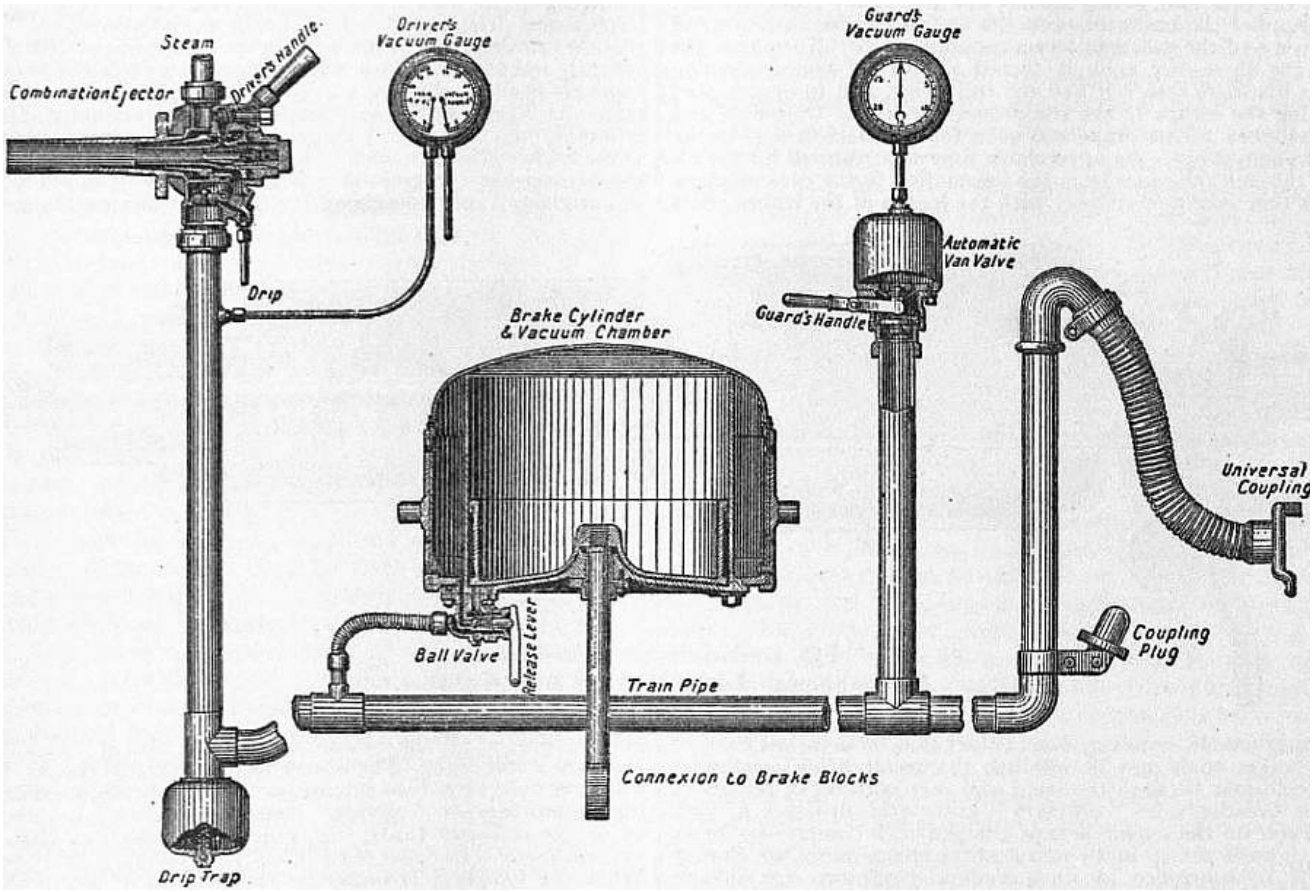


FIG. 2—Automatic Vacuum-Brake, showing its general arrangement.

In the automatic vacuum-brake, the exhausting apparatus generally consists of a combined large and small ejector (a form of jet-pump) worked by steam and under the control of the driver, though sometimes a mechanical air-pump, driven from the crosshead of the locomotive, is substituted for the small ejector. These ejectors, of which the small one is at work continuously while the large one is only employed when it is necessary to create vacuum quickly, *e.g.* to take off the brakes after a short stop, produce in the train-pipe a vacuum equal to about 20 in. of mercury, or in other words reduce the pressure within it to about one-third of an atmosphere. The train-pipe extends the whole length of the train and communicates under each vehicle with a cylinder, to the piston of which, by suitable rods and levers, the brake-shoes are connected. The communication between the train-pipe and the cylinder is controlled by a ball-valve, one form of which is shown in fig. 2. The release-valve is for the purpose of withdrawing the ball from its seat when it is necessary to take off the brakes by hand; it is made air-tight by a small diaphragm, the pressure of which, when there is vacuum in the pipe, pulls in the spindle and allows the ball to fall freely into its seat. When air is exhausted through the train-pipe it travels out from below the piston direct, and from above it past the ball, which is thus forced off its seat, to roll back again when the exhaustion is complete. In this state of affairs the piston is held in equilibrium and the brake-blocks are free of the wheels. To apply them, air is admitted to the train-pipe, either purposely by the guard or driver, or accidentally by the rupture of the train-pipe or coupling-hose between the vehicles. The air passes to the lower side of the piston, but is prevented from gaining access to the upper side by the ball-valve which blocks the passage; hence the pressure becomes different on the two sides of the piston, which in consequence is forced upwards and thus applies the brakes. They are released by the re-establishment of equilibrium (by the use of the large ejector if necessary); when this is done the piston falls and the brakes drop off. The general arrangement of the apparatus is shown in fig. 2. To render the application of the brakes nearly simultaneous throughout a long train, the valve in the guard's van is arranged to open automatically when the driver suddenly lets in air to the train-pipe. This valve has a small hole through its stem, and is secured at the top by a diaphragm to a small dome-like chamber, which is exhausted when a vacuum is created in the train-pipe. A gradual application destroys the vacuum in the chamber as quickly as in the pipe and the diaphragm remains unmoved; but with a sudden one the vacuum below the valve is destroyed more quickly, and with the difference of pressure the diaphragm lifts the valve and admits air. A rapid-acting valve (fig. 3) is sometimes interposed between the train-pipe and the cylinder on each vehicle. In the normal or running position, a vacuum is maintained below the valve A and above the diaphragm B, while the chamber below B and above A is at atmospheric pressure. For an emergency application of the brake, air is suddenly admitted to the train-pipe and thus to the lower side of A, and the pressure acting on the under side of B is sufficient to cause it to lift the valve A, and to admit air from the atmosphere, both to the brake-cylinder and the train-pipe, through the clappet-valve D, which also rises because of the difference of pressure on its two sides. In a graduated application, neither D nor A rises from its seat, but air from the train-pipe finds access to the brake-cylinder by passing around the peg C,

***Automatic Vacuum-Brake.***

which is so proportioned as to allow the necessary amount of air to enter the brake-cylinder, and so obtain simultaneous action of the brake throughout the train. When the handle E is turned so as to prevent the clappet D from rising, the rapid action is cut out and the brake acts as an ordinary vacuum automatic brake. A modification of the device for obtaining accelerated action, described above in connexion with the Westinghouse brake, is also applicable. Accelerating chambers, again containing air at atmospheric pressure, are provided on each vehicle and are connected with the train-pipe by valves which open as the vacuum in the latter begins to decrease with the operation of the driver's valve. The air thus admitted into the train-pipe effects a still further local reduction of the vacuum, which is sufficient to actuate the accelerating valve of each next succeeding vehicle and is thus rapidly propagated throughout the train.

***Brake trials.***

Famous tests of railway brakes were those made by Sir Douglas Galton and Mr George Westinghouse on the London, Brighton and South Coast railway, in England, in 1878, and by a committee of the Master Car Builders' Association, near Burlington, Iowa, in 1886 and 1887. The object of the former series (for accounts of which see *Proc. Inst. Mech. Eng.*, 1878, 1879) was to determine the co-efficient of friction between the brake-shoe and the wheel, and between the wheel and rail at different velocities when the wheels were revolving and when skidded, *i.e.* stopped in their rotation and caused to slide. These experiments were the first of their kind ever undertaken, and for many years their results furnished most of the trustworthy data obtainable on the friction of motion. It was found that the co-efficient of friction between cast-iron shoes and steel-tired wheels increased as the speed of the train decreased, varying from 0.111 at 55 m. an hour to 0.33 when the train was just moving. It also decreased with the time during which the brakes were applied; thus at 20 m. an hour the co-efficient was at the beginning 0.182, after ten seconds 0.133, after twenty seconds 0.099. Generally speaking, especially at moderate speeds, the decrease in the co-efficient of friction due to time is less than the increase due to decrease of speed, although when the time is long the reverse may be true. When the wheels are skidded the retardation of the train is always reduced; therefore, for the greatest braking effect, the pressures on the brake-shoes should never be sufficient to cause the wheels to slide on the rails. The Burlington brake tests were undertaken to determine the practicability of using power brakes on long and heavy freight trains. In the 1886 tests there were five competitors—three buffer-brakes, one compressed-air brake, and one vacuum-brake. The tests comprised stops with trains of twenty-five and fifty vehicles, at 20 and 40 m. an hour, on the level and on gradients of 1 in 100. They demonstrated that the buffer-brakes were inadequate for long trains, and that considerable improvements in the continuous brakes, both compressed-air and vacuum, would be needed to make them act quickly enough to avoid excessive shocks in the rear vehicles. In 1887 the trials of the year before were repeated by the same committee, and at the same place. Trains of fifty vehicles, about 2000 ft. long and fitted with each brake, were again provided, and there were again five competitors, but they all entered continuous brakes—three compressed-air brakes, one vacuum and one electric. The results of the first day's test of the train equipped with Westinghouse brakes are shown in Table I., the distances in which are the feet run by the train after the brakes were set, and the times the seconds that elapsed from the application of the brakes to full stop.



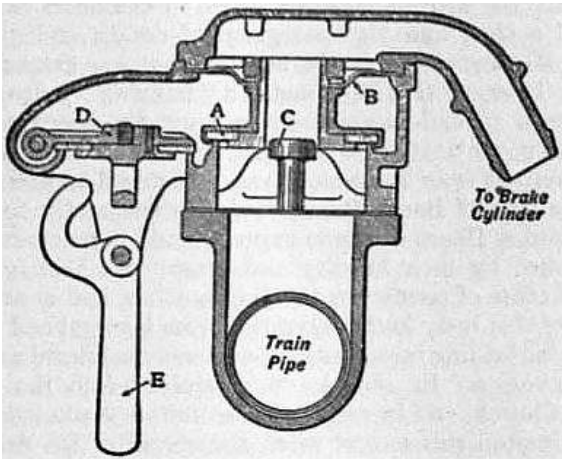


Fig. 3—Rapid-acting Vacuum-Brake Valve.

Table I.—*Stops of a Train of Fifty Empty Cars, 1887— Automatic Air-Brakes.*

| Speed in Miles per Hour. | Distance in Feet. | Time in Seconds. | Equivalent Distance at 20 m. and 40. | |
|---|---|---|---|---|
| 19½ | 186 | 9¾ | 196 | · · |
| 19¼ | 215 | 11 | 233 | · · |
| 36½ | 588 | 17 | · · | 693 |

The remarkable shortness of these stops is the more evident when they are compared with the best results obtained in 1886, as shown in Table II.

TABLE II.—*Stops of a Train of Fifty Empty Cars, 1886— Automatic Air-Brakes.*

| Speed in Miles. | Distance in Feet. | Time in Seconds. | Equivalent Distance at 20 m. and 40. | |
|---|---|---|---|---|
| 23.5 | 424 | 17½ | 307 | · · |
| 20.3 | 354 | 16 | 340 | · · |
| 40 | 922 | 22½ | · · | 922 |
| 40 | 927 | 22¾ | · · | 927 |

The time that elapsed between the application of the brakes on the engine and on the fiftieth vehicle was almost twice as great in 1886 as in 1887, being in the latter tests only five to six seconds, and in 1887 the stops were made in less than two-thirds the distance required in 1886. Still, violent shocks were caused by the rear vehicles running against those in front, before the brakes on the former were applied with sufficient force to hold them, and these shocks were so severe as to make the use of the brakes in practice impossible on long trains. When the triple-valves were actuated electrically, however, the stops were still further improved, as shown in Table III.

TABLE III.—*Stops of a Train of Fifty Empty Cars— Electric Application of Air-Brakes*.

| Speed in Miles. | Distance in Feet. | Time in Seconds. | Equivalent Distance at 20 m. and 40. | |
|---|---|---|---|---|
| 21½ | 160 | 7 | 139 | · · |
| 23 | 183 | 8 | 138 | · · |
| 38 | 475 | 14½ | · · | 519 |
| 36½ | 460 | 14 | · · | 545 |

Although the same levers, shoes, rods and other connexions were used, there were no shocks in the fiftieth car of the train on any stop, whether on the level or on a gradient. The committee in charge reported that the best type of brake for long freight trains was one operated by air, in which the valves were actuated by electricity, but they expressed doubt of the practicability of using electricity on freight trains. The Westinghouse Company then proceeded to quicken the action of the triple-valve, operated by air only, so that stops with fifty-car trains could be made without shock, and without electrically operated valves; and they were so successful in this respect that, towards the end of the same year, 1887, with a train of fifty vehicles, stops were made without shock, fully equalling in quickness and shortness of distance run any that had been made at the trials by the electrically operated brakes.

In 1889 some further tests were made by Sir Douglas Galton with the automatic vacuum-brake, on a practically level portion of the Manchester, Sheffield & Lincolnshire railway (now the Great Central). The train was composed of an engine, tender and forty carriages, the total length over buffers being 1464 ft., and the total weight 574 tons, of which 423 tons were braked. At a speed of about 32 m. an hour this train was brought to a standstill in twelve seconds after the application of the brakes, in a distance of 342 ft.

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**BRAKELOND, JOCELYN DE** (*fl.* 1200), English monk, and author of a chronicle narrating the fortunes of the monastery of Bury St Edmunds between 1173 and 1202. He is only known to us through his own work. He was a native of Bury St Edmunds; he served his novitiate under Samson of Tottington, who was at that time master of the novices, but afterwards sub-sacrist, and, from 1182, abbot of the house. Jocelyn took the habit of religion in 1173, during the time of Abbot Hugo (1157-1180), through whose improvidence and laxity the abbey had become impoverished and the inmates dead to all respect for discipline. The fortunes of the abbey changed for the better with the election of Samson as Hugo’s successor. Jocelyn, who became abbot’s chaplain within four months of the election, describes the administration of Samson at considerable length. He tells us that he was with Samson night and day for six years; the picture which he gives of his master, although coloured by enthusiastic admiration, is singularly frank and intimate. It is all the more convincing since Jocelyn is no stylist. His Latin is familiar and easy, but the reverse of classical. He thinks and writes as one whose interests are wrapped up in his house; and the unique interest of his work lies in the minuteness with which it describes the

policy of a monastic administrator who was in his own day considered as a model.

Jocelyn has also been credited with an extant but unprinted tract on the election of Abbot Hugo (Harleian MS. 1005, fo. 165); from internal evidence this appears to be an error. He mentions a (non-extant) work which he wrote, before the *Cronica*, on the miracles of St Robert, a boy whom the Jews of Bury St Edmunds were alleged to have murdered (1181).

See the editions of the *Cronica Jocelini de Brakelonda* by T. Arnold (in *Memorials of St Edmund's Abbey*, vol. i. Rolls series, 1890), and by J.G. Rokewood (Camden Society, 1840); also Carlyle's *Past and Present*, book ii. A translation and notes are given in T.E. Tomlin's *Monastic and Social Life in the Twelfth Century in the Chronicle of Jocelyn de Brakelond* (1844). There is also a translation of Jocelyn by Sir E. Clarke (1907).

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**BRAMAH, JOSEPH** (1748-1814), English engineer and inventor, was the son of a farmer, and was born at Stainborough, Yorkshire, on the 13th of April 1748. Incapacitated for agricultural labour by an accident to his ankle, on the expiry of his indentures he worked as a cabinet-maker in London, where he subsequently started business on his own account. His first patent for some improvements in the mechanism of water-closets was taken out in 1778. In 1784 he patented the lock known by his name, and in 1795 he invented the hydraulic press. For an important part of this, the collar which secured water-tightness between the plunger and the cylinder in which it worked, he was indebted to Henry Maudslay, one of his workmen, who also helped him in designing machines for the manufacture of his locks. In 1806 he devised for the Bank of England a numerical printing machine, specially adapted for bank-notes. Other inventions of his included the beer-engine for drawing beer, machinery for making aerated waters, planing machines, and improvements in steam-engines and boilers and in paper-making machinery. In 1785 he suggested the possibility of screw propulsion for ships, and in 1802 the hydraulic transmission of power; and he constructed waterworks at Norwich in 1790 and 1793. He died in London on the 9th of December 1814.



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**BRAMANTE,** or Bramante Lazzari (*c.* 1444-1514), Italian architect and painter, whose real name was Donate d'Augnolo, was born at Monte-Asdrualdo in Urbino, in July 1444. He showed a great taste for drawing, and was at an early age placed under Fra Bartolommeo, called Fra Carnavale. But though he afterwards gained some fame as a painter, his attention was soon absorbed by architecture. He appears to have studied under Scirro Scirri, an architect in his native place, and perhaps under other masters. He then set out from Urbino, and proceeded through several of the towns of Lombardy, executing works of various magnitudes, and examining patiently all remains of ancient art. At last, attracted by the fame of the great Duomo, he reached Milan, where he remained from 1476 to 1499. He seems to have left Milan for Rome about 1500. He painted some frescoes at Rome, and devoted himself to the study of the ancient buildings, both in the city and as far south as Naples. About this time the Cardinal Caraffa commissioned him to rebuild the cloister of the Convent della Pace. Owing to the celerity and skill with which Bramante did this, the cardinal introduced him to Pope Alexander VI. He began to be consulted on nearly all the great architectural operations in Rome, and executed for the pope the palace of the Cancelleria or chancery. Under Julius II., Alexander's successor, Bramante's talents began to obtain adequate sphere of exercise. His first large work was to unite the straggling buildings of the palace and the Belvedere. This he accomplished by means of two long galleries or corridors enclosing a court. The design was only in part completed before the death of Julius and of the architect. So impatient was the pope and so eager was Bramante, that the foundations were not sufficiently well attended to; great part of it had, therefore, soon to be rebuilt, and the whole is now so much altered that it is hardly possible to decipher the original design.

Besides executing numerous smaller works at Rome and Bologna, among which is specially mentioned by older writers a round temple in the cloister of San Pietro-a-Montorio, Bramante was called upon by Pope Julius to take the first part in one of the greatest architectural enterprises ever attempted—the rebuilding of St Peter's. Bramante's designs were complete, and he pushed on the work so fast that before his death he had erected the four great piers and their arches, and completed the cornice and the vaulting in of this portion. He also vaulted in the principal chapel. After his death on the 11th of March 1514, his design was much altered, in

particular by Michelangelo.

See Pungileoni, *Memoire intorno alla vita ed alle opere di Bramante* (Rome, 1836); H. Semper, *Donato Bramante* (Leipzig, 1879).

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**BRAMPTON, HENRY HAWKINS,** Baron (1817-1907), English judge, was born at Hitchin, on the 14th of September 1817. He received his education at Bedford school. The son of a solicitor, he was early familiarized with legal principles. Called to the bar at the Middle Temple in 1843, he at once joined the old home circuit, and after enjoying a lucrative practice as a junior, took silk in 1859. His name is identified with many of the famous trials of the reign of Queen Victoria. He was engaged in the Simon Bernard case (of the Orsini plot celebrity), in that of *Roupell* v. *Waite*, and in the Overend-Gurney prosecutions. The two *causes célèbres*, however, in which Hawkins attained his highest legal distinction were the Tichborne trials and the great will case of *Sugden* v. *Lord St Leonards*. In both of these he was victorious. In the first his masterly cross-examination of the witness Baigent was one of the great features of the trial. He did a lucrative business in references and arbitrations, and acted for the royal commissioners in the purchase of the site for the new law courts. Election petitions also formed another branch of his extensive practice. Hawkins was raised to the bench in 1876, and was assigned to the then exchequer division of the High Court, not as baron (an appellation which was being abolished by the Judicature Act), but with the title of Sir Henry Hawkins. He was a great advocate rather than a great lawyer. His searching voice, his manner, and the variety of his facial expression, gave him an enormous influence with juries, and as a cross-examiner he was seldom, if ever, surpassed. He was an excellent judge in chambers, where he displayed a clear and vigorous grasp of details and questions of fact. His knowledge of the criminal law was extensive and intimate, the reputation he gained as a "hanging" judge making him a terror to evil-doers; and the court for crown cases reserved was never considered complete without his assistance. In 1898 he retired from the bench, and was raised to the peerage under the title of Baron Brampton. He frequently took part in determining House of Lords appeals, and his judgments were distinguished by their lucidity and grasp. He held for many years the office of counsel to the Jockey Club, and as an active member of that body found relaxation from his legal and judicial duties at the leading race meetings, and was considered a capable judge of horses. In 1898 he was received into the Roman Catholic Church, and in 1903 he presented, in conjunction with Lady Brampton (his second wife), the chapel of SS. Augustine and Gregory to the Roman Catholic cathedral of Westminster, which was consecrated in that year. In 1904 he published his *Reminiscences*. He died in London on the 6th of October 1907, and Lady Brampton in the following year.

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**BRAMPTON,** a market town in the Eskdale parliamentary division of Cumberland, England, 9 m. E.N.E. of Carlisle, on a branch of the North Eastern railway. Pop. (1901) 2494. It is picturesquely situated in a narrow valley opening upon that of the Irthing. The town has an agricultural trade, breweries, and manufactures of cotton and tweeds. The neighbourhood is rich in historical associations. Two miles N.E. of Brampton is the castle of Naworth, a fine example of a Border fortress. It was built in the reign of Edward III., by a member of the family of Dacre, who for many generations had had their stronghold here. Overlooking a deep wooded ravine, with streams to the east and west, the great quadrangular castle was naturally defended except on the south, where it was rendered secure by a double moat and drawbridge. By marriage in 1577 with Lady Elizabeth Dacre it passed into the hands of William Howard, afterwards lord warden of the Marches, the "Belted Will" of Sir Walter Scott and the Border ballads, who acquired great fame by his victories over the Scottish moss-troopers. The castle, the walls of which have many secret passages and hiding-places, is inhabited, and in its hall are numerous fine pictures, including a portrait of Charles I. by Van Dyck. Not far distant is Lanercost Priory, where in 1169 an Augustinian monastery was established. In 1311 Robert Bruce and his army were quartered here, and the priory was pillaged in 1346 by David, king of Scotland. From this time its prosperity declined, and at its dissolution under Henry VIII. it consisted only of a prior and seven canons. The Early English church has a restored nave, but retains much fine carving. The chancel is ruined, but the interesting crypt is preserved.

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**BRAMWELL, GEORGE WILLIAM WILSHERE BRAMWELL,** Baron (1808-1892), English judge, was born in London on the 12th of June 1808, being the eldest son of George Bramwell, of the banking firm of Dorrien, Magens, Dorrien & Mello. He was educated privately, and at the age of sixteen he entered Dorriens' bank. In 1830 he gave up this business for the law, being admitted as a student at Lincoln's Inn in 1830, and at the Inner Temple in 1836. At first he practised as a special pleader, but was eventually called to the bar at both Inns in 1838. He soon worked his way into a good practice both in London and the home circuit, his knowledge of law and procedure being so well recognized that in 1850 he was appointed a member of the Common Law Procedure Commission, which resulted in the Common Law Procedure Act of 1852. This act he drafted jointly with his friend Mr (afterwards Mr Justice) Willes, and thus began the abolition of the system of special pleading. In 1851 Lord Cranworth made Bramwell a queen's counsel, and the Inner Temple elected him a bencher—he had ceased to be a member of Lincoln's Inn in 1841. In 1853 he served on the royal commission to inquire into the assimilation of the mercantile laws of Scotland and England and the law of partnership, which had as its result the Companies Act of 1862. It was he who, during the sitting of this commission, suggested the addition of the word "limited" to the title of companies that sought to limit their liability, in order to prevent the obvious danger to persons trading with them in ignorance of their limitation of liability. As a queen's counsel Bramwell enjoyed a large and steadily increasing practice, and in 1856 he was raised to the bench as a baron of the court of exchequer. In 1867, with Mr Justice Blackburn and Sir John Coleridge, he was made a member of the judicature commission. In 1871 he was one of the three judges who refused the seat on the judicial committee of the privy council to which Sir Robert Collier, in evasion of the spirit of the act creating the appointment, was appointed; and in 1876 he was raised to the court of appeal, where he sat till the autumn of 1881. As a puisne judge he had been conspicuous as a sound lawyer, with a strong logical mind unfettered by technicalities, but endowed with considerable respect for the common law. His rulings were always clear and decisive, while the same quality marked his dealings with fact, and, coupled with a straightforward, unpretentious manner, gave him great influence with juries. In the court of appeal he was perhaps not so entirely in his element as at *nisi prius*, but the same combination of sound law, strong common sense and clear expression characterized his judgments. His decisions during the three stages of his practical career are too numerous to be referred to particularly, although *Ryder* v. *Wombwell* (L. R. 3 Ex. 95); *R.* v. *Bradshaw* (14 Cox C. C. 84); *Household Fire Insurance Company* v. *Grant* (4 Ex. Div. 216); *Stonor* v. *Fowle* (13 App. Cas. 20), *The Bank of England* v. *Vagliano Brothers* (App. Cas. 1891) are good examples. Upon his retirement, announced in the long vacation of 1881, twenty-six judges and a huge gathering of the bar entertained him at a banquet in the Inner Temple hall. In December of the same year he was raised to the peerage, taking the title Baron Bramwell of Hever, from his home in Kent. In private life Bramwell had simple tastes and enjoyed simple pleasures. He was musical and fond of sports. He was twice married: in 1830 to Jane (d. 1836), daughter of Bruno Silva, by whom he had one daughter, and in 1861 to Martha Sinden. He died on the 9th of May 1892.



His younger brother, Sir Frederick Bramwell (1818-1903), was a well-known consulting engineer and "expert witness."

> At all times Lord Bramwell had been fond of controversy and controversial writing, and he wrote constant letters to *The Times* over the signature B. (he also signed himself at different times Bramwell, G.B. and L.L.). He joined in 1882 the Liberty and Property Defence League, and some of his writings after that date took the form of pamphlets published by that society.

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**BRAN,** in Celtic legend, the name of (1) the hero of the Welsh *Mabinogi of Branwen*, who dies in the attempt to avenge his sister's wrongs; he is the son of Llyr (= the Irish sea-god Ler), identified with the Irish Bran mac Allait, Allait being a synonym of Ler; (2) the son of Febal, known only through the 8th-century Irish epic, *The Voyage of Bran* (to the world below); (3) the dog of Ossian's Fingal. Bran also appears as a historical name, Latinized as *Brennus*. See Kuno Meyer and D. Nutt, *The Voyage of Bran* (London, 1895).

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**BRAN,** the ground husk of wheat, oats, barley or other cereals, used for feeding cattle, packing and other purposes (see Flour). The word occurs in French *bren* or *bran*, in the dialects of other Romanic languages, and also in Celtic, cf. Breton *brenn*, Gaelic *bran*. The *New English Dictionary* considers these Celtic forms to be borrowed from French or English. In modern French *bren*

means filth, refuse, and this points to some connexion with Celtic words, *e.g.* Irish *brean*, manure. If so, the original meaning would be refuse. “Bran-new,” *i.e.* quite new, is now the common form of “brand-new,” that which is fresh from the “brand,” the branding-iron used for marking objects, &c.

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**BRANCH** (from the Fr. *branche*, late Lat. *branca*, an animal’s paw), a limb of a tree; hence any offshoot, *e.g.* of a river, railway, &c., of a deer’s antlers, of a family or genealogical tree, and generally a subdivision or department, as in “a branch of learning.” The phrase, to destroy “root and branch,” meaning to destroy utterly, taken originally from Malachi iv. 1, was made famous in 1641 by the so-called “Root and Branch” Bill and Petition for the abolition of episcopal government, in which petition occurred the sentence, “That the said government, with all its dependencies, roots and branches, be destroyed.” Among technical senses of the word “branch” are: the certificate of proficiency given to pilots by Trinity House; and in siege-craft a length of trench forming part of a zigzag approach.

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**BRANCO,** or Parima, a river of northern Brazil and tributary of the Rio Negro, formed by the confluence of the Takutú, or “Upper Rio Branco,” and Uraricoera, about 3° N. lat. and 60° 28′ W. long., and flowing south by west to a junction with the Negro. It has rapids in its upper course, but the greater part of its length of 348 m. is navigable for steamers of light draught. The Takutú rises in the Roraima and Coïrrit ranges on the Guiana frontier, while the Uraricoera rises in the Serra de Parima, on the Venezuelan frontier, and has a length of 360 m. before reaching the Branco. These are white water rivers, from which the Branco (white) derives its name, and at its junction with the Negro the two differently-coloured streams flow side by side for some distance before mingling.

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**BRANCOVAN,** or Brancoveanu, the name of a family which has played an important part in the history of Rumania. It was of Servian origin and was connected with the family of Branko or Brankovich. Constantine Brancovan, the most eminent member of the family, was born in 1654, and became prince of Walachia in 1689. In consequence of his anti-Turkish policy of forming an alliance first with Austria and then with Russia, he was denounced to the Porte, deposed from his throne, brought under arrest to Constantinople and imprisoned (1710) in the fortress of Yedi Kuleh (Seven Towers). Here he was tortured by the Turks, who hoped thus to discover the fortune of £3,000,000, which Constantine was alleged to have amassed. He was beheaded with his four sons on the 26th of August 1714. His faithful friend Enake Vacarescu shared his fate. Constantine Brancovan became, through his tragic death, the hero of Rumanian popular ballads. His family founded and endowed the largest hospital in Walachia, the so-called Spital Brancovanescu.

See O.G. Lecca, *Familiile Boereşti Române* (Bucharest, 1899), p. 90, sqq.

(M. G.)

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**BRAND, JOHN** (1744-1806), English antiquary, was born on the 19th of August 1744 at Washington, Durham, where his father was parish clerk. His early years were spent at Newcastle-on-Tyne with his uncle, a cordwainer, to whom he was apprentice in his fourteenth year. Showing promise, however, at Newcastle grammar school, friends interested themselves in him and assisted him to go to Oxford. It was not, however, until his twenty-eighth year that he matriculated at Lincoln College, but before this he had been ordained, holding in succession the curacies of Bolam, Northumberland, of St Andrew’s, Newcastle, and of Cramlington, 8 m. from

the county town. He graduated in 1775 and two years later was elected fellow of the Society of Antiquaries. Having for a short time been under-usher at the Newcastle grammar school, the duke of Northumberland, a former patron, gave him in 1784 the rectory of the combined parishes of St Mary-at-Hill and St Mary Hubbard, London. Appointed secretary to the Society of Antiquaries in the same year, he was annually re-elected until his death in 1806. He was buried in the chancel of his church. His most important work is *Observations on Popular Antiquities: including the whole of Mr Bourne's "Antiquitates Vulgares," with addenda to every chapter of that work*. This was published in London in 1777, and after Brand's death, a new edition embodying the MSS. left by him, was published by Sir Henry Ellis in 1813. Brand also published a poem entitled: *On Illicit Love, written among the ruins of Godstow Nunnery, near Oxford* (1775, Newcastle); *The History and Antiquities of Newcastle-upon-Tyne* (2 vols., London, 1789), and many papers in the *Archaeologia*.



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**BRAND, SIR JOHN HENRY** (1823-1888), president of the Orange Free State, was the son of Sir Christoffel Brand, speaker of the House of Assembly of the Cape Colony. He was born at Cape Town on the 6th of December 1823, and was educated at the South African College in that city. Continuing his studies at Leiden, he took the degree of D.C.L. in 1845. He was called to the English bar from the Inner Temple in 1849, and practised as an advocate in the supreme court of the Cape of Good Hope from that year until 1863. In 1858 he was appointed professor of law in the South African College. He was elected president of the Orange Free State in 1863, and subsequently re-elected for five years in 1869, 1874, 1879 and 1884. In 1864 he resisted the pressure of the Basuto on the Free State boundary, and after vainly endeavouring to induce Moshesh, the Basuto chief, to keep his people within bounds, he took up arms against them in 1865. This first war ended in the treaty of Thaba Bosigo, signed on the 3rd of April 1866; and a second war, caused by the treachery of the Basuto, ended in the treaty of Aliwal North, concluded on the 12th of February 1869. In 1871 Brand was solicited by a large party to become president of the Transvaal, and thus unite the two Dutch republics of South Africa; but as the project was hostile to Great Britain he declined to do so, and maintained his constant policy of friendship towards England, where his merits were recognized in 1882 by the honour of the G.C.M.G. He died on the 14th of July 1888. (See Orange Free State: *History*.)

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**BRANDE, WILLIAM THOMAS** (1788-1866), English chemist, was born in London on the 11th of January 1788. After leaving Westminster school, he was apprenticed, in 1802, to his brother, an apothecary, with the view of adopting the profession of medicine, but his bent was towards chemistry, a sound knowledge of which he acquired in his spare time. In 1812 he was appointed professor of chemistry to the Apothecaries' Society, and delivered a course of lectures before the Board of Agriculture in place of Sir Humphry Davy, whom in the following year he succeeded in the chair of chemistry at the Royal Institution, London. His *Manual of Chemistry*, first published in 1819, enjoyed wide popularity, and among other works he brought out a *Dictionary of Science, Literature and Art* in 1842, on a new edition of which he was engaged when he died at Tunbridge Wells on the 11th of February 1866.

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**BRANDENBURG,** the name of a margraviate and electorate which played an important part in German history, and afterwards grew into the kingdom of Prussia. During the early years of the Christian era, the district was inhabited by the Semnones, and afterwards by various Slavonic tribes, who were partially subdued by Charlemagne, but soon regained their independence. The history of Brandenburg begins when the German king, Henry the Fowler, defeated the Havelli, or Hevelli, and took their capital, Brennibor, from which the name Brandenburg is derived. It soon came under the rule of Gero, margrave of the Saxon east mark, who pressed the campaign against the Slavs with vigour, while Otto the Great founded bishoprics at Havelberg and Brandenburg. When Gero died in 965, his mark was divided into two parts, the northern portion, lying along both banks of the middle Elbe, being called the north or old mark, and forming the nucleus of the later margraviate of Brandenburg. After Otto the Great died, the Slavs regained

much of their territory, Brandenburg fell again into their hands, and a succession of feeble margraves ruled only the district west of the Elbe, together with a small district east of that river.

A new era began in 1106 when Lothair, count of Supplinburg, became duke of Saxony. Aided by Albert the Bear, count of Ballenstädt, he renewed the attack on the Slavs, and in 1134 appointed Albert margrave of the north mark. The new margrave continued the work of Lothair, and about 1140 made a treaty with Pribislaus, the childless duke of Brandenburg, by which he was recognized as the duke's heir. He took at once the title margrave of Brandenburg, but when Pribislaus died in 1150, a stubborn contest followed with Jazko, a relation of the late duke, which was terminated in 1157 in Albert's favour. Albert was the real founder of Brandenburg. Under his rule Christianity and civilization were extended, bishoprics were restored and monasteries founded. The country was colonized with settlers from the lower Rhineland, land was brought under cultivation, forts were built, German laws and customs introduced, and gradually the woods and marshes were converted into lands of comparative fertility.

***Albert the Bear.***

When Albert died in 1170, Brandenburg fell to his eldest son, Otto I. (*c*. 1130-1184), who compelled the duke of Pomerania to own his supremacy, and slightly increased by conquest the area of the mark. Otto's son, Otto II., was the succeeding margrave, and having quarrelled with his powerful neighbour, Ludolf, archbishop of Magdeburg, was forced to own the archbishop's supremacy over his allodial lands. He died in 1205, and was followed by his step-brother, Albert II. (*c*. 1174-1220), who assisted the emperor Otto IV. in various campaigns, but later transferred his allegiance to Otto's rival, Frederick of Hohenstaufen, afterwards the emperor Frederick II. His sons, John I. and Otto III., ruled Brandenburg in common until the death of John in 1266, and their reign was a period of growth and prosperity. Districts were conquered or purchased from the surrounding dukes; the marriage of Otto with Beatrice, daughter of Wenceslaus, king of Bohemia, in 1253, added upper Lusatia to Brandenburg; and the authority of the margraves was extended beyond the Oder. Many monasteries and towns were founded, among them Berlin; the work of Albert the Bear was continued, and the prosperity of Brandenburg formed a marked contrast to the disorder which prevailed elsewhere in Germany. Brandenburg appears about this time to have fallen into three divisions—the old mark lying west of the Elbe, the middle mark between the Elbe and the Oder, and the new mark, as the newly conquered lands beyond the Oder began to be called. When Otto died in 1267, the area of the mark had been almost doubled, and the margraves had attained to an influential position in the Empire. The *Sachsenspiegel*, written before 1235, mentions the margrave as one of the electors, by virtue of the office of chamberlain, which had probably been conferred on Albert the Bear by the German king Conrad III.

***Otto III.***

In 1258 John and Otto had agreed upon a division of their lands, but the arrangement only took effect on Otto's death in 1267, when John's son, John II., received the electoral dignity, together with the southern part of the margraviate, which centred around Stendal, and Otto's son, John III., the northern or Saltzwedel portion. John II.'s brother, Otto IV., who became elector in 1281, had passed his early years in struggles with the archbishop of Magdeburg, whose lands stretched like a wedge into the heart of Brandenburg. In 1280 he was wounded in the head with a dart, and as he retained there a part of the weapon for a year, he was called "Otto with the dart." He secured the appointment of his brother Eric as archbishop of Magdeburg in 1283, and was afterwards engaged in various feuds. Songs attributed to him are found in F.H. von der Hagen's *Minnesinger*. Otto was succeeded in 1309 by his nephew, Valdemar, who, assisted by other members of his family, conquered Pomerellen, which he shared with the Teutonic order in 1310, and held his own in a struggle with the kings of Poland, Sweden and Denmark and others, over the possession of Stralsund.

***Otto IV.***

In order to pay for these wars, and to meet the expenses of a splendid court, the later margraves had sold various rights to the towns and provinces of Brandenburg, and so aided the development of local government. John III. of Saltzwedel had shared his possessions with his brothers, but in 1303 they were reunited by his nephew Hermann, who purchased lower Lusatia in the same year. Hermann's daughter Agnes married the elector Valdemar, and on the death of her only brother, John VI., in 1317, the possessions of the Saltzwedel branch of the family passed to Valdemar, together with Landsberg and the Saxon Palatinate, which had been purchased from Albert the Degenerate, landgrave of Thuringia. Valdemar thus gathered the whole of the mark under his rule, together with upper and lower Lusatia, and various outlying districts. He died childless in 1319, and was succeeded by his nephew Henry II., who died in 1320, when the Ascanian family, as the descendants of Albert the Bear were called, from the Latinized form of the name of their ancestral castle of Aschersleben, became extinct.



Brandenburg now fell into a deplorable condition, portions were seized by neighbouring princes, and the mark itself was disputed for by various claimants. In 1323 King Louis IV. took advantage of this condition to bestow the mark upon his young son, Louis, and thus Brandenburg was added to the possessions of the Wittelsbach family, although Louis did not receive the extensive lands of the Ascanian margraves.

***Wittelsbach dynasty.***

Upper and lower Lusatia, Landsberg, and the Saxon Palatinate had been inherited by female members of the family, and passed into the hands of other princes, the old mark was retained by Agnes, the widow of Valdemar, who was married again to Otto II., duke of Brunswick, and the king was forced to acknowledge these claims, and to cede districts to Mecklenburg and Bohemia. During the early years of the reign of Louis, who was called the margrave Louis IV. or V., Brandenburg was administered by Bertold, count of Henneberg, who established the authority of the Wittelsbachs in the middle mark, which, centring round Berlin, was the most important part of the margraviate. The quarrel between King Louis and Pope John XXII. was inimical to the interests of Brandenburg, which was ravaged by the Poles, torn by the strife of contending clerical factions, and alternately neglected and oppressed by the margrave. Trade and commerce were at a standstill, agriculture was neglected, the privileges and estates of the margrave passed into private hands, the nobles were virtually independent, and the towns sought to defend themselves by means of alliances. During the struggle between the families of Wittelsbach and Luxemburg, which began in 1342, there appeared in Brandenburg an old man who claimed to be the margrave Valdemar. He was gladly received by the king of Poland, and other neighbouring princes, welcomed by a large number of the people, and in 1348 invested with the margraviate by King Charles IV., who eagerly seized this opportunity to deal a blow at his enemy. This step compelled Louis to make peace with Charles, who abandoned the false Valdemar, invested Louis and his step-brothers with Brandenburg, and in return was recognized as king. Louis recovered the old mark in 1348, drove his opponent from the land, and in 1350 made a treaty with his step-brothers, Louis the younger and Otto, at Frankfort-on-Oder, by which Brandenburg was handed over to Louis the younger and Otto. Louis, who then undertook the government, made peace with his neighbours, finally defeated the false Valdemar, and was recognized by the Golden Bull of 1356 as one of the seven electors. The emperor Charles IV. took advantage of a family quarrel over the possessions of Louis the elder, who died in 1361, to obtain a promise from Louis the younger and Otto, that the margraviate should come to his own son, Wenceslaus, in case the electors died childless. Louis the younger died in 1365, and when his brother Otto, who had married a daughter of Charles IV., wished to leave Brandenburg to his own family Charles began hostilities; but in 1373 an arrangement was made, and Otto, by the treaty of Fürstenwalde, abandoned the margraviate for a sum of 500,000 gold gulden.

Under the Wittelsbach rule, the estates of the various provinces of Brandenburg had obtained the right to coin money, to build fortresses, to execute justice, and to form alliances with foreign states. Charles invested Wenceslaus with the margraviate in 1373, but undertook its administration himself, and passed much of his time at a castle which he built at Tangermünde. He diminished the burden of taxation, suppressed the violence of the nobles, improved navigation on the Elbe and Oder, and encouraged commerce by alliances with the Hanse towns, and in other ways. He caused a *Landbook* to be drawn up in 1375, in which are recorded all the castles, towns and villages of the land with their estates and incomes. When Charles died in 1378, and Wenceslaus became German and Bohemian king, Brandenburg passed to the new king's half-brother Sigismund, then a minor, and a period of disorder ensued. Soon after Sigismund came of age, he pledged a part of Brandenburg to his cousin Jobst, margrave of Moravia, to whom in 1388 he handed over the remainder of the electorate in return for a large sum of money, and as the money was not repaid, Jobst obtained the investiture in 1397 from King Wenceslaus. Sigismund had also obtained the new mark on the death of his brother John in 1396, but sold this in 1402 to the Teutonic order. Jobst paid very little attention to Brandenburg, and the period was used by many of the noble families to enrich themselves at the expense of the poorer and weaker towns, to plunder traders, and to carry on feuds with neighbouring princes. When in 1410 Sigismund and Jobst were rivals for the German throne, Sigismund, anxious to obtain another vote in the electoral college, declared the bargain with Jobst void, and empowered Frederick VI. of Hohenzollern, burgrave of Nuremberg, to exercise the Brandenburg vote at the election. (See Frederick I., Elector of Brandenburg.) In 1411 Jobst died and Brandenburg reverted to Sigismund, who appointed Frederick as his representative to govern the margraviate, and a further step was taken when, on the 30th of April 1415, the king invested Frederick of Hohenzollern and his heirs with Brandenburg, together with the electoral privilege and the office of chamberlain, in return for a payment of 400,000 gold gulden, but the formal ceremony of investiture was delayed until the 18th of April 1417, when it took place at Constance.

***Imperial control.***

During the century which preceded the advent of the Hohenzollerns in Brandenburg its internal condition had become gradually worse and worse, and had been accompanied by a considerable loss of territory. The central power had become weakened and the central organization relaxed, while the electorate had lost most of the advantages which formerly distinguished it from other German fiefs. Under the rule of the earliest margraves, it was the official side of their position that was prominent, and it was not forgotten that they were technically only the representatives of the emperor. But in the 13th century this feeling began to disappear, and Brandenburg enjoyed an independence and carried out an independent policy in a way that was not paralleled by any other German state. The emperor was still suzerain indeed, but his relations

***Condition before the Hohenzollern rule.***

with the mark were so insignificant that they exercised practically no influence on its development; and so the power of the Ascanian margraves was virtually unlimited. This independence was enhanced by the fact that few great nobles had followed Albert the Bear in his work of conquest, and that consequently there were few large lordships with their crowd of dependents. The towns, the village communities and the knights held their lands and derived their rights directly from the margraves. The towns and villages had generally been laid out by contractors or *locatores*, men not necessarily of noble birth, who were installed as hereditary chief magistrates of the communities, and received numerous encouragements to reclaim waste lands. This mode of colonization was especially favourable to the peasantry, who seem in Brandenburg to have retained the disposal of their persons and property at a time when villenage or serfdom was the ordinary *status* of their class elsewhere. The dues paid by these contractors in return for the concessions formed the main source of the revenue of the margraves. Gradually, however, the expenses of warfare, liberal donations to the clergy, and the maintenance of numerous and expensive households, compelled them to pledge these dues for sums of ready money. This proceeding gave the barons and knights an opportunity to buy out the village magistrates and to replace them with nominees of their own. Thus the condition of the peasants grew worse, and their freedom was practically destroyed when the emperor Louis IV. recognized the jurisdiction of the nobles over their estates. Henceforth the power of the nobles steadily increased at the expense of the peasants, who soon sank into servitude. Instead of communicating directly with the margrave through his burgraves and bailiffs, or *vogts*, the village communities came to be represented by the nobles who had obtained possession of their lands. Many of the towns were forced into the same position. Others were able to maintain their independence, and to make use of the pecuniary needs of the margraves to become practically municipal republics. Their strength, however, was perhaps more usefully shown in their ability to resist the nobles, a proceeding which saved industry and commerce from extinction at a time of unbridled lawlessness. In the pecuniary embarrassments of the margraves also originated the power of the *Stände*, or estates, consisting of the nobles, the clergy and the towns. The first recorded instance of the *Stände* co-operating with the rulers occurred in 1170; but it was not till 1280 that the margrave solemnly bound himself not to raise a *bede* or special voluntary contribution without the consent of the estates. In 1355 the *Stände* secured the appointment of a permanent councillor, without whose concurrence the decrees of the margraves were invalid. In the century which followed the extinction of the Ascanian house, liberty degenerated into licence, and the country was given over to anarchy. Only the most powerful towns were able to maintain their independence; others, together with the clergy, regularly paid blackmail to the neighbouring nobles. Under these conditions it is no wonder that the electorate not only completely lost its political importance, but also suffered a considerable diminution of territory. Upper and lower Lusatia, the new mark of Brandenburg, and other outlying districts had been shorn away, and the electorate now consisted of the old mark, the middle mark with Priegnitz, Uckermark and Sternberg, a total area of not more than 10,000 sq.m.



Such was the condition and extent of Brandenburg in 1411 when Frederick of Hohenzollern became the representative of King Sigismund therein. Entering the electorate with a strong force in June 1412, his authority was quickly recognized in the middle mark, but the nobles of the old mark and of Priegnitz refused to follow this example. The two succeeding years were skilfully used by Frederick to make peace with the neighbouring princes, and having thus isolated his domestic enemies, he turned his arms against them early in 1414. Their strongholds were stormed, and in a few weeks their leaders were either prisoners or fugitives. A general peace was then declared at Tangermünde which enabled Frederick to leave the mark to the rule of his wife, Elizabeth, and to turn his attention elsewhere. Returning to Brandenburg as elector in 1416, the last flickers of the insurrection were extinguished; and when Frederick was invested at Constance in April 1417 his authority over the mark was undisputed. His next difficulty was with Pomerania, which had been nominally under the suzerainty of Brandenburg since 1181. The revival of this claim by the elector provoked an invasion of the mark by an army of Pomeranians with their allies in 1420, when Frederick inflicted a severe defeat upon them at Angermünde; but in 1424 a temporary coolness between the elector and the emperor Sigismund led to a renewal of the attack which Frederick was unable to repulse. This reverse, together with the pressure of other business, induced him to leave Brandenburg in January 1426, after handing over its government to his eldest son, John. John, called the “Alchemist,” who was born in 1403, had been disappointed in his hope of obtaining the vacant electoral duchy of Saxe-Wittenberg in 1423. Lacking the diplomatic and military qualities of his father, his difficulties were augmented by the poverty of the country, and the evils which Frederick had suppressed quickly returned. The feeling of security vanished, the towns banded themselves together for defensive purposes, the rights of the margrave were again pledged to provide money, and in 1432 the land was ravaged by the Hussites. John never attained to the electoral dignity; for, in 1437, his father in arranging a division of his territories decided that Brandenburg should pass to his second and fourth sons, both of whom were named Frederick. The elder of the two took up the government at once, whereupon John left the mark for South Germany, where he remained until his death in 1464.

***Frederick of Hohenzollern, 1412.***

Frederick II., who became elector on his father's death in September 1440, was born on the 19th of November 1413, and earned the surname of "Iron" through his sternness to his country's enemies. He had little difficulty in repressing the turbulence of the nobles which had been quickened into life during the regency of his brother, but found it less easy to deal with the towns. Three strong leagues had been formed among them about 1431, and the spirit of municipal independence was most prominently represented by the neighbouring and allied towns of Berlin and Cöln. In his conflict with the towns over his refusal to ratify all their privileges the elector's task was lightened by a quarrel between the magistrates and the burghers of Berlin, which he was called in to decide in 1442. He deposed the governing oligarchy, changed the constitution of the town, forbade all alliances and laid the foundations of a castle. The inhabitants soon chafed under these restrictions. A revolt broke out in 1447, but the power of the elector overawed the people, who submitted their case to the estates, with the result that the arrangement of 1442 was re-established. In 1447 Frederick was compelled to cede the old mark and Priegnitz to his younger brother, Frederick, under whose feeble rule they quickly fell into disorder. In 1463, however, when the younger Frederick died childless, the elector united them again with his own possessions and took measures to suppress the prevailing anarchy. In his dealings with neighbouring rulers Frederick pursued a peaceful and conciliatory policy. In 1442 he obtained some small additions to his territory, and the right of succession to the duchy of Mecklenburg in case the ducal family should die out. In 1445 an old feud with the archbishop of Magdeburg was settled, and in 1457 a treaty of mutual succession was made with the houses of Saxony and Hesse. Cottbus and Peitz in Lusatia were acquired, and retained after a quarrel with George Podiebrad, king of Bohemia, and the new mark of Brandenburg was purchased from the Teutonic order in 1454. An attempt, however, to secure the duchy of Pomerania-Stettin failed, and the concluding years of this reign were troubled by warfare with the Pomeranians.

***Frederick II.***

The general success of Frederick's rule was secured by the sedulous care with which he confined himself to the work of government. He is said to have refused the thrones of Poland and Bohemia; and although he made pilgrimages to the Holy Land and to Rome, his interest in ecclesiastical questions was mainly directed towards quickening the religious life of his people. He obtained important concessions from Pope Nicholas V. with regard to the appointment of bishops and other ecclesiastical matters in 1447, and in general maintained cordial relations with the papacy. About 1467 his only son, John, died, and increasing infirmity led him to contemplate abdication. An arrangement was made with his brother, Albert Achilles, to whom early in 1470 the mark was handed over, and Frederick retired to Plassenburg where he died on the 10th of February 1471.

Albert appeared in Brandenburg early in the same year, and after receiving the homage of his people took up the struggle with the Pomeranians, which he soon brought to a satisfactory conclusion; for in May 1472 he not only obtained the cession of several districts, but was recognized as the suzerain of Pomerania and as its future ruler. The expenses of this war led to a quarrel with the estates. A subsidy was granted which the elector did not regard as adequate, and by a dexterous use of his power he established his right to take an excise on beer. Albert's most important contribution to the history of Brandenburg was the issue on the 24th of February 1473 of the *Dispositio Achillea*. By this instrument the elector decreed that the electoral mark should pass in its entirety to his eldest son, an establishment of primogeniture which had considerable influence on the future development of the country. He then entrusted the government to his eldest son, John, and left Brandenburg. Handicapped by poverty, John had to face attacks from two quarters. The Pomeranians, inspired by the declaration of the emperor Frederick III. that their land was a direct fief of the Empire, and aided by Matthias Corvinus, king of Hungary, took up arms; and a quarrel broke out with John, duke of Sagan, over the possessions of John's brother-in-law, Henry XI., duke of Glogau. To deal with these difficulties Albert returned to Brandenburg in 1478, and during his stay drove back the Pomeranians, and added Crossen and other parts of duke Henry's possessions to the electorate. Again left in charge of the country, John beat back a fresh attack made by John of Sagan in 1482; and he became elector on his father's death in March 1486. He added the county of Zossen to his possessions in 1490, and in 1493 made a fresh treaty with the duke of Pomerania. Although he brought a certain degree of order into the finances, his poverty and the constant inroads of external enemies prevented him from seriously improving the condition of the country. John, who was called "Cicero," either on account of his eloquence, or of his knowledge of Latin, was interested in learning, welcomed Italian scholars to the electorate, and strove to improve the education of his people. He died at Arneburg on the 9th of January 1499, and was succeeded by his son Joachim I.

***Albert Achilles.***



When Joachim undertook the government of Brandenburg he had to deal with an amount of disorder almost as great as that which had taxed the energies of Frederick I. a century before. Highway robbery was general, the lives and property of traders were in continual jeopardy, and the machinery for the enforcement of the laws was almost at a standstill. About 1504 an attack of unusual ferocity on some

***Joachim.***

Frankfort traders aroused the elector's wrath, and during the next few years the execution of many lawbreakers and other stern measures restored some degree of order. In this and in other ways Joachim proved himself a sincere friend to the towns and a protector of industry. Following the economic tendencies of the time he issued sumptuary laws and encouraged manufactures; while to suppress the rivalry among the towns he established an order of precedence for them. Equally important was his work in improving the administration of justice, and in this direction he was aided by scholars from the university which he had founded at Frankfort-on-Oder in 1506. He gave a new organization to the highest court of justice, the *Kammergericht*, secured for himself an important voice in the choice of its members, and ordered that the local law should be supplemented by the law of Rome. He did not largely increase the area of Brandenburg, but in 1524 he acquired the county of Ruppin, and in 1529 he made a treaty at Grimnitz with George and Barnim XI., dukes of Pomerania, by which he surrendered the vexatious claim to suzerainty in return for a fresh promise of the succession in case the ducal family should become extinct. Joachim's attitude towards the teaching of Martin Luther which had already won many adherents in the electorate, was one of unrelenting hostility. The Jews also felt the weight of his displeasure, and were banished in 1510.

Ignoring the *Dispositio Achillea*, the elector bequeathed Brandenburg to his two sons. When he died in July 1535 the elder, Joachim II., became elector, and obtained the old and middle marks, while the younger, John, received the new mark. John went definitely over to the side of the Lutherans in 1538, while Joachim allowed the reformed doctrines free entrance into his dominions in 1539. The elector, however, unlike his brother, did not break with the forms of the Church of Rome, but established an ecclesiastical organization independent of the pope, and took up a position similar to that of King Henry VIII. in England. Many of the monasteries were suppressed, a consistory was set up to take over the functions of the bishops and to act as the highest ecclesiastical court of the country. In 1541 the new ecclesiastical system was confirmed by the emperor Charles V. With regard to this policy the elector was probably influenced by considerations of greed. The bishoprics of Brandenburg, Havelberg and Lebus were secularized; their administration was entrusted to members of the elector's family; and their revenues formed a welcome addition to his impoverished exchequer. Nor did Joachim neglect other opportunities for adding to his wealth and possessions. In 1537 he had concluded a treaty with Frederick III., duke of Liegnitz, which guaranteed to the Hohenzollerns the succession to the Silesian duchies of Liegnitz, Brieg and Wohlau in the event of the ducal family becoming extinct; this arrangement is important as the basis of the claim made by Frederick the Great on Silesia in 1740. The treaty was declared invalid by the German king, Ferdinand I.; but the elector insisted on its legality, and in 1545 strengthened his position by arranging a double marriage between members of his own family and that of Duke Frederick. Of more immediate consequence was an arrangement made in 1569 with the representatives of Joachim's kinsman, Albert Frederick, duke of Prussia, after which the elector obtained the joint investiture of the duchy of Prussia from Sigismund II., king of Poland, and was assured of the succession if the duke's family became extinct. Joachim's luxurious habits, his partiality for adventurers, and his delight in building, led him to incur such a heavy expenditure that after pledging many of his lands and rights he was compelled in 1540 to appeal for help to the estates. Taking advantage of his difficulties, the estates voted him a sum of money as the price of valuable concessions, the most important of which was that the elector should make no alliance without their consent. Fresh liabilities were soon incurred, and in spite of frequent contributions from the estates Joachim left at his death in January 1571 a heavy burden of debt to his son and successor, John George.

***Joachim II.***

The elector's death was followed ten days later by that of his brother, John, and as John left no sons the whole of Brandenburg, together with the districts of Beeskow and Storkow which had been added by purchase to the new mark, were united under the rule of his nephew, John George. Born on the 11th of September 1525 this prince had served in the field under Charles V., and, disliking his father's policy and associates, had absented himself from Berlin, and mainly confined his attention to administering the secularized bishopric of Brandenburg which he had obtained in 1560. When he became elector he hastened to put his ideas into practice. His father's favourites were exiled; foreigners were ousted from public positions and their places taken by natives; and important economies were effected, which earned for John George the surname of *Oekonom*, or steward. To lighten the heavy burden of debt left by Joachim the elector proposed a tax on wheat and other cereals. Some opposition was shown, but eventually the estates of both divisions of the mark assented; only, however at the price of concessions to the nobles, predominant in the diet, which thrust the peasantry into servitude. Thus the rule of John George was popular with the nobles, and to some extent with the towns. Protestant refugees from France and the Netherlands were encouraged to settle in Brandenburg, and a period of peace was beneficial to a land, the condition of which was still much inferior to that of other parts of Germany. In religion the elector was a follower of Luther, whose doctrines were prevalent among his people. He had accepted the *Formula Concordiae*, a Lutheran document promulgated in June 1580, and sought to prevent any departure from its tenets. His dislike of Calvinism, or his antipathy to external complications,

***John George.***

however, prevented him from taking any serious steps to defend Protestantism from the attacks of the counter-reformation. He did indeed join the league of Torgau, which voted assistance to Henry IV. of France in 1591; but he refused to aid the United Provinces, or even to give assistance to his eldest son, Joachim Frederick, administrator of the archbishopric of Magdeburg, whose claim to sit and vote in the imperial diet was contested, or to his grandson, John George, whose election to the bishopric of Strassburg was opposed by a Roman Catholic minority in the chapter. This indifference to the welfare of the Protestants added to the estrangement between the elector and his eldest son, which was further accentuated when John George, ignoring the *Dispositio Achillea*, bequeathed the new mark to one of his younger sons. He died on the 8th of January 1598.

Joachim Frederick, who now became elector, was born on the 27th of January 1546. Since 1553 he had held the bishopric of Havelberg, since 1555 that of Lebus; he had been administrator of Magdeburg since 1566, and of Brandenburg since 1571. Resigning these dignities in 1598, he contested his father's will, and was successful in preventing a division of the electorate. An agreement with George Frederick, the childless margrave of Ansbach and Bayreuth, paved the way for an arrangement with the elector's younger brothers, who after the margrave's death in April 1603, shared his lands in Franconia, and were compensated in other ways for surrendering all claims on Brandenburg. This agreement, known as the Gera Bond, ratified the *Dispositio Achillea*. By George Frederick's death, Joachim became administrator of the duchy of Prussia, ruled nominally by the weak-minded Albert Frederick, but he had some difficulty in asserting his position. In Brandenburg he made concessions to the nobles at the expense of the peasantry, and admitted the right of the estates to control taxation. In religious matters he was convinced of the necessity of a union between Lutherans and Calvinists, and took steps to bring this about. Public opinion, however, in Brandenburg was too strong for him, and he was compelled to fall back upon the Lutheran *Formula* and the religious policy of his father. Joachim seems to have been a wise ruler, who improved in various ways the condition of the mark. He married Catherine, daughter of John, margrave of Brandenburg-Cüstrin, and when he died, on the 18th of July 1608, was succeeded by his eldest son John Sigismund.



***Joachim Frederick.***

The new elector, born on the 8th of November 1572, had married in 1594 Anna, daughter of Albert Frederick of Prussia, a union which not only strengthened the pretensions of the electors of Brandenburg to the succession in that duchy, but gave to John Sigismund a claim on the duchies of Cleves, Jülich and Berg, and other Rhenish lands should the ruling family become extinct. In March 1609 the death of Duke John William left these duchies without a ruler, and by arrangement they were occupied jointly by the elector and by his principal rival, Wolfgang, son of Philip Louis, count palatine of Neuburg. This proceeding aroused some opposition, and, complicated by religious considerations and by the excited state of European politics, almost precipitated a general war. However, in November 1614 the dispute was temporarily settled by the treaty of Xanten. Brandenburg obtained the duchy of Cleves with the counties of Mark and Ravensberg, but as the Dutch and Spanish garrisons were not withdrawn, these lands were only nominally under the elector's rule. In 1609, John Sigismund had joined the Evangelical Union, probably to win support in the Rhineland, and the same consideration was doubtless one reason why, in 1613, he forsook the Lutheran doctrines of his family, and became an adherent of the reformed, or Calvinist, faith. This step aroused grave discontent in the electorate, and, quickly abandoning his attempts to proselytize, the elector practically conceded religious liberty to his subjects. Over the Cleves-Jülich succession, John Sigismund had incurred heavy expenses, and the public debt had again mounted up. He was thus obliged to seek aid from the estates, and in return for grants to make concessions to the nobles. The elector spent much of his time in Prussia striving to assert his authority in that duchy, and in August 1618, according to the arrangement of 1569, became duke by the death of Albert Frederick. He only enjoyed this dignity for a short time, as he died on the 23rd of December 1619. He was succeeded by his eldest son, George William.

***John Sigismund.***

The new elector, born on the 3rd of November 1597, proved a weak and incapable ruler. He had married Elizabeth, daughter of Frederick IV., elector palatine of the Rhine, and sister of the elector Frederick V., afterwards king of Bohemia, and before his accession had acted as his father's representative in Cleves. Although a Protestant he was under the influence of Adam, count of Schwarzenberg, who was a Roman Catholic of imperialist sympathies. As a result the elector remained neutral during the early years of the Thirty Years' War in spite of his relationship with Frederick of the Palatinate, and the obvious danger to his Rhenish lands. This attitude was not successful. Brandenburg was ravaged impartially by both parties, and in 1627 George William attacked his brother-in-law, Gustavus Adolphus of Sweden, who was using Prussia as a base of operations for his war against Poland. This campaign was short and inglorious for Brandenburg, and the elector was soon compelled to make peace. Although alarmed by the edict of restitution of 1629, George William took no steps to help the Protestants. In 1631, however, Gustavus Adolphus marched on Berlin, compelled the elector to cede the fortress of Spandau, and to aid him with men and

***George William.***

money. The Brandenburg troops then assisted the Swedes until after the death of Gustavus in 1632, and the Swedish defeat at Nördlingen in 1634, when the elector assented to the treaty of Prague, which was made in May 1635 between the emperor Ferdinand II. and John George I., elector of Saxony. The imperialists did nothing, however, to drive the Swedes from Brandenburg, and the unfortunate land was entirely at the mercy of the enemy. This was the principal reason why the elector was unable to annex Pomerania when its last duke, Bogislaus XIV., died in 1637. In 1638 George William transferred his residence to Königsberg, leaving Schwarzenberg to administer the electorate. Although his harsh measures aroused some irritation, the count did something to rid the land of the Swedes and to mitigate its many evils; but its condition was still very deplorable when George William died at Königsberg on the 1st of December 1640, leaving an only son, Frederick William. The most important facts in the internal history of Brandenburg during the 16th century were the increase in the power of the estates, owing chiefly to the continuous pecuniary needs of the electors; the gradual decline in the political importance of the towns, due mainly to intestine feuds; and the lapse of the peasantry into servitude. These events gave a preponderance of power to the nobles, but concurrently a number of circumstances were silently preparing the way for a great increase of authority on the part of the ruler. The substitution of the elector for the pope as head of the church; the introduction of Roman law with its emphasis on a central authority and a central administration; the determined and successful efforts to avoid any partition of the electorate; and the increasing tendency of the separate sections of the diet to act independently; all tended in this direction. This new order was heralded in 1604 by the establishment of a council of state, devoted to the interests of the elector, which strengthened his authority, and paved the way for a bureaucratic government.

When Frederick William, the “Great Elector,” became ruler of Brandenburg in 1640 he found the country in a very deplorable condition. Trade and agriculture were almost destroyed, and the inhabitants, compelled to support the Swedish army of occupation, suffered also from the disorderly conduct of the native soldiers. Although the young elector spent the two first years of his reign mainly in Prussia, he was by no means forgetful of Brandenburg, and began resolutely to root out the many evils which had sprung up during the feeble rule of his father. The powers of Schwarzenberg were curtailed; the state council was restored; and the licence of the soldiers was restrained, while their numbers were reduced. Then turning his attention to the Swedes a truce was arranged, and soon afterwards, in return for an indemnity, they agreed to evacuate the electorate. Having returned to Brandenburg in 1643, Frederick William remained neutral during the concluding years of the Thirty Years’ War, and set to work to organize an army and to effect financial reforms. About the same time diplomatic methods freed Cleves, Mark and Ravensberg from foreign troops, but the estates of these lands gained a temporary victory when the elector attacked their privileges. However, in 1647 his title was formally admitted by Wolfgang, count palatine of Neuburg.

***Frederick William, the “Great Elector.”***

The terms of the treaty of Westphalia in 1648 are the best commentary on the general success of the elector’s policy. Although he was obliged to give up his claim to the western part of Pomerania in favour of Sweden, he secured the eastern part of that duchy, together with the secularized bishoprics of Halberstadt, Minden and Kammin, and other lands, the whole forming a welcome addition to the area of Brandenburg. He was also promised the archbishopric of Magdeburg when its administrator, Augustus, duke of Saxe-Weissenfels, should die. This event happened in 1680 when he secured the lands of the archbishopric. The elector did not, however, take possession of the newly-acquired territories at once. Fresh difficulties arose with Sweden, and it was not until 1653 that eastern Pomerania was freed from her soldiers. Meanwhile a new quarrel had broken out with Wolfgang of Neuburg. In 1650 Frederick William attacked his rival, but a variety of circumstances, among others a change of government in the Netherlands, and the resistance of the estates of Cleves, thwarted his plans, and he was compelled to listen to the mediating powers, and to acquiesce in the *status quo*.



Profiting by these reverses the elector then undertook a series of internal reforms, tending to strengthen the central authority, and to mitigate the constant lack of money, which was perhaps his chief obstacle to success; a work in which he was aided by George, count of Waldeck (1620-1692), who became his chief adviser about this time. In 1651 the powers of the state council were extended to include all the lands under the elector’s rule; and a special committee was appointed to effect financial economies, and so to augment the electoral resources. In imperial politics Frederick William supported the election of Ferdinand, son of the emperor Ferdinand III., as king of the Romans in 1653; but when the emperor failed to fulfil his promises, influenced by Waldeck, he acted in opposition to the imperial interests, and even formed a plan for a great alliance against the Habsburgs. These projects were disturbed by the war which broke out in 1655 between Sweden and Poland. In this struggle the elector fought first on one side and then on the other; but the important consequences of his conduct belong rather to the history of the duchy of Prussia (*q.v.*). The transfer of the elector’s support from Sweden to Poland in 1656 was followed by the fall from power of Waldeck, who was succeeded by Otto von Schwerin (1616-1679), under whose influence the elector’s relations with the emperor became more cordial.

The increase in the prestige of Brandenburg was due chiefly to his army, which was gradually brought to a high state of efficiency. A proper organization was established to superintend the pay and maintenance of the soldiers, and they were commanded by experienced officers, among others by Georg Derfflingen (1606-1695), and Otto von Sparr (1605-1668). The general poverty, however, made the estates reluctant to support a standing army, and after the peace of Oliva in 1660, it was reduced to about 3500 men. The continual difficulties with the estates of his different dominions had harassed and hampered the elector, and the general peace which followed the treaty of Oliva offered a favourable opportunity to curtail their powers. Undaunted by two previous rebuffs he attacked the estates of Cleves, and by a display of force gained a substantial victory. Some important privileges were annulled, and he obtained a considerable sum of money. The *Landtag* of Brandenburg was not cowed so easily into submission, but an increase of revenue was obtained, and the stubborn struggle which ensued in Prussia ended in a victory for the ruler. This increased income enabled the elector to take a more considerable part in European politics. In 1663 he assisted the imperialists in their struggle with the Turks; in 1666 the dispute over Cleves, Mark and Ravensberg was finally settled, and Brandenburg were confirmed in the possession of these lands; and in the same year a reconciliation was effected with Sweden. Several disputes which threatened to disturb the peace of the Empire were settled through his mediation, and he compelled the citizens of Magdeburg to do homage to him. In religious matters he interceded with the emperor and the diet for the Protestants, and sought, but without success, to bring about a reconciliation between Lutherans and Calvinists in Brandenburg.

The elector’s relations with Louis XIV. of France are full of interest. After the conclusion of the war of devolution in 1667, he allied himself with Louis, and together they agreed to support the candidature of Wolfgang of Neuburg for the vacant Polish throne. In 1668, moreover, he refused to join the triple alliance against France, but soon afterwards became aware of the danger to his country from the aggressive policy of Louis. The United Provinces were bound to him by religious interests, political considerations, and family ties alike, and he could not be indifferent when their position was threatened by France. In spite of tempting offers from Louis, he was the first to join the Dutch when they were attacked by Louis in 1672, and conducted an ineffectual campaign on the Rhine until June 1673, when he was forced to make peace. In July 1674, however, he joined the Empire, the United Provinces and Spain, and in return for a subsidy, fought against France in Alsace. Meanwhile Louis had instigated the Swedes to invade Brandenburg, which had been left to the care of John George II., prince of Anhalt-Dessau. Hastening from Franconia to defend the electorate, Frederick William gained a complete victory over a superior number of the enemy at Fehrbellin on the 28th of June 1675, a great and glorious day for the arms of Brandenburg. Aided by the imperialists and the Danes, he followed up this success, and cleared Brandenburg and Pomerania of the Swedes, capturing Stettin in 1677 and Stralsund in 1678, while an attack made by Sweden on Prussia was successfully repelled. The general peace of Nijmwegen was followed by the treaty of St Germain-en-Laye in June 1679 between Sweden and Brandenburg. Owing, however, to the insistence of Louis XIV. and the indifference, or weakness, of the emperor Leopold I., the elector was forced to restore western Pomerania to Sweden, in return for the payment of 300,000 crowns by France. This feebleness on the part of his ally induced Frederick William to listen more readily to the overtures of Louis, and in 1679, and again in 1681, he bound himself to support the interests of France. He had, moreover, a further grievance against the emperor as Leopold refused to recognize his right to the Silesian duchies of Liegnitz, Brieg and Wohlau, which had been left without a ruler in 1675. About 1684, however, the foreign policy of Brandenburg underwent another change. Disliking the harshness shown by Louis to the Protestants, the elector concluded an alliance with William, prince of Orange, in August 1685; and entered into more friendly relations with the emperor. Further incensed against France by the revocation of the edict of Nantes in 1685, he made an alliance with Leopold in January 1686, agreeing in return for a subsidy to send troops against the Turks. Soon afterwards he received Schwiebus to compensate him for abandoning his claim on the Silesian duchies, and in a secret treaty made promises of support to Leopold. The great elector died in May 1688, leaving his territories to his eldest son, Frederick.

The remarkable services of Frederick William to his country can best be judged by comparing its condition in 1640 with that in 1688. At his accession the greater part of his territory was occupied by strangers and devastated by war, and in European politics Brandenburg was merely an appendage of the empire. Its army was useless; its soil was poor; its revenue was insignificant. At his death the state of Brandenburg-Prussia was a power to be reckoned with in all European combinations. Inferior to Austria alone among the states of the Empire, it was regarded as the head of the German Protestantism; while the fact that one-third of its territory lay outside the Empire added to its importance. Its area had been increased to over 40,000 sq. m.; its revenue had multiplied sevenfold; and its small army was unsurpassed for efficiency. The elector had overthrown Sweden and inherited her position on the Baltic, and had offered a steady and not ineffectual resistance to the ambition of France.

While thus winning for himself a position in the councils of Europe, Frederick William was not

less active in strengthening the central authority within his own dominions. He found Brandenburg a constitutional state, in which the legislative power was shared between the elector and the diet; he left it to his successor substantially an absolute monarchy. Many circumstances assisted to bring about this change, among the chief of which were the want of harmonious action on the part of the estates, and the decline in the political power of the towns. The substitution of a permanent excise for the subsidies granted from time to time by the estates also tended to increase his independence, and the officials or *Steuerräthe*, appointed by him to collect this tax in the towns, gradually absorbed many of the administrative functions of the local authorities. The nobles and prelates generally preferred to raise their share of the revenue by the old method of a *bede*, or contribution, thus weakening the remaining bond between them and the burghers.



In matters of general administration Frederick William showed himself a prudent and careful ruler, and laid the foundation of the future greatness of Prussia in almost every department. The wounds inflicted by the Thirty Years' War were in a great measure healed, and the finances and credit of the state were established on a firm basis. Agriculture and commerce were improved and encouraged by a variety of useful measures, and in this connexion the settlement of a large number of Flemings, and the welcome extended to French Protestants, both before and after the revocation of the edict of Nantes, were of incalculable service. A small but efficient navy was founded, and strict economy, together with increasing resources, enabled a disciplined army to be maintained. Education was not neglected, a trading company was established, and colonies were founded on the west coast of Africa. In religious matters Calvinists and Lutherans were placed upon an equality, but the elector was unable to impress his own spirit of tolerance upon the clergy, who were occupied with ecclesiastical squabbles while the state of education and of public morals left much to be desired. The condition of the peasantry, however, during this reign reached its lowest point, and the "recess," or charter, of 1653 practically recognizes the existence of villenage. While the nobles had been losing power with regard to the ruler they had been increasing it at the expense of the peasants. The Thirty Years' War afforded them frequent opportunities of replacing the village *Schulzen*, or magistrates, with officials of their own; and the fact that their share of taxation was wholly wrung from the peasants made the burden of the latter much heavier than that of the townsmen.

***Frederick III.***

The new elector, Frederick III., followed in general the policy of his father. Having persuaded his step-brothers to surrender the principalities bequeathed to them by the great elector, he assisted William of Orange to make his descent on England; then in 1688 allied himself with other German princes against Louis XIV., and afterwards fought for the Empire against both France and Turkey. Before he became elector Frederick had promised the emperor that he would restore Schwiebus, and he was now called upon to fulfil this engagement, which after some murmuring he did in 1695. This fact, however, together with some slights put upon him at the peace of 1697, led him to look with less favour upon imperial interests. Frederick's chief adviser about this time was Eberhard Danckelmann (1643-1722), whose services in continuing the reforming work of the great elector were very valuable; but having made many enemies, the electress Sophia among them, he fell from power in 1697, and was imprisoned for several years. The most important work of the elector was to crown the labours of his father by securing the kingly title for himself and his descendants. Broached in 1692 this matter was brought up again in 1698 when the emperor and his ministers, faced with the prospect of a fight over the Spanish succession, were anxious to conciliate Brandenburg. It was at length decided that the title should be taken from Prussia rather than from Brandenburg as the former country lay outside the Empire, and in return Frederick promised to assist Leopold with 8000 men. The coronation ceremony took place at Königsberg on the 18th of January 1701. The territorial additions to Brandenburg during this reign were few and unimportant, but the comparative wealth and prosperity enabled the elector to do a good deal for education, and to spend some money on buildings. In 1694 the university of Halle was founded; academies for arts and sciences were established, and Berlin was greatly improved. The subsequent history of Brandenburg is merged in that of Prussia (*q.v.*).

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(A. W. H.*)

**BRANDENBURG,** the central and one of the largest provinces of Prussia, consisting of a part of the former electorate of Brandenburg from which it derives its name. With the other territories of the elector of Brandenburg, it was merged in 1701 in the kingdom of Prussia, and when the administration of Prussia was reformed in 1815, Brandenburg became one of the provinces of Prussia. The boundaries of the new province, however, differed considerably from those of the old district. The old mark, the district on the left bank of the Elbe, was added to the province of Saxony, and in return a district to the south, taken from the kingdom of Saxony, was added to the province of Brandenburg. It has an area of 15,382 sq. m., and is divided into the two governments of Potsdam and Frankfort-on-Oder; the capital, Berlin, forming a separate jurisdiction. The province is a sandy plain interspersed with numerous fertile districts and considerable stretches of woodland, mostly pine and fir. Its barrenness was formerly much exaggerated, when it was popularly described as the “sandbox of the Holy Roman Empire.” It is generally well watered by tributaries of its two principal rivers, the Elbe and the Oder, and is besides remarkable for the number of its lakes, of which it contains between 600 and 700. The mineral products comprise lignite, limestone, gypsum, alum and potter’s earth; barley and rye are the usual cereals; fruits and vegetables are abundant; and considerable quantities of hemp, flax, hops and tobacco are raised. The breeding of sheep receives much attention, and the province exports wool in considerable quantity. Bees are largely kept, and there is an abundance of game. The rivers and lakes also furnish fish, particularly carp, of excellent quality. The climate is cold and raw in winter, excessively hot in summer, and there are frequently violent storms of wind. The manufacturing industry of the province is both varied and extensive, but is for the most part concentrated in the principal towns. The most important branches are the spinning and weaving of wool and cotton, the manufacturing of paper, and the distillation of brandy. Pop. (1895) 2,821,695; (1905) 3,529,839.

**BRANDENBURG,** a town of Germany, capital of the district and province of same name, on the river Havel, 36 m. S.W. from Berlin, on the main line to Magdeburg and the west. Pop. (1905) 51,251, including 3643 military. The town is enclosed by walls, and is divided into three parts by the river—the old town on the right and the new town on the left bank, while on an island between them is the “cathedral town,”—and is also called, from its position, “Venice.” Many of the houses are built on piles in the river. There are five old churches (Protestant), all more or less noteworthy. These are the Katharinenkirche (nave 1381-1401, choir c. 1410, western tower 1583-1585), a Gothic brick church with a fine carved wooden altar and several interesting medieval tombs; the Petrikirche (14th century Gothic); the cathedral (Domkirche), originally a Romanesque basilica (1170), but rebuilt in the Gothic style in the 14th century, with a good altar-piece (1465), &c., and noted for its remarkable collection of medieval vestments; the Gothardskirche, partly Romanesque (1160), partly Gothic (1348); the Nikolaikirche (12th and 13th centuries), now no longer used. There is also a Roman Catholic church. Of other buildings may be mentioned the former town hall of the “old town” (Altstadt Rathaus), built in the 13th and 14th centuries, now used as government offices; the new Real-gymnasium; and the town hall in the Neustadt, before which, in the market-place, stands a Rolandssäule, a colossal figure 18 ft. in height, hewn out of a single block of stone. A little north of the town is the Marienberg, or Harlungerberg, on which the heathen temple of Triglaff and afterwards the church and convent of St Mary were built. On the top stands a lofty monument to the soldiers from the Mark who fell in the wars of 1864, 1866 and 1870-71. The town has a considerable trade, with manufactures of woollens, silks, linens, hosiery and paper, as well as breweries, tanneries, boat-building and bicycle factories.



Brandenburg, originally *Brennaburg* (*Brennabor*) or *Brendanburg*, was originally a town of the Slavic tribe of the Hevelli, from whom it was captured (927-928) by the German king Henry I. In 948 Otto I. founded a bishopric here, which was subordinated first to the archdiocese of Mainz, but from 968 onwards to the newly created archbishopric of Magdeburg. It was, however, destroyed by the heathen Wends in 983, and was only restored when Albert the Bear recaptured the town from them in 1153. In 1539 the bishop of Brandenburg, Matthias von Jagow, embraced the Lutheran faith, and five years later the Protestant worship was established in the cathedral. The see was administered by the elector of Brandenburg until 1598 and then abolished, its territories being for the most part incorporated in the electoral domains. The cathedral chapter, however, survived, and though suppressed in 1810, it was restored in 1824. It consists of twelve canons, of whom three only are spiritual, the other nine prebends being held by noblemen; all are in the gift of the king of Prussia.

The “old” and “new” towns of Brandenburg were for centuries separate towns, having been united under a single municipality so late as 1717.

See Schillmann, *Geschichte der Stadt Brandenburg* (Brandenburg, 1874-1882).

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**BRANDER, GUSTAVUS** (1720-1787), English naturalist, who came of a Swedish family, was born in London in 1720, and was brought up as a merchant, in which capacity he achieved success and became a director of the Bank of England. His leisure time was occupied in scientific pursuits, and at his country residence at Christchurch in Hampshire he became interested in the fossils so abundant in the clays of Hordwell and Barton. A set of these was presented by him to the British Museum, and they were described by D.C. Solander in the beautifully illustrated work entitled *Fossilia Hantoniensia collecta, et in Musaeo Britannico deposita a Gustavo Brander* (London, 1766). Brander was elected F.R.S. in 1754, and he was also a trustee of the British Museum. He died on the 21st of January 1787.

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**BRANDES, GEORG MORRIS COHEN** (1842- ), Danish critic and literary historian, was born in Copenhagen on the 4th of February 1842. He became a student in the university in 1859, and first studied jurisprudence. From this, however, his maturer taste soon turned to philosophy and aesthetics. In 1862 he won the gold medal of the university for an essay on *The Nemesis Idea among the Ancients*. Before this, indeed since 1858, he had shown a remarkable gift for verse-writing, the results of which, however, were not abundant enough to justify separate publication. Brandes, indeed, did not collect his poems till so late as 1898. At the university, which he left in 1864, Brandes was much under the influence of the writings of Heiberg in criticism and Sören Kierkegaard in philosophy, influences which have continued to leave traces on his work. In 1866 he took part in the controversy raised by the works of Rasmus Nielsen in a treatise on “Dualism in our Recent Philosophy.” From 1865 to 1871 he travelled much in Europe, acquainting himself with the condition of literature in the principal centres of learning. His first important contribution to letters was his *Aesthetic Studies* (1868), in which, in several brief monographs on Danish poets, his maturer method is already foreshadowed. In 1870 he published several important volumes, *The French Aesthetics of Our Days*, dealing chiefly with Taine, *Criticisms and Portraits*, and a translation of *The Subjection of Women* of John Stuart Mill, whom he had met that year during a visit to England. Brandes now took his place as the leading critic of the north of Europe, applying to local conditions and habits of thought the methods of Taine. He became *docent* or reader in *Belles Lettres* at the university of Copenhagen, where his lectures were the sensation of the hour. On the professorship of Aesthetics becoming vacant in 1872, it was taken as a matter of course that Brandes would be appointed. But the young critic had offended many susceptibilities by his ardent advocacy of modern ideas; he was known to be a Jew, he was convicted of being a Radical, he was suspected of being an atheist. The authorities refused to elect him, but his fitness for the post was so obvious that the chair of Aesthetics in the university of Copenhagen remained vacant, no one else daring to place himself in comparison with Brandes. In the midst of these polemics the critic began to issue the most ambitious of his works, *Main Streams in the Literature of the Nineteenth Century*, of which four volumes appeared between 1872 and 1875 (English translation, 1901-1905). The brilliant novelty of this criticism of the literature of the chief countries of Europe at the beginning of the 19th century, and his description of the general revolt against the pseudo-classicism of the 18th century, at once attracted attention outside Denmark. The tumult which gathered round the person of the critic increased the success of the work, and the reputation of Brandes grew apace, especially in Germany and Russia. Among his later writings must be mentioned the monographs on *Sören Kierkegaard* (1877), on *Esaias Tegnér* (1878), on *Benjamin Disraeli* (1878), *Ferdinand Lassalle* (in German, 1877), *Ludvig Holberg* (1884), on *Henrik Ibsen* (1899) and on *Anatole France* (1905). Brandes has written with great fulness on the main contemporary poets and novelists of his own country and of Norway, and he and his disciples have long been the arbiters of literary fame in the north. His *Danish Poets* (1877), containing studies of Carsten Hauch, Ludwig Bödtcher, Christian Winther, and Paludan-Müller, his *Men of the Modern Transition* (1883), and his *Essays* (1889), are volumes essential to the proper study of modern Scandinavian literature. He wrote an excellent book on *Poland* (1888; English translation, 1903), and was one of the editors of the German version of *Ibsen*. In 1877 Brandes left Copenhagen and settled in Berlin, taking a considerable part in the aesthetic life of that city. His political views, however, made Prussia

uncomfortable for him, and he returned in 1883 to Copenhagen, where he found a whole new school of writers and thinkers eager to receive him as their leader. The most important of his recent works has been his study of Shakespeare (1897-1898), which was translated into English by William Archer, and at once took a high position. It was, perhaps, the most authoritative work on Shakespeare, not principally intended for an English-speaking audience, which had been published in any country. He was afterwards engaged on a history of modern Scandinavian literature. In his critical work, which extends over a wider field than that of any other living writer, Brandes has been aided by a singularly charming style, lucid and reasonable, enthusiastic without extravagance, brilliant and coloured without affectation. His influence on the Scandinavian writers of the 'eighties was very great, but a reaction, headed by Holger Drachmann, against his "realistic" doctrines, began in 1885 (see DENMARK: *Literature*). In 1900 he collected his works for the first time in a complete and popular edition, and began to superintend a German complete edition in 1902.

His brother Edvard Brandes (b. 1847), also a well-known critic, was the author of a number of plays, and of two psychological novels: *A Politician* (1889), and *Young Blood* (1899).

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**BRANDING** (from Teutonic *brinnan*, to burn), in criminal law a mode of punishment; also a method of marking goods or animals; in either case by stamping with a hot iron. The Greeks branded their slaves with a Delta, Δ, for Δοῦλος. Robbers and runaway slaves were marked by the Romans with the letter F (*fur*, *fugitivus*); and the toilers in the mines, and convicts condemned to figure in gladiatorial shows, were branded on the forehead for identification. Under Constantine the face was not permitted to be so disfigured, the branding being on the hand, arm or calf. The canon law sanctioned the punishment, and in France galley-slaves could be branded "TF" (*travaux forcés*) until 1832. In Germany, however, branding was illegal. The punishment was adopted by the Anglo-Saxons, and the ancient law of England authorized the penalty. By the Statute of Vagabonds (1547) under Edward VI. vagabonds, gipsies and brawlers were ordered to be branded, the first two with a large V on the breast, the last with F for "fraymaker." Slaves, too, who ran away were branded with S on cheek or forehead. This law was repealed in 1636. From the time of Henry VII. branding was inflicted for all offences which received benefit of clergy (*q.v.*), but it was abolished for such in 1822. In 1698 it was enacted that those convicted of petty theft or larceny, who were entitled to benefit of clergy, should be "burnt in the most visible part of the left cheek, nearest the nose." This special ordinance was repealed in 1707. James Nayler, the mad Quaker, who in the year 1655 claimed to be the Messiah, had his tongue bored through and his forehead branded B for blasphemer.



In the Lancaster criminal court a branding-iron is still preserved in the dock. It is a long bolt with a wooden handle at one end and an M (malefactor) at the other. Close by are two iron loops for firmly securing the hands during the operation. The brander, after examination, would turn to the judge and exclaim, "A fair mark, my lord." Criminals were formerly ordered to hold up their hands before sentence to show if they had been previously convicted.

Cold branding or branding with cold irons became in the 18th century the mode of nominally inflicting the punishment on prisoners of higher rank. "When Charles Moritz, a young German, visited England in 1782 he was much surprised at this custom, and in his diary mentioned the case of a clergyman who had fought a duel and killed his man in Hyde Park. Found guilty of manslaughter he was *burnt* in the hand, if that could be called burning which was done with a cold iron" (Markham's *Ancient Punishments of Northants*, 1886). Such cases led to branding becoming obsolete, and it was abolished in 1829 except in the case of deserters from the army. These were marked with the letter D, not with hot irons but by tattooing with ink or gunpowder. Notoriously bad soldiers were also branded with BC (bad character). By the British Mutiny Act of 1858 it was enacted that the court-martial, in addition to any other penalty, may order deserters to be marked on the left side, 2 in. below the armpit, with the letter D, such letter to be not less than 1 in. long. In 1879 this was abolished.

See W. Andrews, *Old Time Punishments* (Hull, 1890); A.M. Earle, *Curious Punishments of Bygone Days* (London, 1896).

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**BRANDIS, CHRISTIAN AUGUST** (1790-1867), German philologist and historian of philosophy, was born at Hildesheim and educated at Kiel University. In 1812 he graduated at

Copenhagen, with a thesis *Commentationes Eleaticae* (a collection of fragments from Xenophanes, Parmenides and Melissus). For a time he studied at Göttingen, and in 1815 presented as his inaugural dissertation at Berlin his essay *Von dem Begriff der Geschichte der Philosophie*. In 1816 he refused an extraordinary professorship at Heidelberg in order to accompany B.G. Niebuhr to Italy as secretary to the Prussian embassy. Subsequently he assisted I. Bekker in the preparation of his edition of Aristotle. In 1821 he became professor of philosophy in the newly founded university of Bonn, and in 1823 published his *Aristotelius et Theophrasti Metaphysica*. With Boeckh and Niebuhr he edited the *Rheinisches Museum*, to which he contributed important articles on Socrates (1827, 1829). In 1836-1839 he was tutor to the young king Otho of Greece. His great work, the *Handbuch der Geschichte der griechisch-röm. Philos*. (1835-1866; republished in a smaller and more systematic form, *Gesch. d. Entwickelungen d. griech. Philos*., 1862-1866), is characterized by sound criticism. Brandis died on the 21st of July 1867.

See Trendelenburg, *Zur Erinnerung an C. A. B*. (Berlin, 1868).

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**BRANDON,** a city and port of entry of Manitoba, Canada, on the Assiniboine river, and the Canadian Pacific and Canadian Northern railways, situated 132 m. W. of Winnipeg, 1184 ft. above the sea. Pop. (1891) 3778; (1907) 12,519. It is in one of the finest agricultural sections and contains a government experimental farm, grain elevators, saw and grist mills. It was first settled in 1881, and incorporated as a city in 1882.

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**BRANDON,** a market town in the Stowmarket parliamentary division of Suffolk, England, on the Little Ouse or Brandon river, 86½ m. N.N.E. from London by the Ely-Norwich line of the Great Eastern railway. Pop. (1901) 2327. The church of St Peter is Early English with earlier portions; there is a free grammar school founded in 1646; and the town has some carrying trade by the Little Ouse in corn, coal and timber. Rabbit skins of fine texture are dressed and exported. Extensive deposits of flint are worked in the neighbourhood, and the work of the “flint-knappers” has had its counterpart here from the earliest eras of man. Close to Brandon, but in Norfolk across the river, at the village of Weeting, are the so-called Grimes’ Graves, which, long supposed to show the foundations of a British village, and probably so occupied, were proved by excavation to have been actually neolithic flint workings. The pits, though almost completely filled up (probably as they became exhausted), were sunk through the overlying chalk to the depth of 20 to 60 ft., and numbered 254 in all. Passages branched out from them, and among other remains picks of deer-horn were discovered, one actually bearing in the chalk which coated it the print of the workman’s hand.

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**BRANDY,** an alcoholic, potable spirit, obtained by the distillation of grape wine. The frequently occurring statement that the word “brandy” is derived from the High German *Branntwein* is incorrect, inasmuch as the English word (as Fairley has pointed out) is quite as old as any of its continental equivalents. It is simply an abbreviation of the Old English *brandewine*, *brand-wine* or *brandy wine*, the word “brand” being common to all the Teutonic languages of northern Europe, meaning a thing burning or that has been burnt. John Fletcher’s *Beggar’s Bush* (1622) contains the passage, “Buy brand wine”; and from the Roxburgh *Ballads* (1650) we have “It is more fine than brandewine.” The word “brandy” came into familiar use about the middle of the 17th century, but the expression “brandywine” was retained in legal documents until 1702 (Fairley). Thus in 1697 (*View Penal Laws*, 173) there occurs the sentence, “No aqua vitae or brandywine shall be imported into England.” The *British Pharmacopoeia* formerly defined French brandy, which was the only variety mentioned (officially *spiritus vini gallici*), as “Spirit distilled from French wine; it has a characteristic flavour, and a light sherry colour derived from the cask in which it has been kept.” In the latest edition the Latin title *spiritus vini gallici* is retained, but the word *French* is dropped from the text, which now reads as follows: “A spirituous liquid distilled from wine and matured by age, and containing not less than 36½% by weight or 43½% by volume

of ethyl hydroxide." The *United States Pharmacopoeia* (1905), retains the Latin expression *spiritus vini gallici* (English title *Brandy*), defined as "an alcoholic liquid obtained by the distillation of the fermented, unmodified juice of fresh grapes."

Very little of the brandy of commerce corresponds exactly to the former definition of the *British Pharmacopoeia* as regards colouring matter, inasmuch as trade requirements necessitate the addition of a small quantity of caramel (burnt sugar) colouring to the spirit in the majority of cases. The object of this is, as a rule, not that of deceiving the consumer as to the apparent age of the brandy, but that of keeping a standard article of commerce at a standard level of colour. It is practically impossible to do this without having recourse to caramel colouring, as, practically speaking, the contents of any cask will always differ slightly, and often very appreciably, in colour intensity from the contents of another cask, even though the age and quality of the spirits are identical.

The finest brandies are produced in a district covering an area of rather less than three million acres, situated in the departments of Charente and Charente Inférieure, of which the centre is the town of Cognac. It is generally held that only brandies produced within this district have a right to the name "cognac." The Cognac district is separated into district zones of production, according to the quality of the spirit which each yields. In the centre of the district, on the left bank of the Charente, is the *Grande Champagne*, and radiating beyond it are (in order of merit of the spirit produced) the *Petite Champagne*, the *Borderies* (or *Premiers Bois*), the *Fins Bois*, the *Bons Bois*, the *Bois Ordinaires*, and finally the *Bois communs dits à terroir*. Many hold that the brandy produced in the two latter districts is not entitled to the name of "cognac," but this is a matter of controversy, as is also the question as to whether another district called the *Grande Fine Champagne*, namely, that in the immediate neighbourhood of the little village of Juillac-le-Coq, should be added to the list. The pre-eminent quality of the Cognac brandies is largely due to the character of the soil, the climate, and the scientific and systematic cultivation of the vines. For a period—from the middle 'seventies to the 'nineties of the 19th century—the cognac industry was, owing to the inroads of the phylloxera, threatened with almost total extinction, but after a lengthy series of experiments, a system of replanting and hybridizing, based on the characteristics of the soils of the various districts, was evolved, which effectually put a stop to the further progress of the disease. In 1907 the area actually planted with the vine in the Cognac district proper was about 200,000 acres, and the production of cognac brandy, which, however, varies widely in different years, may be put down at about five million gallons per annum. The latter figure is based on the amount of wine produced in the two Charentes (about forty-five million gallons in 1905).



Brandy is also manufactured in numerous other districts in France, and in general order of commercial merit may be mentioned the brandies of Armagnac, Marmande, Nantes and Anjou. The brandies commanding the lowest prices are broadly known as the *Trois-Six de Monlpellier*. In a class by themselves are the *Eaux-de-vie de Marc*, made from the wine pressings or from the solid residues of the stills. Some of these, particularly those made in Burgundy, have characteristic qualities, and are considered by many to be very fine. The consumption is chiefly local. Brandy of fair quality is also made in other wine-producing countries, particularly in Spain, and of late years colonial (Australian and Cape) brandies have attracted some attention. The comsumption of brandy in the United Kingdom amounts to about two million gallons.

Brandy, in common with other potable spirits, owes its flavour and aroma to the presence of small quantities of substances termed secondary or by-products (sometimes "impurities"). These are dissolved in the ethyl alcohol and water which form over 99% of the spirit. The nature and quantity of all of these by-products have not yet been fully ascertained, but the knowledge in this direction is rapidly progressing. Ch. Ordonneau fractionally distilled 100 litres of 25-year-old cognac brandy, and obtained the following substances and quantities thereof:—

| | Grammes in 100 Litres. |
|---|---|
| Normal propyl alcohol | 40.0 |
| Normal butyl alcohol | 218.6 |
| Amyl alcohol | 83.8 |
| Hexyl alcohol | 0.6 |
| Heptyl alcohol | 1.5 |
| Ethyl acetate | 35.0 |
| Ethyl propionate, butyrate and caproate | 3.0 |
| Oenanthic ether (about) | 4.0 |
| Aldehyde | 3.0 |
| Acetal | traces |
| Amines | traces |

Most of the above substances, in fact probably all of them, excepting the oenanthic ether, are contained in other spirits, such as whisky and rum. The oenanthic ether (ethyl pelargonate) is one of the main characteristics which enable us chemically to differentiate between brandy and other distilled liquors. Brandy also contains a certain quantity of free acid, which increases with age, furfural, which decreases, and small quantities of other matters of which we have as yet little knowledge.

The table gives analyses, by the present author (excepting No. 3, which is by F. Lusson), of undoubtedly genuine commercial cognac brandies of various ages.

Genuine Cognac Brandies.

(Excepting the alcohol, results are expressed in grammes per 100 litres of absolute alcohol.)

| Age, &c. | Alcohol % by vol. | Total Acid. | Non-volatile Acid. | Esters. | "Higher Alcohols." | Aldehyde. | Furfural. |
|---|---|---|---|---|---|---|---|
| 1. *New* 1904 | 61.7 | 45 | 5 | 82 | 125 | 8 | 2.3 |
| 2. *New*, still heated by steam coil | 56.3 | 22 | 4 | 61 | 100 | 3 | 1.2 |
| 3. *New* | 67.7 | 51 | .. | 158 | 152 | 6 | 1.3 |
| 4. *Five years old*, 1900 vintage | 57.7 | 92 | 37 | 125 | .. | .. | .. |
| 5. *1875 vintage*, pale | 46.7 | 144 | 37 | 177 | 261 | 55 | 1.0 |
| 6. *1848 vintage*, brown | 38.5 | 254 | 109 | 190 | 488 | 32 | 2.1 |

*Note.*—In the above table the acid is expressed in terms of acetic acid, the esters are expressed as ethyl acetate, and the aldehyde as acetaldehyde. The "Higher Alcohol" figures do not actually represent these substances, but indicate the relative coloration obtained with sulphuric acid when compared with an iso-butyl standard under certain conditions.

*Storage and Maturation.*—Brandy is stored in specially selected oak casks, from which it extracts a certain quantity of colouring matter and tannin, &c. Commercial cognac brandies are generally blends of different growths and vintages, the blending being accomplished in large vats some little time prior to bottling. The necessary colouring and sweetening matter is added in the vat. In the case of pale brandies very little colouring and sweetening are added, the usual quantity being in the neighbourhood of ½ to 1%. Old "brown brandies," which are nowadays not in great demand, require more caramel and sugar than do the pale varieties. The preparation of the "liqueur," as the mixed caramel and sugar syrup is termed, is an operation requiring much experience, and the methods employed are kept strictly secret. Fine "liqueur" is prepared with high-class brandy, and is stored a number of years prior to use. Brandy, as is well known, improves very much with age (for chemical aspects of maturation see Spirits), but this only holds good when the spirit is in *wood*, for there is no material appreciation in quality after bottling. It is a mistake to believe, however, that brandy improves indefinitely, even when kept in wood, for, as a matter of fact, after a certain time—which varies considerably according to the type of brandy, the vintage, &c.—there is so much evaporation of alcohol that a number of undesirable changes come about. The brandy begins to "go back," and becomes, as it is called, "worn" or "tired." It is necessary, therefore, that the bottling should not be deferred too long. Sometimes, for trade reasons, it is necessary to keep brandy in cask for a long period, and under these conditions the practice is to keep a series of casks, which are treated as follows:—The last cask is kept filled by occasionally adding some spirit from the cask next in order, the latter is filled up by spirit taken from the third cask from the end, and so on, until the first cask in the row is reached. The latter is filled up or "topped" with some relatively fresh spirit.

Brandy is much employed medicinally as a food capable of supplying energy in a particularly labile form to the body, as a stimulant, carminative, and as a hypnotic.

*Adulteration.*—A good deal has been written about the preparation of artificial brandy by means of the addition of essential oils to potato or beetroot spirit, but it is more than doubtful whether this practice was really carried on on a large scale formerly. What undoubtedly did occur was that much beet, potato or grain spirit was used for blending with genuine grape spirit. Prosecutions under the Food and Drugs Act, by certain English local authorities in the year 1904, resulted in the practical fixation of certain chemical standards which, in the opinion of the present writer, have, owing to their arbitrary and unscientific nature, resulted in much adulteration of a type previously non-existent. There is no doubt that at the present time artificial esters and higher alcohols, &c., are being used on an extensive scale for the preparation of cheap brandies, and the position, in this respect, therefore, has not been inproved. Where formerly fraud was practically confined to the blending of genuine brandy with spirit other than that derived from the grape, it is now enhanced by the addition of artificial essences to the blend of the two spirits.

(P. S.)

**BRANDYWINE,** the name of a stream in Pennsylvania and Delaware, U.S.A., which runs into the Delaware river a few miles east of Wilmington, Delaware. It is famous as the scene of the battle of Brandywine in the American War of Independence, fought on the 11th of September 1777 about 10 m. north-west of Wilmington, and a few miles inside the Pennsylvania border. Sir William Howe, the British commander-in-chief, while opposed to Washington's army in New Jersey, had formed the plan of capturing Philadelphia from the south side by a movement by sea to the head of Delaware Bay. But contrary winds and accidents delayed the British transports so long that Washington, who was at first puzzled, was able to divine his opponents' intentions in time; and rapidly moving to the threatened point he occupied a strong entrenched position at the fords over the Brandywine, 25 m. south-west of Philadelphia. Here on the 11th of September the British attacked him. Howe's plan, which was carefully worked out and exactly executed, was to deliver an energetic feint attack against the American front, to take a strong column 12 m. up the stream, and crossing beyond Washington's right to attack his entrenchments in rear. Washington was successfully held in play during the movement, and General Sullivan, the commander of the American right wing, misled by the conflicting intelligence which reached him from up-stream, was surprised about noon by definite information as to the approach of Cornwallis on his right rear. Changing front "right back" in the dense country, he yet managed to oppose a stubborn resistance to the flanking attack, and with other troops that were hurried to the scene his division held its ground for a time near Birmingham meeting-house. But Howe pressed his attack sharply and drove back the Americans for 2 m.; the holding attack of the British right was converted into a real one, and by nightfall Washington was in full retreat northward toward Chester, protected by General Greene and a steady rear-guard, which held off Howe's column for the necessary time. The British were too exhausted to pursue, and part of Howe's force was inextricably mixed up with the advancing troops of the frontal attack. The American loss in killed, wounded and prisoners was about 1000; that of the British less than 600. Howe followed up his victory, and on the 27th of September entered Philadelphia.

**BRANFORD,** a township, including a borough of the same name, in New Haven county, Connecticut, U.S.A., at the mouth of the Branford river and at the head of a short arm of Long Island Sound, about 7 m. E.S.E. of New Haven. Pop. of the township (1890) 4460; (1900) 5706 (1968 foreign-born);(1910) 6047; of the borough (1910) 2560. The borough is served by the New York, New Haven & Hartford railway, and by an electric line connecting with New Haven. A range of rocky hills commands fine views of the Sound, the shore is deeply indented, the harbour and bays are dotted with islands, and the harbour is deep enough for small craft, and these natural features attract many visitors during the summer season. In Branford is the James Blackstone Memorial library (1896), designed by Solon Spencer Beman (b. 1853) in the Ionic style (the details being taken from the Erechtheum at Athens). On the interior of the dome which covers the rotunda are a series of paintings by Oliver Dennett Grover (b. 1861) illustrating the evolution of book-making, and between the arches are medallion portraits, by the same artist, of New England authors—Longfellow, Emerson, Hawthorne, Lowell, Bryant, Whittier, Holmes and Mrs Stowe. The library was erected by Timothy B. Blackstone (1829-1900), a native of Branford, and president of the Chicago & Alton railway from 1864 to 1899—as a memorial to his father, a descendant of William Blackstone (d. 1675), the New England pioneer. The principal industries of Branford are the manufacture of malleable iron fittings, locks and general hardware, the quarrying of granite, and oyster culture.

The territory of Totoket (now the township of Branford) was purchased from the Indians by the New Haven Plantation, in December 1638, for eleven coats of trucking cloth and one coat of English cloth, but with the reservation for a few Indians of what is still known as Indian Neck. In 1640 the general court of New Haven granted it to the Rev. Samuel Eaton (1596?-1665), a brother of Theophilus Eaton, on condition that he brought friends from England to settle it. As Eaton went to England and did not return, Totoket was granted in 1644 to settlers mostly from Wethersfield, Conn., on condition that they should organize a church state after the New Haven model and join the New Haven Jurisdiction. The settlement was made in the same year, and about two years later several new families came from Southampton, Long Island, under the leadership of the Rev. Abraham Pierson (*c.* 1608-1678), an ardent advocate of the church state, who was chosen pastor at Totoket. The present name of the township, derived from Brentford, England, was adopted about 1645. After the members of the New Haven Jurisdiction had submitted to Connecticut, Pierson, in 1666-1667, led the most prominent citizens of Branford to New Jersey,

where they were leaders in founding Newark. The borough of Branford was incorporated in 1893.

See E.C. Baldwin, *Branford Annals*, in Papers of New Haven Colony Historical Society (New Haven, 1882 and 1888).

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**BRANGWYN, FRANK** (1867- ), English painter, was born at Bruges, and received his first instruction from his father, the owner of an establishment for church embroideries and kindred objects, who took a leading part in the Gothic revival under Pugin. When the family moved to England, Brangwyn attracted the attention of William Morris by a drawing on which he was engaged at South Kensington museum. He worked for some time in Morris's studio, and then travelled more than once to the East, whereby his sense of colour and the whole further development of his art became deeply influenced. Indeed, the impressions he then received, and his love of Oriental decorative art—tiles and carpets—exercised a greater influence on him than any early training or the works of any European master. His whole tendency is essentially decorative: a colour-sense of sumptuous richness is wedded to an equally strong sense of well-balanced, harmonious design. These qualities, together with a summary suppression of the details which tie a subject to time and place, give his compositions a nobly impressive and universal character, such as may be seen in his decorative panel "Modern Commerce" in the ambulatory of the Royal Exchange, London. Among other decorative schemes executed by him are those for "L'Art nouveau" in the rue de Provence, Paris; for the hall of the Skinners' Company, London; and for the British room at the Venice International Exhibition, 1905. The Luxembourg museum has his "Trade on the Beach"; the Venice municipal museum, the "St Simon Stylites"; the Stuttgart gallery, the "St John the Baptist"; the Munich Pinakothek, the "Assisi"; the Carnegie Institute in Pittsburg, his "Sweetmeat Seller"; the Prague gallery, his "Turkish Boatmen"; and the National Gallery of New South Wales, "The Scoffers." Brangwyn embarked successfully in many fields of applied art, and made admirable designs for book decoration, stained glass, furniture, tapestry, metal-work and pottery. He devoted himself extensively to etching, and executed many plates of astonishing vigour and dramatic intensity. He was elected associate of the Royal Academy in 1904.

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**BRANKS,** (probably akin to Irish *brancas*, a halter; Ger. *Pranger*, fetter, pillory), or Scolding-Bridle, a contrivance formerly in use throughout England and Scotland for the punishment of scolding women. It is said to have originated in the latter country. It seems to have never been a legalized form of punishment; but corporations and lords of manors in England, town councils, kirk-sessions and barony courts in Scotland assumed a right to inflict it. While specially known as the "Gossip's or Scold's Bridle" the branks was also used for women convicted of petty offences, breaches of the peace, street-brawling and abusive language. It was the equivalent of the male punishments of the stocks and pillory. In its earliest form it consisted of a hoop head-piece of iron, opening by hinges at the side so as to enclose the head, with a flat piece of iron projecting inwards so as to fit into the mouth and press the tongue down. Later it was made, by a multiplication of hoops, more like a cage, the front forming a mask of iron with holes for mouth, nose and eyes. Sometimes the mouth-plate was armed with a short spike. With this on her head the offending woman was marched through the streets by the beadle or chained to the market-cross to be gibed at by passers. The date of origin is doubtful. It was used at Edinburgh in 1567, at Glasgow in 1574, but not before the 17th century in any English town. A brank in the church of Walton-on-Thames, Surrey, bears date 1633; while another in a private collection has the crowned cipher of William III. The Ashmolean Museum at Oxford, the Scottish National Museum of Antiquities at Edinburgh, the towns of Lichfield, Shrewsbury, Leicester and Chester have examples of the brank. As late as 1856 it was in use at Bolton-le-Moors, Lancashire.



See W. Andrews, *Old Time Punishments* (Hull, 1890); A.M. Earle, *Curious Punishments of Bygone Days* (Chicago, 1896).

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**BRANT, JOSEPH** (1742-1807), American Indian chief of the Mohawk tribe, known also by his

Indian name, THAYENDANEGEA, was born on the banks of the Ohio river in 1742. In early youth he attracted the attention of Sir William Johnson, who sent him to be educated by Dr Eleazar Wheelock at Lebanon, Conn., in Moor's Indian charity school, in which Dartmouth College had its origin. He took part, on the side of the English, in the French and Indian War, and in 1763 fought with the Iroquois against Pontiac. Subsequently he settled at Canajoharie, or Upper Mohawk Castle (in what is now Montgomery county, New York), where, being a devout churchman, he devoted himself to missionary work, and translated the Prayer Book and St Mark's Gospel into the Mohawk tongue (1787). When Guy Johnson (1740-1788) succeeded his uncle, Sir William, as superintendent of Indian affairs in 1774, Brant became his secretary. At the outbreak of the War of Independence, he remained loyal, was commissioned colonel, and organized and led the Mohawks and other Indians allied to the British against the settlements on the New York frontier. He took part in the Cherry Valley Massacre, in the attack on Minisink and the expedition of General St Leger which resulted in the battle of Oriskany on the 6th of August 1777. After the war he discouraged the continuance of Indian warfare on the frontier, and aided the commissioners of the United States in securing treaties of peace with the Miamis and other western tribes. Settling in Upper Canada, he again devoted himself to missionary work and in 1786 visited England, where he raised funds with which was erected the first Episcopal church in Upper Canada. His character was a peculiar compound of the traits of an Indian warrior—with few rivals for daring leadership—and of a civilized politician and diplomat of the more conservative type. He died on an estate granted him by the British government on the banks of Lake Ontario on the 24th of November 1807. A monument was erected to his memory at Brantford, Ontario, Canada (named in his honour) in 1886.

See W.L. Stone, *Life of Joseph Brant* (2 vols., New York, 1838; new ed., Albany, 1865); Edward Eggleston and Elizabeth E. Seelye, *Brant and Red Jacket* in "Famous American Indians" (New York, 1879); and a *Memoir* (Brantford, 1872).

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**BRANT, SEBASTIAN** (1457-1521), German humanist and satirist, was born at Strassburg about the year 1457. He studied at Basel, took the degree of doctor of laws in 1489, and for some time held a professorship of jurisprudence there. Returning to Strassburg, he was made syndic of the town, and died on the 10th of May 1521. He first attracted attention in humanistic circles by his Latin poetry, and edited many ecclesiastical and legal works; but he is now only known by his famous satire, *Das Narrenschiff* (1494), a work the popularity and influence of which were not limited to Germany. Under the form of an allegory—a ship laden with fools and steered by fools to the fools' paradise of Narragenia—Brant here lashes with unsparing vigour the weaknesses and vices of his time. Although, like most of the German humanists, essentially conservative in his religious views, Brant's eyes were open to the abuses in the church, and the *Narrenschiff* was a most effective preparation for the Protestant Reformalion. Alexander Barclay's *Ship of Fools* (1509) is a free imitation of the German poem, and a Latin version by Jacobus Locher (1497) was hardly less popular than the German original. There is also a large quantity of other "fool literature." Nigel, called Wireker (fl. 1190), a monk of Christ Church Priory, Canterbury, wrote a satirical *Speculum stultorum*, in which the ambitious and discontented monk figured as the ass Brunellus, who wanted a longer tail. Brunellus, who has been educated at Paris, decides to found an order of fools, which shall combine the good points of all the existing monastic orders. *Cock Lovell's Bote* (printed by Wynkyn de Worde, c. 1510) is another imitation of the *Narrenschiff*. Cock Lovell is a fraudulent currier who gathers round him a rascally collection of tradesmen. They sail off in a riotous fashion up hill and down dale throughout England. Brant's other works, of which the chief was a version of Freidank's *Bescheidenheit* (1508), are of inferior interest and importance.

Brant's *Narrenschiff* has been edited by F. Zarncke (1854); by K. Goedeke (1872); and by F. Bobertag (Kürschner's *Deutsche Nationalliteratur*, vol. xvi., 1889). A modern German translation was published by K. Simrock in 1872. On the influence of Brant in England see especially C.H. Herford, *The Literary Relations of England and Germany in the 16th Century* (1886).

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**BRANTFORD,** a city and port of entry of Ontario, Canada, on the Grand river, and on the Grand Trunk, and Toronto, Hamilton & Buffalo railways. The river is navigable to within 2½ m. of the town; for the remaining distance a canal has been constructed. Agricultural implements, plough, engine, bicycle and stove works, potteries and large railway shops constitute the

important industrial establishments. It contains an institute for the education of the blind, maintained by the provincial government, and a women's college. The city is named in honour of the Mohawk Indian chief, Joseph Brant (Thayendanegea), who settled in the neighbourhood after the American War of Independence, in which he had led the Six Nations (Iroquois) on the British side. The amalgamated tribes of the Six Nations still make it their headquarters, and a monument to Brant has been erected in Victoria Square. Brantford is one of the most flourishing industrial towns of the province, and its population rose from 9616 in 1881 to 20,713 in 1907.

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**BRANTINGHAM, THOMAS DE** (d. 1394), English lord treasurer and bishop of Exeter, came of a Durham family. An older relative, Ralph de Brantingham, had served Edward II. and Edward III., and Thomas was made a clerk in the treasury. Edward III. obtained preferment for him in the church, and from 1361 to 1368 he was employed in France in responsible positions. He was closely associated with William of Wykeham, and while the latter was in power as chancellor, Brantingham was lord treasurer (1369-1371, and 1377-1381), being made bishop of Exeter in 1370. He continued to play a prominent part in public affairs under Richard II., and in 1389 was again lord treasurer for a few months. He died in 1394 and was buried in Exeter cathedral.

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**BRANTÔME, PIERRE DE BOURDEILLE,** Seigneur and Abbé de (*c.* 1540-1614), French historian and biographer, was born in Périgord about 1540. He was the third son of the baron de Bourdeille. His mother and his maternal grandmother were both attached to the court of Marguerite of Valois, and at her death in 1549 he went to Paris, and later (1555) to Poitiers, to finish his education. He was given several benefices, the most important of which was the abbey of Brantôme (see below), but he had no inclination for an ecclesiastical career. At an early age he entered the profession of arms. He showed himself a brave soldier, and was brought into contact with most of the great leaders who were seeking fame or fortune in the wars that distracted the continent. He travelled much in Italy; in Scotland, where he accompanied Mary Stuart (then the widow of Francis I.); in England, where he saw Queen Elizabeth (1561, 1579); in Morocco (1564); and in Spain and Portugal. He fought on the galleys of the order of Malta, and accompanied his great friend, the French commander Philippe Strozzi (grandson of Filippo Strozzi, the Italian general, and nephew of Piero), in his expedition against Terceira, in which Strozzi was killed (1582). During the wars of religion under Charles IX. he fought in the ranks of the Catholics, but he allowed himself to be won over temporarily by the ideas of the reformers, and though he publicly separated himself from Protestantism it had a marked effect on his mind. A fall from his horse compelled him to retire into private life about 1589, and he spent his last years in writing his *Memoirs* of the illustrious men and women whom he had known. He died on the 15th of July 1614.



Brantôme left distinct orders that his manuscript should be printed; a first edition appeared, however, late (1665-1666) and not very complete. Of the later editions the most valuable are: one in 15 volumes (1740); another by Louis Jean Nicolas Monmerqué (1780-1860) in 8 volumes (1821-1824), reproduced in Buchan's *Panthéon littéraire*; that of the Bibliothèque elzévirienne, begun (1858) by P. Mérimée and L. Lacour, and finished, with vol. xiii., only in 1893; and Lalanne's edition for the Société de l'Histoire de France (12 vols., 1864-1896). Brantôme can hardly be regarded as a historian proper, and his *Memoirs* cannot be accepted as a very trustworthy source of information. But he writes in a quaint conversational way, pouring forth his thoughts, observations or facts without order or system, and with the greatest frankness and naïveté. His works certainly gave an admirable picture of the general court-life of the time, with its unblushing and undisguised profligacy. There is not a *homme illustre* or a *dame galante* in all his gallery of portraits who is not stained with vice; and yet the whole is narrated with the most complete unconsciousness that there is anything objectionable in their conduct.

> The edition of L. Lalanne has great merit, being the first to indicate the Spanish, Italian and French sources on which Brantôme drew, but it did not utilize all the existing MSS. It was only after Lalanne's death that the earliest were obtained for the Bibliothèque Nationale. At Paris and at Chantilly (Musée Condé) all Brantôme's original MSS., as revised by him several times, are now collected (see the *Bibliothèque de l'école des Chartes*, 1904), and a new and definitive edition has therefore become possible. Brantôme's poems (which amount to more than 2200 verses) were first published in 1881; see Lalanne's edition.

**BRANTÔME,** a town of south-western France, in the department of Dordogne, 20 m. N. by W. of Périgueux by steam-tramway. Pop. (1906) 1230. The town is built, in great part, on an island in the river Dronne. It is well known for the remains of an abbey founded by Charlemagne about 770 and afterwards destroyed by the Normans. The oldest existing portion is a square tower dating from the 11th century, built upon a rock beside the church which it overlooks. It communicates by a staircase with the church, a rectangular building partly Romanesque, partly Gothic, to the west of which are the remains of a cloister. The abbey buildings date from the 18th century, and now serve as hôtel-de-ville, magistrature and schools. Caves in the neighbouring rocks were inhabited by the monks before the building of the abbey; one of them, used as an oratory, contains curious carvings, representing the Last Judgment and the Crucifixion. In the middle of the 16th century Pierre de Bourdeille came into possession of the abbey, from which he took the name of Brantôme.

Brantôme has some old houses and a church of the 15th century, which was once fortified and is now used as a market. Truffles are the chief article of commerce; and there are quarries of freestone in the neighbourhood. The dolmen which is known as Pierre-Levée, to the east of the town, is the most remarkable in Périgord.

**BRANXHOLM,** or Branksome, a feudal castle, now modernized, and an ancient seat of the Buccleuchs, on the Teviot, 3 m. S.W. of Hawick, Roxburgh, Scotland. It was at Branksome Hall that Sir Walter Scott laid the scene of *The Lay of the Last Minstrel*.

**BRANXTON,** or Brankston, a village of Northumberland, England, 10½ m. E. by N. of Kelso, and 2 m. E.S.E. of Coldstream, and 10 m. N.W. of Wooler. It was on Branxton Hill, immediately south of the village, that the battle of Flodden (*q.v.*) was fought between the English and the Scots on the 9th of September 1513. During the fight the Scots centre pushed as far as Branxton church, but “the King’s Stone,” which lies N.W. of the church and is popularly supposed to mark the spot where James IV. fell, is some three-quarters of a mile from the scene of the battle; it is believed in reality to mark the sepulchre of a chieftain, whose name had already perished in the 16th century. Branxton church, dedicated to St Paul, was rebuilt in 1849 in Norman style. Of the older building nothing remains save the chancel arch.

**BRAOSE, WILLIAM DE** (d. 1211), lord of Brecknock, Radnor and Limerick, spent the early part of his life fighting the Welsh in Radnorshire. He was high in King John’s favour, received a large number of honours, and was even given the custody of Prince Arthur. But John and he quarrelled, probably over money (1207). In 1208 John began to suspect the fidelity of the whole family, and William had to fly to Ireland. After a number of attempted reconciliations, he was outlawed (1210) and died at Corbeil (1211). It is said that his wife and son were starved to death by John.

See *Foedera*, i. 107; *Histoire des ducs* (ed. Michel), Wendover; Kate Norgate’s *John Lackland*.

A descendant, William de Braose (d. 1326), lord of Gower, was a devoted follower of Edward I., and in 1299 was summoned to parliament as baron de Braose; and his nephew Thomas de Braose (d. 1361) also distinguished himself in the wars and was summoned as baron de Braose in 1342. This latter barony became extinct in 1399; but a claim to the barony of William de Braose, which, as he had no son, fell into abeyance between his two daughters and co-heirs, Alina (wife of Lord Mowbray) and Joan (wife of John de Bohun), or their descendants, may still be traced by careful genealogists in various noble English families.

**BRASCASSAT, JACQUES RAYMOND** (1804-1867), French painter, was born at Bordeaux, and studied art in Paris, where in 1825 he won a *prix de Rome* with a picture ("Chasse de Méléagre") now in the Bordeaux gallery. He went to Italy and painted a number of landscapes which were exhibited between 1827 and 1835; but subsequently he devoted himself mainly to animal-painting, in which his reputation as an artist was made. His "Lutte de taureaux" (1837), in the *musée* at Nantes, and his "Vache attaquée par des loups" (1845), in the Leipzig museum, were perhaps the best of his pictures; but he was remarkable for his accuracy of observation and correct drawing. He was elected a member of the Institute in 1846. He died at Paris on the 28th of February 1867.

**BRAS D'OR,** a landlocked and tideless gulf or lake of high irregular outline, 50 m. long by 20 m. broad, almost separating Cape Breton Island (province of Nova Scotia, Canada) into two parts. A ship canal across the isthmus (about 1 m. wide) completes the severance of the island. The entrance to the gulf is on the N.E. coast of the island, and it is connected with the Atlantic by the Great and Little Bras d'Or channels, which are divided by Boulardeire Island. One channel is 25 m. long and from ¼ m. to 3 m. broad, but is of little depth, the other (used by shipping) is 22 m. long, 1 to 1½ m. wide, and has a depth of 60 fathoms. The gulf or lake is itself divided into two basins, the inner waters being known as the Great Bras d'Or Lake. The waters are generally from 12 to 60 fathoms deep, but in the outer basin (known as the Little Bras d'Or Lake) are soundings said to reach nearly 700 ft. The shores of the gulf are very picturesque and well wooded and have attracted many tourists. Sea fishing (cod, mackerel, &c.) is the chief industry. The name is said to be a corruption of an Indian word, but it assumed its present form during the French occupation of Cape Breton Island.

**BRASDOR, PIERRE** (1721-1799), French surgeon, was born in the province of Maine. He took his degree in Paris as master of surgery in 1752, and was appointed regius professor of anatomy and director of the Academy of Surgery. He was a skilful operator, whose name was long attached to a ligature of his invention; and he was an ardent advocate of inoculation. He died in Paris on the 28th of September 1799.

**BRASIDAS** (d. 422 B.C.), a Spartan officer during the first decade of the Peloponnesian War. He was the son of Tellis and Argileonis, and won his first laurels by the relief of Methone, which was besieged by the Athenians (431 B.C.). During the following year he seems to have been eponymous ephor (Xen. *Hell.* ii. 3, 10), and in 429 he was sent out as one of the three commissioners (σύμβουλοι) to advise the admiral Cnemus. As trierarch he distinguished himself in the assault on the Athenian position at Pylos, during which he was severely wounded (Thuc. iv. n. 12).



In the next year, while Brasidas mustered a force at Corinth for a campaign in Thrace, he frustrated an Athenian attack on Megara (Thuc. iv. 70-73), and immediately afterwards marched through Thessaly at the head of 700 helots and 1000 Peloponnesian mercenaries to join the Macedonian king Perdiccas. Refusing to be made a tool for the furtherance of Perdiccas's ambitions, Brasidas set about the accomplishment of his main object, and, partly by the rapidity and boldness of his movements, partly by his personal charm and the moderation of his demands, succeeded during the course of the winter in winning over the important cities of Acanthus, Stagirus, Amphipolis and Torone as well as a number of minor towns. An attack on Eion was foiled by the arrival of Thucydides, the historian, at the head of an Athenian squadron. In the spring of 423 a truce was concluded between Athens and Sparta, but its operation was at once

imperilled by Brasidas's refusal to give up Scione, which, the Athenian partisans declared, revolted two days after the truce began, and by his occupation of Mende shortly afterwards. An Athenian fleet under Nicias and Nicostratus recovered Mende and blockaded Scione, which fell two years later (421 B.C.). Meanwhile Brasidas joined Perdiccas in a campaign against Arrhabaeus, king of the Lyncesti, who was severely defeated. On the approach of a body of Illyrians, who, though summoned by Perdiccas, unexpectedly declared for Arrhabaeus, the Macedonians fled, and Brasidas's force was rescued from a critical position only by his coolness and ability. This brought to a head the quarrel between Brasidas and Perdiccas, who promptly concluded a treaty with Athens, of which some fragments have survived (*I.G.* i. 42).

In April 422 the truce with Sparta expired, and in the same summer Cleon was despatched to Thrace, where he stormed Torone and Galepsus and prepared for an attack on Amphipolis. But a carelessly conducted reconnaissance gave Brasidas the opportunity for a vigorous and successful sally. The Athenian army was routed with a loss of 600 men and Cleon was slain. On the Spartan side only seven men are said to have fallen, but amongst them was Brasidas. He was buried at Amphipolis with impressive pomp, and for the future was regarded as the founder (οἰκιστής) of the city and honoured with yearly games and sacrifices (Thuc. iv. 78-v. 11). At Sparta a cenotaph was erected in his memory near the tombs of Pausanias and Leonidas, and yearly speeches were made and games celebrated in their honour, in which only Spartiates could compete (Paus. in. 14).

Brasidas united in himself the personal courage characteristic of Sparta with those virtues in which the typical Spartan was most signally lacking. He was quick in forming his plans and carried them out without delay or hesitation. With an oratorical power rare amongst the Lacedaemonians he combined a conciliatory manner which everywhere won friends for himself and for Sparta (Thuc. iv. 81).

See in particular Thucydides, ii.-v.; what Diodorus xii. adds is mainly oratorical elaboration or pure invention. A fuller account will be found in the histories of Greece (*e.g.* those of Grote, Beloch, Busolt, Meyer) and in G. Schimmelpfeng, *De Brasidae Spartani rebus gestis atque ingenio* (Marburg, 1857).

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**BRASS,** a river, town and district of southern Nigeria, British West Africa. The Brass river is one of the deltaic branches of the Niger, lying east of the Rio Nun or main channel of the river. From the point of divergence from the main stream to the sea the Brass has a course of about 100 m., its mouth being in 6° 20′ E., 4° 35′ N. Brass town is a flourishing trading settlement at the mouth of the river. It is the headquarters of a district commissioner and the seat of a native court. Its most conspicuous building is a fine church, the gift of a native chief. The capital of the Brass tribes is Nimbé, 30 m. up river.

The Brass river, called by its Portuguese discoverers the Rio Bento, is said to have received its English name from the brass rods and other brass utensils imported by the early traders in exchange for palm-oil and slaves. The Brass natives, of the pure negro type, were noted for their savage character. In 1856 their chiefs concluded a treaty with Great Britain agreeing to give up the slave-trade in exchange for a duty on the palm-oil exported. Finding their profitable business as middlemen between the up-river producer and the exporter threatened by the appearance of European traders, they made ineffective complaints to the British authorities. The establishment of the Royal Niger Company led to further loss of trade, and on the 29th of January 1895 the natives attacked and sacked the company's station at Akassa on the Rio Nun, over forty prisoners being killed and eaten as a sacrifice to the fetish gods. In the following month a punitive expedition partially destroyed Nimbé, and a heavy fine was paid by the Brass chiefs. Since then the country has settled down under British administration. The trade regulations of which complaint had been made were removed in 1900 on the establishment of the protectorate of Southern Nigeria (see NIGERIA).

Valuable information concerning the country and people will be found in the *Report by Sir John Kirk on the Disturbances at Brass (Africa*, No. 3, 1896).

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**BRASS** (O. Eng. *braes*), an alloy consisting mainly if not exclusively of copper and zinc; in its older use the term was applied rather to alloys of copper and tin, now known as bronze (*q.v.*)Thus

the brass of the Bible was probably bronze, and so also was much of the brass of later times, until the distinction between zinc and tin became clearly recognized. The Latin word *aes* signifies either pure copper or bronze, not brass, but the Romans comprehended a brass compound of copper and zinc under the term *orichalcum* or *aurichalcum*, into which Pliny states that copper was converted by the aid of cadmia (a mineral of zinc).

In England there is good evidence of the manufacture of brass with zinc at the end of the 16th century, for Queen Elizabeth by patent granted to William Humfrey and Christopher Schutz the exclusive right of working calamine and making brass. This right subsequently devolved upon a body called the “Governors, Assistants and Societies of the City of London of and for the Mineral and Battery Works,” which continued to exercise its functions down to the year 1710.

When a small percentage of zinc is present, the colour of brass is reddish, as in *tombac* or red brass, which contains about 10%. With about 20% the colour becomes more yellow, and a series of metals is obtained which simulate gold more or less closely; such are *Dutch metal, Mannheim gold, similar* and *pinchbeck*, the last deriving its name from a London clockmaker, Christopher Pinchbeck, who invented it in 1732. Ordinary brass contains about 30% of zinc, and when 40% is present, as in *Muntz, yellow* or *patent* metal (invented by G.F. Muntz in 1832), the colour becomes a full yellow. When the proportion of zinc is largely increased the colour becomes silver-white and finally grey. The limit of elasticity increases with the percentage of zinc, as also does the amount of elongation before fracture, the maximum occurring with 30%. The tenacity increases with the proportion of zinc up to a maximum with 45%; then it decreases rapidly, and with 50% the metals are fragile. By varying the proportion between 30 and 43% a series of alloys may be prepared presenting very varied properties. The most malleable of the series has an elongation of about 60%, with a tensile strength of 17.5 tons per sq. in. Increase in the proportion of zinc gives higher tensile strength, accompanied, however, by a smaller percentage of elongation and a materially increased tendency to produce unsound castings. The quality of copper-zinc alloys is improved by the addition of a small quantity of iron, a fact of which advantage is taken in the production of Aich’s metal and delta metal. Of the latter there are several varieties, modified in composition to suit different purposes. Some of them possess high tensile strength and ductility. They are remarkably resistant to corrosion by sea-water, and are well suited for screw-propellers as well as for pump-plungers, pistons and glands. Heated to a dull red delta metal becomes malleable and can be worked under the hammer, press or stamps. By such treatment an ultimate tensile strength of 30 tons per sq. in. may be obtained, with an elongation of 32% in 2 in. and a contraction of area of 30%.



In the arts brass is a most important and widely used alloy. As compared with copper its superior hardness makes it wear better, while being more fusible it can be cast with greater facility. It is readily drawn into fine wire, and formed into rolled sheets and rods which are machined into a huge number of useful and ornamental articles. It is susceptible of a fine polish, but tarnishes with exposure to the air; the brilliancy of the surface can, however, be preserved if the metal is thoroughly cleansed by “dipping” in nitric acid and “lacquered” with a coating of varnish consisting of seed-lac dissolved in spirit.

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**BRASSES, MONUMENTAL,** a species of engraved sepulchral memorials which in the early part of the 13th century began to take the place of tombs and effigies carved in stone. Made of hard *latten* or sheet brass, let into the pavement, and thus forming no obstruction in the space required for the services of the church, they speedily came into general use, and continued to be a favourite style of sepulchral memorial for three centuries. Besides their great value as historical monuments, they are interesting as authentic contemporary evidence of the varieties of armour and costume, or the peculiarities of palaeography and heraldic designs, and they are often the only authoritative records of the intricate details of family history. Although the intrinsic value of the metal has unfortunately contributed to the wholesale spoliation of these interesting monuments, they are still found in remarkable profusion in England, and they were at one time equally common in France, Germany and the Low Countries. In France, however, those that survived the troubles of the 16th century were totally swept away during the reign of terror, and almost the only evidence of their existence is now supplied by the collection of drawings bequeathed by Gough to the Bodleian library. The fine memorials of the royal house of Saxony in the cathedrals of Meissen and Freiberg are the most artistic and striking brasses in Germany. Among the 13th-century examples existing in German churches are the full-length memorials of Yso von Welpe, bishop of Verden (1231), and of Bernard, bishop of Paderborn (1340). Many fine Flemish specimens exist in Belgium, especially at Bruges. Only two or three examples, and these of late date, are known in Scotland, among which are the memorials of Alexander Cockburn (1564) at Ormiston; of the regent Murray (1569) in the collegiate church of St Giles, Edinburgh;

and of the Minto family (1605) in the south aisle of the nave of Glasgow cathedral. England is the only country which now possesses an extensive series of these interesting memorials, of which it is calculated that there may be about 4000 still remaining in the various churches. They are most abundant in the eastern counties, and this fact has been frequently adduced in support of the opinion that they were of Flemish manufacture. But in the days when sepulchral brasses were most in fashion the eastern counties of England were full of commercial activity and wealth, and nowhere do the engraved memorials of civilians and prosperous merchants more abound than in the churches of Ipswich, Norwich, Lynn and Lincoln. Flemish brasses do occur in England, but they were never numerous, and they are readily distinguished from those of native workmanship. The Flemish examples have the figures engraved in the centre of a large plate, the background filled in with diapered or scroll work, and the inscription placed round the edge of the plate. The English examples have the figures cut out to the outline and inserted in corresponding cavities in the slab, the darker colour of the stone serving as a background. This is not an invariable distinction, however, as “figure-brasses” of Flemish origin are found both at Bruges and in England. But the character of the engraving is constant, the Flemish work being more florid in design, the lines shallower, and the broad lines cut with a chisel-pointed tool instead of the lozenge-shaped burin. The brass of Robert Hallum, bishop of Salisbury, the envoy of Henry V. to the council of Constance, who died and was interred there in 1416, precisely resembles the brasses of England in the peculiarities which distinguish them from continental specimens. Scarcely any of the brasses which now exist in England can be confidently referred to the first half of the 13th century, though several undoubted examples of this period are on record. The full-sized brass of Sir John d’Aubernon at Stoke d’Abernon in Surrey (*c*. 1277) has the decorations of the shield filled in with a species of enamel. Other examples of this occur, and the probability is, that, in most cases, the lines of the engraving were filled with colouring-matter, though brass would scarcely bear the heat requisite to fuse the ordinary enamels. A well-known 13th-century example is that of Sir Roger de Trumpington (*c*. 1290), who accompanied Prince Edward in his expedition to Palestine and is represented cross-legged. About half a dozen instances of this peculiarity are known. The 14th-century brasses are much more numerous, and present a remarkable variety in their details. The finest specimen is that of Nicholas Lord Burnell (1315) in the church of Acton Burnell, Shropshire. In the 15th century the design and execution of monumental brasses had attained their highest excellence. The beautiful brass of Thomas Beauchamp, earl of Warwick (d. 1401), and his wife Margaret, which formerly covered the tomb in St Mary’s church, Warwick, is a striking example. One of the best specimens of plate armour is that of Sir Robert Stantoun (1458) in Castle Donnington church, Leicestershire, and one of the finest existing brasses of ecclesiastics is that of Abbot de la Mare of St Albans. It is only in the 16th century that the engraved representations become portraits. Previous to that period the features were invariably represented conventionally, though sometimes personal peculiarities were given. A large number of brasses in England are *palimpsests*, the back of an ancient brass having been engraved for the more recent memorial. Thus a brass commemorative of Margaret Bulstrode (1540) at Hedgerley, on being removed from its position, was discovered to have been previously the memorial of Thomas Totyngton, abbot of St Edmunds, Bury (1312). The abbey was only surrendered to Henry VIII. in 1539, so that before the year was out the work of spoliation had begun, and the abbot’s brass had been removed and re-engraved to Margaret Bulstrode. In explanation of the frequency with which ancient brasses have thus been stolen and re-erected after being engraved on the reverse, as at Berkhampstead, it may be remarked that all the sheet brass used in England previous to the establishment of a manufactory at Esher by a German in 1649, had to be imported from the continent.

PLATE I.

Fig. 1.—Sir John D'Abernon, 1277. Stoke D'Abernon Surrey.

Fig. 2.—Margaret de Camoys. 1310. Trotton, Sussex.

Fig. 3.—Henry de Grofhurst, c. 1330 Horsemonden, Kent.

Fig. 4.—Sir Nicholas Burnell, 1382. Acton Burnell, Shropshire.

Fig. 5.—Margaret Lady Cobham, 1385. Cobham, Kent.

Fig. 6.—Sir John Corp and Eleanor, his grand-daughter 1391, 1361. Stoke Fleming, Devonshire.

Fig. 7.—Sir Symon de Felbrigge and Margaret his wife, 1400. Felbrigge, Norfolk.

Figs. 1 and 6 from Waller's *Monumental Brasses.*

Figs. 5 and 7 from Boutell's *Monumental Brasses.*

Figs. 2, 3, and 4 by permission of the *Monumental Brass Society*.

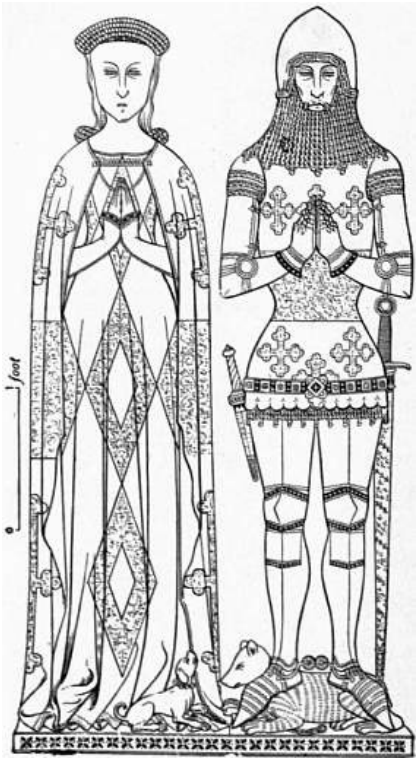

Fig. 1.—Thomas de Beauchamp, Earl of Warwick and Lady, 1406 and 1401. St. Mary's Church, Warwick.

Fig. 2.—Thomas Cranley, Archbishop of Dublin, 1417. New College, Oxford.

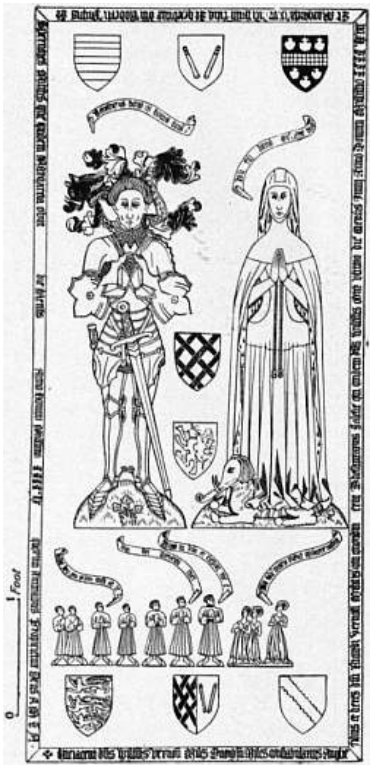

Fig. 3.—Sir William Vernon and Lady, 1467. Tong Church, Shropshire.

Fig. 4.—John Shelley, Esq., 1526, and his wife Elizabeth, 1513. Clapham, Sussex.

Fig. 5.—Dame Margaret Chute, 1614. Mardon, Herefordshire.

Fig. 6.—Sir Edward Filmer and Lady, 1638. East Sutton, Kent.

Figs. 1, 2, 3, and 6 from Waller's *Monumental Brasses*.

Figs. 4 and 5 by permission of the *Monumental Brass Society*.

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**BRASSEUR DE BOURBOURG, CHARLES ÉTIENNE** (1814-1874), Belgian ethnographer, was born at Bourbourg, near Dunkirk, on the 8th of September 1814. He entered the Roman Catholic priesthood, was professor of ecclesiastical history in the Quebec seminary in 1845, vicar-general at Boston in 1846, and from 1848 to 1863 travelled as a missionary, chiefly in Mexico and Central America. He gave great attention to Mexican antiquities, published in 1857-1859 a history of Aztec civilization, and from 1861 to 1864 edited a collection of documents in the indigenous languages. In 1863 he announced the discovery of a key to Mexican hieroglyphic writing, but its value is very questionable. In 1864 he was archaeologist to the French military expedition in Mexico, and his *Monuments anciens du Mexique* was published by the French Government in 1866. Perhaps his greatest service was the publication in 1861 of a French translation of the *Popol Vuh*, a sacred book of the Quiché Indians, together with a Quiché grammar, and an essay on Central American mythology. In 1871 he brought out his *Bibliothèque Mexico-Guatemalienne*, and in 1869-1870 gave the principles of his decipherment of Indian picture-writing in his *Manuscrit Troano, études sur le système graphique et la langue des Mayas.* He died at Nice on the 8th of January 1874. His chief merit is his diligent collection of materials; his interpretations are generally fanciful.



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**BRASSEY, THOMAS** (1805-1870), English railway contractor, was born at Buerton, near Chester, on the 7th of November 1805. His father, besides cultivating land of his own, held a large farm of the marquess of Westminster; his ancestors, according to family tradition, having been settled for several centuries at Bulkeley, near Malpas, Cheshire, before they went to Buerton in 1663. Thomas Brassey received an ordinary commercial education at a Chester school. At the age of sixteen he was apprenticed to a surveyor, and on the completion of his term became the partner of his master, eventually assuming the sole management of the business. In the local surveys to which he devoted his attention during his early years he acquired the knowledge and practical experience which were the necessary foundation of his great reputation. His first engagement as railway contractor was entered upon in 1835, when he undertook the execution of a portion of the Grand Junction railway, on the invitation of the distinguished engineer Joseph Locke, who soon afterwards entrusted him with the completion of the London and Southampton railway, a task which involved contracts to the amount of £4,000,000 sterling and the employment of a body of 3000 men. At the same time he was engaged on portions of several other lines in the north of England and in Scotland. In conjunction with his partner, W. Mackenzie, Brassey undertook, in 1840, the construction of the railway from Paris to Rouen, of which Locke was engineer. He subsequently carried out the extension of the same line. A few years later he was engaged with his partner on five other French lines, and on his own account on the same number of lines in England, Wales and Scotland. Brassey was now in control of an industrial army of 75,000 men, and the capital involved in his various contracts amounted to some £36,000,000. But his energy and capacity were equal to still larger tasks. He undertook in 1851 other works in England and Scotland; and in the following year he engaged in the construction of railways in Holland, Prussia, Spain and Italy. One of his largest undertakings was the Grand Trunk railway of Canada, 1100 m. in length, with its fine bridge over the St Lawrence. In this work he was associated with Sir M. Peto and E.L. Betts. In the following years divisions of his industrial army were found in almost every country in Europe, in India, in Australia and in South America. Besides actual railway works, he originated and maintained a great number of subordinate assistant establishments, coal and iron works, dockyards, &c., the direction of which

alone would be sufficient to strain the energies of an ordinary mind. His profits were, of course, enormous, but prosperity did not intoxicate him; and when heavy losses came, as sometimes they did, he took them bravely and quietly. Among the greatest of his pecuniary disasters were those caused by the fall of the great Barentin viaduct on the Rouen and Havre railway, and by the failure of Peto and Betts. Brassey was one of the first to aim at improving the relations between engineers and contractors, by setting himself against the corrupt practices which were common. He resolutely resisted the "scamping" of work and the bribery of inspectors, and what he called the "smothering of the engineer"; and he did much in this way to bring about a better state of things. Large-hearted and generous to a rare degree, modest and simple in his taste and manners, he was conscious of his power as a leader in his calling, and knew how to use it wisely and for noble ends. Honours came to him unsought. The cross of the Legion of Honour was conferred on him. From Victor Emmanuel he received the cross of the Order of St Maurice and St Lazarus; and from the emperor of Austria the decoration of the Iron Crown, which it is said had not before been given to a foreigner. He died at St Leonards on the 8th of December 1870. His life and labours are commemorated in a volume by Sir Arthur Helps (1872).

He left three sons, of whom the eldest, THOMAS (b. 1836), was knighted and afterwards (1886) created BARON BRASSEY. Lord Brassey, who was educated at Rugby and Oxford, entered parliament as a liberal in 1865, and devoted himself largely to naval affairs. He was civil lord of the admiralty (1880-1883), and secretary to the admiralty (1883-1885); and both before and after his elevation to the peerage did important work on naval and statistical inquiries for the government. In 1893-1805 he was president of the Institution of Naval Architects. In 1894 he was a lord-in-waiting, and from 1895 to 1900 was governor of Victoria. In 1908 he was appointed lord warden of the Cinque Ports. His voyages in his yacht "Sunbeam" from 1876 onwards, with his first wife (d. 1887), who published an interesting book on the subject, took him all over the world. Lord Brassey married a second time in 1890. Among other publications, his inauguration of the *Naval Annual* (1886 onwards), and his volumes on *The British Navy*, are the most important. His eldest son Thomas, who edited the *Naval Annual* (1890-1904), and unsuccessfully contested several parliamentary constituencies, was born in 1862.

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**BRASSÓ** (Ger. *Kronstadt*; Rumanian, *Braşov*), a town of Hungary, in Transylvania, 206 m. S.E. of Kolozsvár by rail. Pop. (1900) 34,511. It is the capital of the comitat (county) of the same name, also known as Burzenland, a fertile country inhabited by an industrious population of Germans, Magyars and Rumanians. Brassó is beautifully situated on the slopes of the Transylvanian Alps, in a narrow valley, shut in by mountains, and presenting only one opening on the north-west towards the Burzen plain. The town is entirely dominated by the Zinne of Kapellenberg, a mountain rising 1276 ft. above the town (total altitude 3153 ft.), from which a beautiful view is obtained of the lofty mountains around and of the carefully cultivated plain of the Burzenland, dotted with tastefully built and well-kept villages. On the summit of the mountain is one of the numerous monuments erected in 1896 in different parts of the country to commemorate the thousandth anniversary of the foundation of the Hungarian state. It is known as Árpád's Monument, and consists of a Doric column erected on a circular pedestal, which supports the bronze figure of a warrior from the time of Árpád.

Brassó consists of the inner town, which is the commercial centre, and the suburbs of Blumenau, Altstadt and Obere Vorstadt or Bolgárszeg, inhabited respectively by Germans, Magyars and Rumanians. To the east of the inner town rises the Schlossberg, crowned by the citadel, which was erected in 1553, and constitutes the principal remaining fragment of the old fortifications with which Brassó was encircled. The most interesting building in the town is the Protestant church, popularly called the Black Church, owing to its smoke-stained walls, caused by the great fire of 1689. This church, the finest in Transylvania, is a Gothic edifice with traces of Romanesque influence, and was built in 1385-1425. In the square in front of it is the statue of Johannes Honterus (1498-1549), "the apostle of Transylvania," who was born in Brassó, and established here the first printing-press in Transylvania. In the principal square of the inner town stands the town hall, built in 1420 and restored in the 18th century, with a tower 190 ft. high. Brassó is the most important commercial and manufacturing town of Transylvania. Lying near the frontier of Rumania, with easy access through the Tömös pass, it developed from the earliest time an active trade with that country and with the whole of the Balkan states. Its chief industries are iron and copper works, wool-spinning, turkey-red dyeing, leather goods, paper, cement and petroleum refineries. The timber industry in all its branches, with a speciality for the manufacture of the wooden bottles largely used by the peasantry in Hungary and in the Balkan states, as well as the dairy industry, and ham-curing are also fully developed. A peculiarity of Brassó, which constitutes a survival of the old methods of trade with the Balkan states, is the number of money-changers who ply their trade at small movable tables in the market-place and in

the open street. Brassó is the most populous town of Transylvania, and its population is composed in about equal numbers of Germans, Magyars and Rumanians. The town, especially on market days, presents an animated and picturesque aspect. Here are seen Germans, Szeklers, Magyars, Rumanians, Armenians and Gipsies, each of them wearing their distinctive national costume, and talking and bargaining in their own special idiom.

Amongst the places of interest round Brassó is the watering-place Zaizon, 15 m. to the east, with ferruginous and iodine waters; while about 17 m. to the south-west lies the pretty Rumanian village of Zernest, where in 1690 the Austrian general Heussler was defeated and taken prisoner by Imre (Emerich) Tököly, the usurper of the Transylvanian throne.

Brassó was founded by the Teutonic Order in 1211, and soon became a flourishing town. Through the activity of Honterus it played a leading part in the introduction of the Reformation in Transylvania in the 16th century. The town was almost completely destroyed by the big fire of 1689. During the revolution of 1848-1849 it was besieged by the Hungarians under General Bern from March to July 1849, and several engagements between the Austrian and the Hungarian troops took place in its neighbourhood.

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**BRATHWAIT, RICHARD** (1588-1673), English poet, son of Thomas Brathwait, was born in 1588 at his father's manor of Burneshead, near Kendal, Westmorland. He entered Oriel College, Oxford, in 1604, and remained there for some years, pursuing the study of poetry and Roman history. He removed to Cambridge to study law and afterwards to London to the Inns of Court. Thomas Brathwait died in 1610, and the son went down to live on the estate he inherited from his father. In 1617 he married Frances Lawson of Nesham, near Darlington. On the death of his elder brother, Sir Thomas Brathwait, in 1618, Richard became the head of the family, and an important personage in the county, being deputy-lieutenant and justice of the peace. In 1633 his wife died, and in 1639 he married again. His only son by this second marriage, Sir Stafford Brathwait, was killed in a sea-fight against the Algerian pirates. Richard Brathwait's most famous work is *Barnabae Itinerarium or Barnabees Journall* [1638], by "Corymbaeus," written in English and Latin rhyme. The title-page says it is written for the "travellers' solace" and is to be chanted to the old tune of "Barnabe." The story of "drunken Barnabee's" four journeys to the north of England contains much amusing topographical information, and its gaiety is unflagging. Barnabee rarely visits a town or village without some notice of an excellent inn or a charming hostess, but he hardly deserves the epithet "drunken." At Banbury he saw the Puritan who has become proverbial,

"Hanging of his cat on Monday
For killing of a Mouse on Sunday."

Brathwait's identity with "Corymbaeus" was first established by Joseph Haslewood. In his later years he removed to Catterick, where he died on the 4th of May 1673. Among his other works are: *The Golden Fleece* (1611), with a second title-page announcing "sonnets and madrigals," and a treatise on the *Art of Poesy*, which is not preserved; *The Poets Willow; or the Passionate Shepheard* (1614); *The Prodigals Teares* (1614); *The Schollers Medley, or an intermixt Discourse upon Historicall and Poeticall relations* (1614), known in later editions as a *Survey of History* (1638, &c.); a collection of epigrams and satires entitled *A Strappado for the Divell* (1615), with which was published incongruously *Loves Labyrinth* (edited, 1878, by J.W. Ebsworth); *Natures Embassie; or, the wildemans measures; danced naked by twelve satyres* (1621), thirty satires finding antique parallels for modern vices; with these are bound up *The Shepheards Tales* (1621), a collection of pastorals, one section of which was reprinted by Sir Egerton Brydges in 1815; two treatises on manners, *The English Gentleman* (1630) and *The English Gentlewoman* (1631); *Anniversaries upon his Panarete* (1634), a poem in memory of his wife; *Essaies upon the Five Senses* (1620); *The Psalmes of David ... and other holy Prophets, paraphras'd in English* (1638); *A Comment upon Two Tales of ... Jeffray Chaucer* (1665; edited for the Chaucer Soc. by C. Spurgeon, 1901). Thomas Hearne, on whose testimony (MS. collections for the year 1713, vol. 47, p. 127) the authorship of the *Itinerarium* chiefly rests, not inappropriately called him "the scribler of those times," and the list just given of his works, published under various pseudonyms, is by no means complete.

A full bibliography is given in Joseph Haslewood's edition of *Barnabee's Journall* (ed. W.C. Hazlitt, 1876). See also J. Corser, *Collectanea* (Chetham Soc., 1860, &c.).

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**BRATIANU** (or BRATIANO), **ION C.** (1821-1891), Rumanian statesman, was born at Pitesci in Walachia on the 2nd of June 1821. He entered the Walachian army in 1838, and visited Paris in 1841 for purposes of study. Returning to Walachia, he took part, with his friend C.A. Rosetti and other prominent politicians, in the Rumanian rebellion of 1848, and acted as prefect of police in the provisional government formed in that year. The restoration of Russian and Turkish authority shortly afterwards drove him into exile. He took refuge in Paris, and endeavoured to influence French opinion in favour of the proposed union and autonomy of the Danubian principalities. In 1854, however, he was sentenced to a fine of £120 and three months' imprisonment for sedition, and later confined in a lunatic asylum; but in 1856 he returned home with his brother, Dimitrie Bratianu, afterwards one of his foremost political opponents. During the reign of Prince Cuza (1859-1866), Bratianu figured prominently as one of the Liberal leaders. He assisted in 1866 in the deposition of Cuza and the election of Prince Charles of Hohenzollern, under whom he held several ministerial appointments during the next four years. He was arrested for complicity in the revolution of 1870, but soon released. In 1876, aided by C.A. Rosetti, he formed a Liberal cabinet, which remained in power until 1888. For an account of his work in connexion with the Russo-Turkish War of 1877, the Berlin congress, the establishment of the Rumanian kingdom, the revision of the constitution, and other reforms, see RUMANIA. After 1883 Bratianu acted as sole leader of the Liberals, owing to a quarrel with C.A. Rosetti, his friend and political ally for nearly forty years. His long tenure of office, without parallel in Rumanian history, rendered Bratianu extremely unpopular, and at its close his impeachment appeared inevitable. But any proceedings taken against the minister would have involved charges against the king, who was largely responsible for his policy; and the impeachment was averted by a vote of parliament in February 1890. Bratianu died on the 16th of May 1891. Besides being the leading statesman of Rumania during the critical years 1876-1888, he attained some eminence as a writer. His French political pamphlets, *Mémoire sur l'empire d'Autriche dans la question d'Orient* (1855), *Réflexions sur la situation* (1856), *Mémoire sur la situation de la Moldavie depuis le traité de Paris* (1857), and *La Question religieuse en Roumanie* (1866), were all published in Paris.

For his other writings and speeches see *Din Scrierile şi cuvîntarile lui I.C. Bratianu*, 1821-1891 (Bucharest, 1903, &c.), edited with a biographical introduction by D.A. Sturza. A brief anonymous biography, *Ion C. Bratianu*, appeared at Bucharest in 1893.

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**BRATLANDSDAL** (*i.e.* Bratland valley), a gorge of southern Norway in Stavanger *amt* (county), formed by the Bratland river, a powerful torrent issuing into Lake Suldal. A remarkable road traverses the gorge by means of cuttings and a tunnel, and the scenery is among the most magnificent in Norway. It is usually approached from Stavanger by way of Sand and Lake Suldal, and the road divides above the gorge, branches running north to Odde and south-east through Telemarken. The junction of the roads is near Breifond, 13 m. above Naes at the mouth of the river, on the west shore of Lake Roldal, which is fed by the snowfield to the west, north and east, and is drained by the Bratland river.



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**BRATTISHING,** or BRANDISHING (from the Fr. *bretèche*), in architecture, a sort of crest or ridge on a parapet, or species of embattlement. The term, however, is generally employed to describe the ranges of flowers which form the crests of so many parapets in the Tudor period.

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**BRATTLEBORO,** a village of Windham county, Vermont, U.S.A., in a township (pop. 1910, 7541) of the same name, in the south-east part of the state, 60 m. N. of Springfield, Massachusetts, on the Connecticut river. Pop. (1890) 5467; (1900) 5297 (686 foreign-born); (1910) 6517. It is served by the Central Vermont and the Boston & Maine railways. Situated in a hilly, heavily wooded country, it is an attractive place, with a few houses dating from the 18th century. Among the manufactures are toys, furniture, overalls and organs, the Estey and the Carpenter organs being made there. First settled about 1753, Brattleboro took its name from one of the original patentees, William Brattle (1702-1776), a Massachusetts loyalist. It was

incorporated ten years later.

See H. Burnham, *Brattleboro* (Brattleboro, 1880), and H.M. Burt, *The Attractions of Brattleboro, Glimpses of Past and Present* (Brattleboro, 1866).

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**BRAUNAU** (Czech *Broumov*), a town of Bohemia, Austria, 139 m. E.N.E. of Prague by rail. Pop. (1900) 7622, chiefly German. The town is built on a rocky eminence on the right bank of the Steine. It has an imposing Benedictine abbey, once a castle, but converted into a religious house in 1322, when Ottakar I. gave the district to the Benedictines. Noteworthy also is the great church of Saints Wenceslaus and Adalbert, built between 1683 and 1733. This stands on the site where, in 1618, the Protestants attempted to build a church, the forcible prevention of which by Abbot Wolfgang Solander was the immediate cause of the protest of the Bohemian estates and the "defenestration" of the ministers Martinic and Slavata, which opened the Thirty Years' War. After the battle of the White Hill, near Prague (1620), the town was deprived of all its privileges, which were, however, in great part restored nine years later. It is now a manufacturing centre (cloth, woollen and cotton stuffs, &c.) and has a considerable trade.

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**BRAUNSBERG,** a town of Germany, in the kingdom of Prussia, 38 m. by rail S.W. of Königsberg, on the Passarge, 4 m. from its mouth in the Frisches Haff. Pop. (1900) 12,497. It possesses numerous Roman Catholic institutions, of which the most important is the Lyceum Hosianum (enjoying university rank), founded in 1564 by the cardinal bishop Stanislaus Hosius. Brewing, tanning, and the manufactures of soap, yeast, carriages and bricks are the most important industries of the town, which also carries on a certain amount of trade in corn, ship timber and yarn. The river is navigable for small vessels. The castle of Braunsberg was built by the Teutonic knights in 1241, and the town was founded ten years later. Destroyed by the Prussians in 1262, it was restored in 1279. The town, which was the seat of the bishops of Ermeland from 1255 to 1298, was granted the "law of Lübeck" by its bishop in 1284, and admitted to the Hanseatic League. After numerous vicissitudes it fell into the hands of the Poles in 1520, and in 1626 it was captured by Gustavus Adolphus. The Swedes kept possession till 1635. It fell to Prussia by the first partition of Poland in 1772.

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**BRAVO** (Ital. for "brave"), the name for hired assassins such as were formerly common in Italy. The word had at first no evil meaning, but was applied to the retainers of the great noble houses, or to the cavalier-type of swashbucklers familiar in fiction. In later Italian history, especially in that of Venice, the *bravi* were desperate ruffians who for payment were ready to commit any crime, however foul.

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**BRAWLING** (probably connected with Ger. *brallen*, to roar, shout), in law, the offence of quarrelling, or creating a disturbance in a church or churchyard. During the early stages of the Reformation in England religious controversy too often became converted into actual disturbance, and the ritual lawlessness of the parochial clergy very frequently provoked popular violence. To repress these disturbances an act was passed in 1551, by which it was enacted "that if any person shall, by words only, quarrel, chide or brawl in any church or churchyard, it shall be lawful for the ordinary of the place where the same shall be done and proved by two lawful witnesses, to suspend any person so offending, if he be a layman, from the entrance of the church, and if he be a clerk, from the ministration of his office, for so long as the said ordinary shall think meet, according to the fault." An act of 1553 added the punishment of imprisonment until the party should repent. The act of 1551 was partly repealed in 1828 and wholly repealed as

regards laymen by the Ecclesiastical Courts Jurisdiction Act 1860. Under that act, which applies to Ireland as well as to England, persons guilty of riotous, violent or indecent behaviour, in churches and chapels of the Church of England or Ireland, or in any chapel of any religious denomination, or in England in any place of religious worship duly certified, or in churchyards or burial-grounds, are liable on conviction before two justices to a penalty of not more than £5, or imprisonment for any term not exceeding two months. This enactment applies to clergy as well as to laity, and a clergyman of the Church of England convicted under it may also be dealt with under the Clergy Discipline Act of 1892 (*Girt v. Fillingham*, 1901, L.R. Prob. 176). When Mr J. Kensit during an ordination service in St Paul's cathedral "objected" to one of the candidates for ordination, on grounds which did not constitute an impediment or notable crime within the meaning of the ordination service, he was held to have unlawfully disturbed the bishop of London in the conduct of the service, and to be liable to conviction under the act of 1860 (*Kensit* v. *Dean and Chapter of St Paul's*, 1905, L.R. 2 K.B. 249). The public worship of Protestant Dissenters, Roman Catholics and Jews in England had before 1860 been protected by a series of statutes beginning with the Toleration Act of 1689, and ending with the Liberty of Religious Worship Act 1855. These enactments, though not repealed, are for practical purposes superseded by the summary remedy given by the act of 1860. In Scotland disturbance of public worship is punishable as a breach of the peace (*Dougall* v. *Dykes*, 1861, 4 Irvine 101).

In British possessions abroad interference with religious worship is usually dealt with by legislation, and not as a common-law offence. In India it is an offence voluntarily to cause disturbance to any assembly lawfully engaged in the performance of religious worship or religious ceremonies (Penal Code, s. 296). Under the Queensland Criminal Code of 1899 (s. 207) penalties are imposed on persons who wilfully and without lawful justification or excuse (the proof of which lies on them) disquiet or disturb any meeting of persons lawfully assembled for religious worship, or assault any forces lawfully officiating at such meeting, or any of the persons there assembled.

In the United States disturbance of religious worship is treated as an offence under the common law, which is in many states supplemented by legislation (see Bishop, *Amer. Crim. Law*, 8th ed. 1892, vol. i. s. 542, vol. ii. ss. 303-305; California Penal Code, s. 302; *Revised Laws of Massachusetts*, 1902, chap. 212, s. 30.).

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**BRAY, SIR REGINALD** (d. 1503), British statesman and architect, was the second son of Sir Richard Bray, one of the privy council of Henry VI. Reginald was born in the parish of St John Bedwardine, near Worcester, but the date of his birth is uncertain. He was receiver-general and steward of the household to Sir Henry Stafford, second husband of Margaret, countess of Richmond, whose son afterwards became King Henry VII. The accession of the king Henry VII. favoured the fortunes of Reginald Bray, who was created a knight of the Bath at the coronation and afterwards a knight of the Garter. In the first year of Henry VII.'s reign he was given a grant of the constableship of Oakham Castle in Rutland, and was appointed joint chief justice with Lord Fitz Walter of all the forest south of Trent and chosen of the privy council. Subsequently he was made high treasurer and chancellor of the duchy of Lancaster. In October 1494 he became high steward of the university of Oxford, and he was a member of the parliament summoned in the 11th year of Henry VII's reign. In June 1497 he was at the battle of Blackheath, and his services in repressing the Cornish rebels were rewarded with a gift of estates and the title of knight banneret. His taste and skill in architecture are attested by Henry VII.'s chapel at Westminster and St George's chapel at Windsor. He directed the building of the former, and the finishing and decoration of the latter, to which, moreover, he was a liberal contributor, building at his own expense a chapel still called by his name and ornamented with his crest, the initial letters of his name, and a device representing the hemp-bray, an instrument used by hemp manufacturers. He died in 1503, before the Westminster chapel was completed, and was interred in St George's chapel.



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**BRAY, THOMAS** (1656-1730), English divine, was born at Marton, Shropshire, in 1656, and educated at All Souls' College, Oxford. After leaving the university he was appointed vicar of Over-Whitacre, and rector of Sheldon in Warwickshire, where he wrote his famous *Catechetical Lectures*. Henry Compton, bishop of London, appointed him in 1696 as his commissary to organize the Anglican church in Maryland, and he was in that colony in 1699-1700. He took a

great interest in colonial missions, especially among the American Indians, and it is to his exertions that the Society for the Propagation of the Gospel owes its existence. He also projected a successful scheme for establishing parish libraries in England and America, out of which grew the Society for Promoting Christian Knowledge. From 1706 till his death in February 1730 he was rector of St Botolph-Without, Aldgate, London, being unceasingly engaged in philanthropic and literary pursuits.

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**BRAY,** a village in the Wokingham parliamentary division of Berkshire, England, beautifully situated on the west (right) bank of the Thames, 1 m. S. of Maidenhead Bridge. Pop. (1901) 2978. There are numerous riverside residences in the locality. The church of St Michael has portions of various dates from the Early English period onward, and is much restored. It contains a number of brasses of the 14th, 15th, 16th and 17th centuries. A well-known ballad, “The Vicar of Bray,” tells how a vicar held his position by easy conversions of faith according to necessity, from the days of Charles II. until the accession of George I. and the foundation of “the illustrious house of Hanover” (1714). One Francis Carswell, who is buried in the church, was vicar for forty-two years, approximately during this period, dying in 1709; but the legend is earlier, and the name of the vicar who gave rise to it is not certainly known. That of Simon Aleyn, who held the office from c. 1540 to 1588, is generally accepted, as, in the reigns of Henry VIII., Edward VI., Mary and Elizabeth, he is said to have been successively Papist, Protestant, Papist and Protestant. The name of Simon Simonds is also given on the authority of the vicar of the parish in 1745; Simonds died a canon of Windsor in 1551, but had been vicar of Bray. Tradition ascribes the song to a soldier in Colonel Fuller’s troop of dragoons in the reign of George I.

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**BRAY,** a seaport and watering-place of Co. Wicklow, Ireland, 12 m. S.S.E. of Dublin on the Dublin & South-Eastern railway, situated on both sides of the river Bray. Pop. of urban district (1901) 7424. For parliamentary purposes it is divided between the eastern division of county Wicklow and the southern of county Dublin. A harbour was constructed by the urban district council (the harbour authority) which accommodates ships of 400 tons. There is some industry in brewing, milling and fishing, but the town, which is known as the “Irish Brighton,” is almost wholly dependent for its prosperity on visitors from Dublin and elsewhere. It therefore possesses all the equipments of a modern seaside resort; there is a fine sea-wall with esplanade upwards of a mile in length; the bathing is good, and race meetings are held. The town is rapidly increasing in size. The coast, especially towards the promontory of Bray Head, offers beautiful sea-views, and some of the best inland scenery in the county is readily accessible, such as the Glens of the Dargle and the Downs, the demesne of Powerscourt, the Bray river, with its loughs, and the pass of the Scalp. The demesne of Kilruddery, the seat of the earls of Meath, is specially beautiful. About 1170 Bray was bestowed by Richard de Clare or Strongbow, earl of Pembroke and Strigul, on Walter de Reddesford, who took the title of baron of Bray, and built a castle.

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**BRAYLEY, EDWARD WEDLAKE** (1773-1854), English antiquary and topographer, was born at Lambeth, London, in 1773. He was apprenticed to the enamelling trade, but early developed literary tastes. He formed a close friendship with John Britton, which lasted for sixty-five years. They entered into a literary partnership, and after some small successes at song and play writing they became joint editors of *The Beauties of England and Wales*, themselves writing many of the volumes. Long after he had become famous as a topographer, Brayley continued his enamel work. In 1823 he was elected a fellow of the Society of Antiquaries. He died in London on the 23rd of September 1854. His other works include *Sir Reginalde or the Black Tower* (1803); *Views in Suffolk, Norfolk and Northamptonshire, illustrative of works of Robt. Bloowifield* (1806); *Lambeth Palace* (1806); *The History of the Abbey Church of Westminster* (2 vols., 1818); *Topographical Sketches of Brighthelmstone* (1825); *Historical and Descriptive Accounts of Theatres of London* (1826); *Londiniana* (1829); *History of Surrey* (5 vols., 1841-1848).

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**BRAZIER** (from the Fr. *brasier*, which comes from *braise*, hot charcoal), a metal receptacle for holding burning coals or charcoal, much used in southern Europe and the East for warming rooms. Braziers are often elegant in form, and highly artistic in ornamentation, with chased or embossed feet and decorated exteriors.

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**BRAZIL,** or Brasil, a legendary island in the Atlantic Ocean. The name connects itself with the red dye-woods so called in the middle ages, possibly also applied to other vegetable dyes, and so descending from the *Insulae Purpurariae* of Pliny. It first appears as the *I. de Brazi* in the Venetian map of Andrea Bianco (1436), where it is found attached to one of the larger islands of the Azores. When this group became better known and was colonized, the island in question was renamed Terceira. It is probable that the familiar existence of "Brazil" as a geographical name led to its bestowal upon the vast region of South America, which was found to supply dye-woods kindred to those which the name properly denoted. The older memory survived also, and the Island of Brazil retained its place in mid-ocean, some hundred miles to the west of Ireland, both in the traditions of the forecastle and in charts. In J. Purdy's *General Chart of the Atlantic*, "corrected to 1830," the "Brazil Rock (high)" is marked with no indication of doubt, in 51° 10′ N. and 15° 50′ W. In a chart of currents by A.G. Findlay, dated 1853, these names appear again. But in his 12th edition of Purdy's *Memoir Descriptive and Explanatory of the N. Atlantic Ocean* (1865), the existence of Brazil and some other legendary islands is briefly discussed and rejected. (See also Atlantis.)

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**BRAZIL,** a republic of South America, the largest political division of that continent and the third largest of the western hemisphere. It is larger than the continental United States excluding Alaska, and slightly larger than the great bulk of Europe lying east of France. Its extreme dimensions are 2629 m. from Cape Orange (4° 21′ N.) almost due south to the river Chuy (33° 45′ S. lat.), and 2691 m. from Olinda (Ponta de Pedra, 8° 0′ 57″ S., 34° 50′ W.) due west to the Peruvian frontier (about 73° 50′ W.). The most northerly point, the Serra Roraima on the Venezuela and British Guiana frontier (5° 10′ N.), is 56 m. farther north than Cape Orange. The area, which was augmented by more than 60,000 sq. m. in 1903 and diminished slightly in the boundary adjustment with British Guiana (1904), is estimated to have been 3,228,452 sq. m. in 1900 (A. Supan, *Die Bevölkerung der Erde*, Gotha, 1904). A subsequent planimetric calculation, which takes into account these territorial changes, increases the area to 3,270,000 sq. m.

*Boundaries.*—Brazil is bounded N. by Colombia, Venezuela and the Guianas, N.E., E. and S.E. by the Atlantic, S. by Uruguay, Paraguay and Bolivia, and W. by Argentina, Paraguay, Bolivia, Peru, Ecuador and Colombia. Its territory touches that of every South American nation, except Chile, and with each one there has been a boundary dispute at some stage in its political life. The Spanish and Portuguese crowns attempted to define the limits between their American colonies in 1750 and 1777, and the lines adopted still serve in great part to separate Brazil from its neighbours. Lack of information regarding the geographical features of the interior, however, led to some indefinite descriptions, and these have been fruitful sources of dispute ever since. The Portuguese were persistent trespassers in early colonial times, and their land-hunger took them far beyond the limits fixed by Pope Alexander VI. In the boundary disputes which have followed, Brazil seems to have pursued this traditional policy, and generally with success.



Beginning at the mouth of the Arroyo del Chuy, at the southern extremity of a long sandbank separating Lake Mirim from the Atlantic (33°45′ S. lat.), the boundary line between Brazil and Uruguay passes up that rivulet and across to the most southerly tributary of Lake Mirim, thence down the western shore of that lake to the Jaguarão and up that river to its most southerly source. The line then crosses to the hill-range called Cuchilla de Sant' Anna, which is followed in a north-west direction to the source of the Cuareim, or Quarahy, this river becoming the boundary down to the Uruguay. This line was fixed by the treaty of 1851, by which the control of Lake Mirim remains with Brazil. Beginning at the mouth of the Quarahy, the boundary line between Brazil and Argentina ascends the Uruguay, crosses to the source of the Santo Antonio, and descends that small stream and the Iguassú to the Paraná, where it terminates. This line was defined by the treaty of 1857, and by the decision of President Cleveland in 1895 with regard to the small section between the Uruguay and Iguassú rivers. The boundary with Paraguay was definitely settled in 1872. It ascends the Paraná to the great falls of Guayrá, or Sete Quedas, and thence westward along the water-parting of the Sierra de Maracayú to the *cerro* of that name,

thence northerly along the Sierra d'Amambay to the source of the Estrella, a small tributary of the Apá, and thence down those two streams to the Paraguay. From this point the line ascends the Paraguay to the mouth of the Rio Negro, the outlet of the Bahia Negra, where the Bolivian boundary begins. As regards the Peruvian boundary, an agreement was reached in 1904 to submit the dispute to the arbitration of the president of Argentina in case further efforts to reach an amicable settlement failed. The provisional line, representing the Brazilian claim, begins at the termination of the Bolivian section (the intersection of the 11th parallel with the meridian of 72° 26′ W. approx.) and follows a semicircular direction north-west and north to the source of the Javary (or Yavary), to include the basins of the Purús and Juruá within Brazilian jurisdiction. The line follows the Javary to its junction with the Amazon, and runs thence north by east direct to the mouth of the Apaporis, a tributary of the Yapurá, in about 1° 30′ S. lat., 69° 20′ W. long., where the Peruvian section ends. The whole of this line, however, was subject to future adjustments, Peru claiming all that part of the Amazon valley extending eastward to the Madeira and lying between the Beni and the east and west boundary line agreed upon by Spain and Portugal in 1750 and 1777, which is near the 7th parallel. With regard to the section between the Amazon and the Apaporis river, already settled between Brazil and Peru, the territory has been in protracted dispute between Peru, Ecuador and Colombia; but a treaty of limits between Brazil and Ecuador was signed in 1901 and promulgated in 1905. The boundary with Colombia, fixed by treaty of April 24, 1907, follows the lower rim of the Amazon basin, as defined by Brazil. The Colombian claim included the left bank of the Amazon eastward to the Auahy or Avahy-paraná channel between the Amazon and Yapurá, whence the line ran northward to the Negro near the intersection of the 66th meridian. The Brazilian line ran north and north-west from the mouth of the Apaporis to the 70th meridian, which was followed to the water-parting south of the Uaupés basin, thence north-east to the Uaupés river, which was crossed close to the 69th meridian, thence easterly along the Serra Tunaji and Isana river to Cuyari, thence northerly up the Cuyari and one of its small tributaries to the Serra Capparro, and thence east and south-east along this range to the Cucuhy rock (Pedra de Cucuhy) on the left bank of the Negro, where the Colombian section ends. Negotiations for the settlement of this controversy, which involved fully one-third of the state of Amazonas, were broken off in 1870, but were resumed in 1905. The boundary with Venezuela, which was defined by a treaty of 1859, runs south-eastward from Cucuhy across a level country intersected by rivers and channels tributary to both the Negro and Orinoco, to the Serra Cupuy watershed which separates the rivers of the Amazon and Orinoco valleys. This watershed includes the ranges running eastward and northward under the names of Imeri, Tapiira-peco, Curupira, Parima and Pacaraima, the Venezuelan section terminating at Mt. Roraima. On the 9th of December 1905 protocols were signed at Caracas accepting the line between Cucuhy and the Serra Cupuy located in 1880, and referring the remainder, which had been located by a Brazilian commission in 1882 and 1884, to a mixed commission for verification.

The disputed boundary between Brazil and British Guiana, which involved the possession of a territory having an estimated area of 12,741 sq. m., was settled by arbitration in 1904 with the king of Italy as arbitrator, the award being a compromise division by which Great Britain received about 7336 sq. m. and Brazil about 5405. The definite boundary line starts from Mt. Roraima and follows the water-parting east and south to the source of the Ireng or Mahu river, which with the Takutú forms the boundary as far south as 1° N. to enclose the basin of the Essequibo and its tributaries, thence it turns east and north of east along the Serra Acaria to unite with the unsettled boundary line of Dutch Guiana near the intersection of the 2nd parallel north with the 56th meridian. Negotiations were initiated in 1905 for the definite location of the boundary with Dutch Guiana. Running north-east and south-east to enclose the sources of the Rio Paru, it unites with the French Guiana line at 2° 10′ N., 55° W., and thence runs easterly along the water-parting of the Serra Tumuc-Humac to the source of the Oyapok, which river is the divisional line to the Atlantic coast. The boundary with French Guiana (see Guiana), which had long been a subject of dispute, was settled by arbitration in 1900, the award being rendered by the government of Switzerland. The area of the disputed territory was about 34,750 sq. m.

*Physical Geography.*—A relief map of Brazil shows two very irregular divisions of surface: the great river basins, or plains, of the Amazon-Tocantins and La Plata, which are practically connected by low elevations in Bolivia, and a huge, shapeless mass of highlands filling the eastern projection of the continent and extending southward to the plains of Rio Grande do Sul and westward to the Bolivian frontier. Besides these there are a narrow coastal plain, the low plains of Rio Grande do Sul, and the Guiana highlands on the northern slope of the Amazon basin below the Rio Negro.

***Relief.***

The coastal plain consists in great part of sandy beaches, detritus formations, and partially submerged areas caused by uplifted beaches and obstructed river channels. Mangrove swamps, lagoons and marshes, with inland canals following the coast line for long distances, are characteristic features of a large extent of the Brazilian coast. Parts of this coastal plain, however, have an elevation of 100 to 200 ft., are rolling and fertile in character, and terminate on the coast in a line of bluffs. In the larger depressions, like that of the Reconcavo of Bahia, there are large alluvial areas celebrated for their fertility. This plain is of varying width, and on some parts of the coast it disappears altogether. In

Rio Grande do Sul, where two large lakes have been created by uplifted sand beaches, the coastal plain widens greatly, and is merged in an extensive open, rolling grassy plain, traversed by ridges of low hills (*cuchillas*), similar to the neighbouring republic of Uruguay. The western part of this plain is drained by the Uruguay and its tributaries, which places it within the river Plate (La Plata) basin.

The two great river basins of the Amazon-Tocantins and La Plata comprise within themselves, approximately, three-fifths of the total area of Brazil. Large areas of these great river plains are annually flooded, the flood-plains of the Amazon extending nearly across the whole country and comprising thousands of square miles. The Amazon plain is heavily forested and has a slope of less than one inch to the mile within Brazilian territory—one competent authority placing it at about one-fifth of an inch per mile. The La Plata basin is less heavily wooded, its surface more varied, and its Brazilian part stands at a much higher elevation.



Of the two highland regions of Brazil, that of the northern slope of the Amazon basin belongs physically to the isolated mountain system extending eastward from the Negro and Orinoco to the Atlantic, the water-parting of which forms the boundary line between the Guianas and Brazil. The culminating point is near the western extremity of this chain and its altitude is estimated at 8500 ft. The ranges gradually diminish in elevation towards the east, the highest point of the Tumuc-Humac range, on the frontier of French Guiana, being about 2600 ft. The Brazilian plateau slopes southward and eastward, traversed by broken ranges of low mountains and deeply eroded by river courses. The table-topped hills of Almeyrin (or Almeirim) and Ereré, which lie near the lower Amazon and rise to heights of 800 and 900 ft., are generally considered the southernmost margin of this plateau, though Agassiz and others describe them as remains of a great sandstone sheet which once covered the entire Amazon valley. Its general elevation has been estimated to be about 2000 ft. It is a stony, semi-arid region, thinly wooded, having good grazing *campos* in its extreme western section. Its semi-arid character is due to the mountain ranges on its northern frontier, which extract the moisture from the north-east trades and leave the Brazilian plateau behind them with a very limited rainfall, except near the Atlantic coast. The more arid districts offer no inducement for settlement and are inhabited only by a few roving bands of Indians, but there were settlements of whites in the grazing districts of the Rio Branco at an early date, and a few hundreds of adventurers have occupied the mining districts of the east. In general, Brazilian Guiana, as this plateau region is sometimes called, is one of the least attractive parts of the republic.

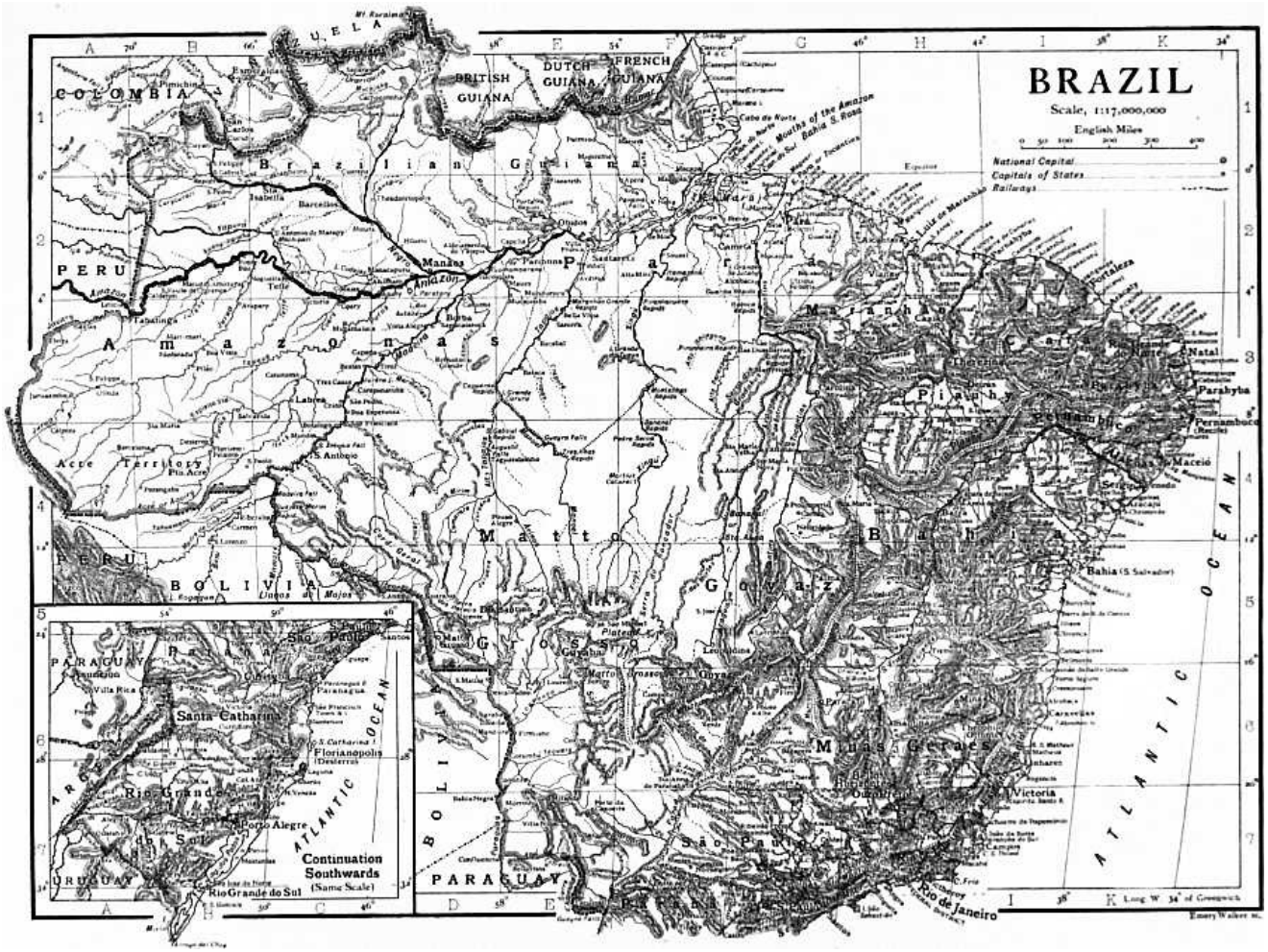
The great Brazilian plateau, which is the most important physical division of Brazil, consists of an elevated tableland 1000 to 3000 ft. above the sea-level, traversed by two great mountain systems, and deeply eroded and indented by numerous rivers. A thick sandstone sheet once covered the greater part if not all of it, remains of which are found on the elevated *chapadas* of the interior and on isolated elevations extending across the republic toward its western frontier. These chapadas and elevations, which are usually described as mountain ranges, are capped by horizontal strata of sandstone and show the original surface, which has been worn away by the rivers, leaving here and there broad flat-topped ridges between river basins and narrower ranges of hills between river courses. From the valleys their rugged, deeply indented escarpments, stretching away to the horizon, have the appearance of a continuous chain of mountains. The only true mountain systems, however, so far as known, are the two parallel ranges which follow the contour of the coast, and the central, or Goyana, system. The first consists of an almost continuous range crossing the northern end of Rio Grande do Sul and following the coast northward to the vicinity of Cape Frio, and thence northward in broken ranges to the vicinity of Cape St Roque, and a second parallel range running from eastern São Paulo northeast and north to the eastern margin of the São Francisco basin in northern Bahia, where that river turns eastward to the Atlantic. The first of these is generally known as the Serra do Mar, or Coast Range, though it is locally known under many names. Its culminating point is in the Organ Mountains (Serra dos Orgãos), near Rio de Janeiro, which reaches an elevation of 7323 ft. The inland range, which is separated from the Coast Range in the vicinity of Rio de Janeiro by the valley of the Parahyba do Sul river, is known as the Serra da Mantiqueira, and from the point where it turns northward to form the eastern rim of the São Francisco basin, as the Serra do Espinhaço. This range is also known under various local names. Its culminating point is toward the western extremity of the Mantiqueira range where the Itatiaya, or Itatiaia-assu, peak rises to an elevation of 8898 ft. (other measurements give 9823 ft.), probably the highest summit in Brazil. This range forms the true backbone of the maritime mountainous belt and rises from the plateau itself, while the Coast Range rises on its eastern margin and forms a rim to the plateau. North of Cape Frio the Coast Range is much broken and less elevated, while the Serra do Espinhaço takes a more inland course and is separated from the coast by great gently-sloping, semi-barren terraces. The second system—the Central or Goyana—consists of two distinct chains of mountains converging toward the north in the elevated *chapadão* between the Tocantins and São Francisco basins. The eastern range of this central system, which crosses western Minas Geraes from the so-called Serra das Vertentes to the valley of the Paracatú, a western tributary of the São Francisco, is called the Serra da Canastra and Serra da Matta da Corde. Its culminating point is toward its southern extremity in the Serra da Canastra, 4206 ft. above sea-level. The western range, or what is definitely known of it, runs across southern Goyaz, south-west to north-east, and forms the water-parting between the Paraná and Tocantins-Araguaya basins. Its

culminating point is in the Montes Pyreneos, near the city of Goyaz, and is about 4500 ft. above sea-level.

The great part of this immense region consists of *chapadões*, as the larger table-land areas are called, *chapadas* or smaller sections of the same, and broadly excavated river valleys. How extensive this work of erosion has been may be seen in the Tocantins-Araguaya basin, where a great pear-shaped depression, approximately 100 to 500 m. wide, 700 m. long, and from 1000 to 1500 ft. deep, has been excavated northward from the centre of the plateau. Southward the Paraná has excavated another great basin and eastward the São Francisco another. Add to these the eroded river basins of the Xingú, Tapajós and Guaporé on the north and west, the Paraguay on the south-west, and the scores of smaller rivers along the Atlantic coast, and we may have some conception of the agencies that have been at work in breaking down and shaping this great table-land, perhaps the oldest part of the continent. The most southern of these *chapadões*, that of the Paraná basin, in which may be included the northern part of the Uruguay and eastern part of the Paraguay basins, includes the greater part of the states of Rio Grande do Sul, Santa Catharina, Paraná and São Paulo, the south-western corner of Minas Geraes, a part of southern Goyaz, and the south-eastern corner of Matto Grosso. The greatest elevation is on its eastern or Atlantic margin where the average is about 3280 ft. above sea-level. The plateau breaks down abruptly toward the sea, and slopes gradually some hundreds of feet toward the south and west. There has been considerable denudation toward the west, the eastern tributaries of the Paraná rising very near the coast. The northern and western parts of this plateau have an average elevation a little less than that of the Atlantic margin, and their slopes are toward the south and east, those of Goyaz and Matto Grosso being abrupt and deeply eroded. This great *chapadão* is in many respects the best part of Brazil, having a temperate climate, extensive areas of fertile soil, rich forests and a regular rainfall. Its Atlantic slopes are heavily wooded, but the western slopes exhibit grass-covered *campos* between the river courses. The São Francisco *chapadão*, which has a general elevation of about 2600 ft., covers the greater part of the states of Minas Geraes and Bahia, and a small part of western Pernambuco, and might also be considered continuous with those of the Parnahyba and Tocantins-Araguaya basins. This region is more tropical in character, partially barren, and has an uncertain rainfall, a large part of the São Francisco basin and the upper Atlantic slope of its eastern rim being subject to long-continued droughts. This region is well wooded along the river courses of Minas Geraes, the lower Atlantic slopes of Bahia, which are perhaps outside the plateau proper, and on the weather side of some of the elevated ridges where the rainfall is heavy and regular. It has extensive *campos* and large areas of exposed rock and stony steppes, but is richly provided with mineral deposits. It breaks down less abruptly toward the Atlantic, the slopes in Bahia being long and gradual. The Parnahyba *chapadão* covers the state of Piauhy, the southern part of Maranhão, and the western part of Ceará. Its general elevation is less than that of the São Francisco region, owing to the slope of the plateau surface toward the Amazon depression and to denudation. It resembles the São Francisco region in its uncertain rainfall and exposure to droughts, and in having large areas of *campos* suitable for grazing purposes. It is thinly wooded, except in the north, where the climatic conditions approach those of the Amazon valley. Its climate is more tropical and its development has gone forward less rapidly than in the more temperate regions of the south. The Amazonian *chapadão*, which includes the remainder of the great Brazilian plateau west of the São Francisco and Parnahyba regions and which appears to be the continuation of these tablelands westward, is much the largest of these plateau divisions. It covers the greater part of the states of Matto Grosso and Goyaz, a large part of southern Pará, the southern margin of Amazonas, and a considerable part of western Maranhão. It includes the river basins of the Tocantins-Araguaya, Xingú, Tapajós, and the eastern tributaries of the Guaporé-Madeira. A considerable part of it has been excavated by these rivers to a level which gives their valleys the elevation and character of lowlands, though isolated hills and ranges with the characteristic overlying horizontal sandstone strata of the ancient plateau show that it was once a highland region. The southern margin of this plateau breaks down abruptly toward the south and overlooks the Paraná and Paraguay basins from elevations of 2600 to 3000 ft. There is great diversity in the character and appearance of this extensive region. It lies wholly within the tropics, though its more elevated districts enjoy a temperate climate. Its *chapadas* are covered with extensive *campos*, its shallow valleys with open woodlands, and its deeper valleys with heavy forests. The rainfall is good, but not heavy. The general slope is toward the Amazon, and its rivers debouch upon the Amazonian plain through a succession of falls and rapids.

There remains only the elevated valley of the Parahyba do Sul, lying between the so-called Serra das Vertentes of southern Minas Geraes and the Serra do Mar, and extending from the Serra da Bocaina, near the city of São Paulo, eastward to Cape Frio and the coastal plain north of that point. It includes a small part of eastern São Paulo, the greater part of the state of Rio de Janeiro, a small corner of Espirito Santo, and a narrow strip along the southern border of Minas Geraes. It is traversed by two mountain chains, the Serra da Mantiqueira and Serra do Mar, and the broad, fertile valley of the Parahyba do Sul which lies between them, and which slopes gently toward the east from a general elevation exceeding 2000 ft. in São Paulo. This region is the smallest of the *chapadão* divisions of the great plateau, and might be considered either a southward extension of the São Francisco or an eastward extension of the Paraná *chapadão*. It is one of the most favoured regions of Brazil, having an abundant rainfall, extensive forests of valuable timber, and large areas of fertile soil. The mountain slopes are still masses of dense

forest, though their lower elevations and neighbouring valleys have been cleared for cultivation and by dealers in rosewood and other valuable woods. This elevated valley is noted for its fertility and was once the principal coffee-producing district of Brazil.




(Click to enlarge.)

***Rivers.***

Outside the two great river systems of the Amazon and river Plate (Rio de la Plata), which are treated under their respective titles, the rivers of Brazil are limited to the numerous small streams and three or four large rivers which flow eastward from the plateau regions directly into the Atlantic. The Amazon system covers the entire north-western part of the republic, the state of Amazonas, nearly the whole of Pará and the greater part of Matto Grosso being drained by this great river and its tributaries. If the Tocantins-Araguaya basin is included in the hydrographic system, the greater part of Goyaz and a small part of Maranhão should be added to this drainage area. The Tocantins is sometimes treated as a tributary of the Amazon because its outlet, called the Rio Pará, is connected with that great river by a number of inland channels. It is an entirely separate river, however, and the inland communication between them is due to the slight elevation of the intervening country above their ordinary levels and to the enormous volume of water brought down by the Amazon, especially in the flood season. As the outlet of the Tocantins is so near to that of the Amazon, and their lower valleys are conterminous, it is convenient to treat them as parts of the same hydrographic basin.

In the extreme north-east corner of the republic where the Brazilian Guiana plateau slopes toward the Atlantic there is a small area lying outside the drainage basin of the Amazon. Its rivers flow easterly into the Atlantic and drain a triangular-shaped area of the plateau lying between the northern frontier and the southern and western watersheds of the Araguary, whose extreme limits are about 0° 30′ N. lat. and 53° 50′ W. long. The more important of these rivers are the Araguary, Amapá, Calçoene, Cassiporé and Oyapok. The Araguary rises in the Tumuc-Humac mountains, in about 2° 30′ N. lat., 52° 10′ W. long., and follows a tortuous course south and north-east to the Atlantic. Its largest tributary, the Amapary, rises still farther west. Little is known of the country through which it flows, and its channel is broken by rapids and waterfalls where it descends to the coastal plain. The Amapá is a short river rising on the eastern slopes of the same range and flowing across a low, wooded plain, filled with lagoons. The Calçoene and Cassiporé enter the Atlantic farther north and have a north-east course across the same plain. All these small rivers are described as auriferous and have attracted attention for this reason. The Oyapok, or Vicente Pinzon, is the best-known of the group and forms the boundary line between Brazil and French Guiana under the arbitration award of 1900. It rises in about 2° 05′ N., 53° 48′ W., and

flows easterly and north-easterly to the Atlantic. Its course is less tortuous than that of the Araguary.

The rivers of the great Brazilian plateau which flow directly to the Atlantic coast may be divided into two classes: those of its northward slope which flow in a northerly and north-easterly direction to the north-east coast of the republic, and those which drain its eastern slope and flow to the sea in an easterly direction. The former reach the coastal plain over long and gradual descents, and are navigable for considerable distances. The latter descend from the plateau much nearer the coast, and are in most cases navigable for short distances only. In both classes navigation is greatly impeded by sandbars at the mouths of these rivers, while in the districts of periodical rainfall it is greatly restricted in the dry season. The more important rivers of the first division, which are described in more detail under the titles of the Brazilian states through which they flow, are the following: the Gurupy, Tury-assú, Mearim, Itapicurú and Balsas, in the state of Maranhão; the Parnahyba and its tributaries in Piauhy; Jaguaribe in Ceará; and the Apody and Piranhas in Rio Grande do Norte. Of these the Parnahyba is the most important, having a total length of about 900 m., broken at intervals by rapids and navigable in sections. It receives only one important tributary from Maranhão—the Rio das Balsas, 447 m. long—and five from Piauhy, the Urussuhy-assú, Gurgueia, Canindé, Poty and Longa. Piauhy is wholly within its drainage basin, although the river forms the boundary line between that state and Maranhão throughout its entire length. All the rivers in this division are influenced by the periodical character of the rainfall, their navigable channels being greatly shortened in the dry season (August-January). In Ceará the smaller rivers become dry channels in the dry season, and in protracted droughts the larger ones disappear also.

The rivers of the second division are included in a very great extension of coast and are influenced by wide differences in climate. Their character is also determined by the distance of the Serra do Mar from the coast, the more southern rivers having short precipitous courses. The more northern rivers are subject to periodical variations in volume caused by wet and dry seasons, but the greater distance of the coast range and the more gradual breaking down of the plateau toward the sea, give them longer courses and a greater extent of navigable water. North of the São Francisco the watershed projecting from the plateau eastward toward Cape St Roque, known as the Serra da Borborema in Parahyba and Rio Grande do Norte where its direction becomes north-east, leaves a triangular section of the easterly slope in which the river courses are short and much broken by rapids. The rainfall, also, is limited and uncertain. The largest of this group of small rivers is the Parahyba do Norte, belonging to the state of Parahyba, whose length is said to be less than 200 m., only 5 or 6 m. of which are navigable for small steamers. The São Francisco, which belongs to the inland plateau region, is the largest river of the eastern coast of Brazil and exists by virtue of climatic conditions wholly different from those of the coast where it enters the Atlantic. The tributaries of the lower half of this great river, which belong to the Atlantic coast region, are small and often dry, but the upper river where the rainfall is heavier and more regular receives several large affluents. The river is navigable up to the Paulo Affonso falls, 192 m. from the coast, and above the falls there is a much longer stretch of navigable water.

From the São Francisco to Cape Frio there are many short rivers rising on the slopes of the plateau and crossing the narrow coastal plain to the sea. There are also a few of greater length which rise far back on the plateau itself and flow down to the plain through deeply cut, precipitous courses. The navigable channels of these rivers are restricted to the coastal plain, except where a river has excavated for itself a valley back into the plateau. The more important of these rivers are the Itapicurú, Paraguassú, Contas or Jussiape, Pardo or Patype, and Jequitinhonha, of Bahia; the Mucury, and Doce, of Espirito Santo; and the Parahyba do Sul of the state of Rio de Janeiro. Of the Bahia group, the Jequitinhonha, sometimes called the Belmonte on its lower course, is the longest and most important, rising near Serro in the state of Minas Geraes and flowing in a curving north-east direction for a distance of about 500 m., 84 of which are navigable inland from the sea. The Mucury and Doce also rise in Minas Geraes, and are much broken in their descent to the lower plains, the former having a navigable channel of 98 m. and the latter of 138 m. The Parahyba, or Parahyba do Sul, which enters the sea about 30 m. north of Cape S. Thomé, is the largest and most important of the Atlantic coast rivers south of the São Francisco. It rises on an elevated tableland in the state of São Paulo and flows across the state of Rio de Janeiro from west to east, through a broad fertile valley producing coffee in its most elevated districts and sugar on its alluvial bottom-lands nearer the sea. It has a total length of 658 m., 57 of which are navigable between S. Fidelis and its mouth, and about 90 m. of its upper course.

South of Cape Frio there are no large rivers along the coast because of the proximity of the Serra do Mar—the coastal plain being very narrow and in places disappearing altogether. There are many short streams along this coast, fed by heavy rainfalls, but they have no geographic importance and no economic value under existing conditions. The largest of these and the only one of commercial value is the Ribeira de Iguape, which has its source on the tablelands of Paraná and after receiving several affluents west of the Serra do Mar breaks through a depression in that range and discharges into the Atlantic some miles below Santos on the southern boundary of the state of São Paulo. This river has a navigable channel of 118 m. below Xiririca, and communicates with an inland canal or waterway extending for many miles along this coast and known as the Iguape, or Mar Pequeno. In Rio Grande do Sul the Atlantic coastal plain

extends westward more than half-way across the state, and is well watered by numerous streams flowing eastward to the Lagôa dos Patos. Of these only two are of large size—the Guayba and Camaquam. The first is formed by the confluence of the Jacuhy, Cahy, Sinos and Gravatahy, and is known under this name only from Porto Alegre to the Ponta de Itapuã, where it enters the Lagôa dos Patos. This river system drains a large part of the northern mountainous region of the state, and has a considerable extension of navigable channels between the plateau margin and the lake. In the extreme southern part of the state, the Lagôa Mirim empties into the Lagôa dos Patos through a navigable channel 61½ m. long, called the Rio São Gonçalo.

The Brazilian rivers of the Rio de la Plata system are numerous and important. Those of the Paraguay drain the south-western part of Matto Grosso, and the tributaries of the Paraná cover the western slopes of the Serra do Mar from Rio Grande do Sul north to the south-west part of Minas Geraes, and include the south-east part of Matto Grosso and the south part of Goyaz within their drainage basin. This is one of the most important fluvial systems of Brazil, but its economic value is impaired by the great waterfalls of Guayrá, or Sete Quedas, and Uribú-punga, and by the rapids and waterfalls in the majority of its affluents near their junction with the main stream. Between the two great waterfalls of the Paraná there is an open channel of 276 m., passing through a rich and healthy country, and receiving large tributaries from one of the most fertile regions of Brazil. Among the larger of these are the great falls of the Iguassú, near the junction of that river with the Paraná. Though the Uruguay plays a less important part, its relations to the country are similar to those of the Paraná, and its tributaries from the plateau region are similarly broken by falls and rapids. The Paraguay is in great part a lowland river, with a sluggish current, and is navigable by large river steamers up to Corumbá, and by smaller steamers to Cuyabá and the mouth of the Jaurú.



***Lakes.***

Compared with the number, length and volume of its rivers, Brazil has very few lakes, only two of which are noticeable for their size. There are a number of lakes in the lowland region of the Amazon valley, but these are mainly overflow reservoirs whose areas expand and contract with the rise and fall of the great river. The coastal plain is also intersected by lagoons, lakes and inland channels formed by uplifted beaches. These inland channels often afford many miles of sheltered navigation. The lakes formed in this manner are generally shallow, and are sometimes associated with extensive swamps, as in southern Bahia. The lakes of the Alagôas coast, however, are long, narrow and deep, occupying valleys which were deeply excavated when the land stood at a higher level, and which were transformed into lakes by the elevation of the coast. The largest of these are the Lagôa do Norte, on whose margin stands the city of Maceió, and the Lagôa do Sul, a few miles south of that city. Both have outlets to the sea, and the former is salt There is a large number of these lakes along the coasts of Espirito Santo and Rio de Janeiro, some of them of considerable size. The two largest lakes of this class are on the coast of Rio Grande do Sul and are known as the Lagôa dos Patos and Lagôa Mirim. Both of these lakes lie nearly parallel with the coast line, are separated from the ocean by broad sand beaches filled with small lakes, and communicate with the ocean through the same channel. The Lagôa dos Patos is about 124 m. long with a maximum width of 37 m., and Lagôa Mirim is 108 m. long with a maximum width of 15 m. Both are navigable, though comparatively shallow and filled with sandbanks. So far as known, there are no lakes of noteworthy size in the interior of the country. There are a few small lakes in Maranhão and Piauhy, some in Goyaz in the great valley of the Araguaya, and a considerable number in Matto Grosso, especially in the Paraguay basin, where the sluggish current of that river is unable to carry away the rainfall in the rainy season.

***Coast.***

The coast of Brazil is indented with a number of almost landlocked bays, forming spacious and accessible harbours. The larger and more important of these are Todos os Santos, on which is located the city of São Salvador or Bahia, and Rio de Janeiro or Guanabara, beside which stands the capital of the republic. These two are freely accessible to the largest ships afloat. The bays of Espirito Santo, Paranaguá and São Francisco have similar characteristics, but they are smaller and more difficult of access. The first is the harbour for the city of Victoria, and the other two for ports of the same name in southern Brazil. The port of Pernambuco, or Recife, is formed by a stone reef lying across the entrance to a shallow bay at the mouth of two small rivers, Beberibe and Capibaribe, and is accessible to steamers of medium draught. Santa Catharina and Maranhão have well-sheltered harbours formed by an island lying in the mouth of a large bay, but the latter is shallow and difficult of access. Pará, Parnahyba, Parahyba, Santos and Rio Grande do Sul are river ports situated near the sea on rivers having the same name; but, with the exception of Pará and Santos, they are difficult of access and are of secondary importance. There are still other bays along the coast which are well adapted for commercial purposes but are used only in the coasting trade. Many of the Atlantic coast rivers would afford excellent port facilities if obstructions were removed from their mouths.

*Geology.*—Brazil is a region which has been free from violent disturbances since an early geological period. It has, indeed, been subject to oscillations, but the movements have been regional in character and have not been accompanied by the formation of any mountain chain or any belt of intense folding. From the Devonian onwards the beds lie flat or dip at low angles. They are faulted but not sharply folded. The mountain ranges of the east of Brazil, from Cape St Roque to the mouth of the river Plate, are composed chiefly of crystalline and metamorphic rocks. Some

of the metamorphic rocks may belong to the older Palaeozoic period, but the greater part of the series is probably Archaean. Similar rocks cover a large area in the province of Goyaz and in the south of the Matto Grosso, and they form, also, the hills which border the basin of the Amazon on the confines of Venezuela and Guiana. They constitute, in fact, an incomplete rim around the basin of sedimentary beds which occupies the Amazonian depression. In a large part of this basin the covering of sedimentary deposits is comparatively thin. The crystalline floor is exposed in the valleys of the Madeira, Xingú, &c. Some of the rocks thus exposed are, however, eruptive (*e.g.* in the Tapajoz), and probably do not belong to the Archaean. The crystalline rocks are succeeded by beds which have been referred to the Cambrian and Silurian systems. In the valley of the Trombetas, one of the northern tributaries of the Amazon, fossils have been found which indicate either the top of the Ordovician or the bottom of the Silurian. In the Maecuru, another northern affluent, graptolites of Ordovician age have been discovered, and Silurian fossils are said to have been found in the Maraca. Elsewhere the identification of the Silurian and older systems does not rest on palaeontological evidence. Devonian beds cover a much more extensive area. They crop out in a band some 25 to 50 m. north of the lower Amazon and in another band at a still greater distance south of that river. These bands are often concealed by more recent deposits, but it is clear that in this region the Devonian beds form a basin or synclinal with the Amazon for its axis. Devonian beds also lie upon the older rocks in the Matto Grosso and other provinces in the interior of Brazil, where they generally form plateaux of nearly horizontal strata. Fossils have been found in many localities. They belong to either the lower or the middle division of the Devonian system. The fauna shows striking analogies with that of the Bokkeveld beds of South Africa on the one hand and of the Hamilton group of North America on the other. The Carboniferous system in Brazil presents itself under two facies, the one marine and the other terrestrial. In the basin of the Lower Amazon the Carboniferous beds lie within the Devonian synclinal and crop out on both sides of the river next to the Devonian bands. There is a lower series consisting of sandstone and an upper series of limestone. The former appears to be almost unfossiliferous, the latter has yielded a rich marine fauna, which belongs to the top of the Carboniferous or to the Permo-carboniferous. In southern Brazil, on the other hand, in Rio Grande do Sul, Paraná, &c., the beds of this period are of terrestrial origin, containing coal seams and remains of plants. Some of the plants are European forms, others belong to the Glossopteris flora characteristic of India and South Africa. The beds are homotaxial with the Karharbári series of India, and represent either the top of the Carboniferous or the base of the Permian of Europe. The only Mesozoic system which is represented in Brazil by marine beds is the Cretaceous, and the marine facies, is restricted to the coasts and the basin of the Amazon. In the province of Sergipe, on the east coast, the beds are approximately on the horizon of the Cenomanian; in the valley of the Amazon they belong to the highest parts of the Cretaceous system, and the fauna shows Tertiary affinities. In the interior of Brazil, the Palaeozoic beds are directly overlaid by a series of red sandstones, &c., which appear to be of continental origin and of which the age is uncertain. Tertiary beds cover a considerable area, especially in the Amazonian depression. They consist chiefly of sands and clays of aeolian and freshwater origin. Of the Pleistocene and recent deposits the most interesting are the remains of extinct animals (*Glyptodon*, *Mylodon*, *Megatherium*, &c.) in the caves of the São Francisco.

From the above account it will appear that, excepting near the coast and in the basin of the Amazon, there is no evidence that any part of Brazil has been under the sea since the close of the Devonian period. During the Triassic and Jurassic periods even the basin of the Amazon appears to have been dry land. Eruptive rocks occur in the Devonian and Carboniferous beds, but there is no evidence of volcanic activity since the Palaeozoic epoch. The remarkable “stone reefs” of the north-east coast are ancient beaches hardened by the infiltration of carbonate of lime. They are quite distinct in their formation from the coral reefs of the same coast.

*Climate.*—Brazil lies almost wholly within the torrid zone, less than one-twelfth of its area lying south of the tropic of Capricorn. In general terms, it is a tropical country, with sub-tropical and temperate areas covering its three southern states and a great part of the elevated central plateau. The forest-covered, lowland valley of the Amazon is a region of high temperatures which vary little throughout the year, and of heavy rainfall. There is no appreciable change of seasons, except that produced by increased rainfall in the rainy season. The average temperature according to Castelnau is about 78°F., or 82.40° to 84.20° F. according to Agassiz. There is an increase in the rainfall from August to October, and again from November to March, the latter being the regular rainy season, but the time varies considerably between the valley of the upper Amazon and those of the upper Madeira and Negro. There is usually a short dry season on the upper Amazon in January and February, which causes two annual floods—that of November-December, and the great flood of March-June. The subsidence of the latter usually lasts until October. The average rainfall throughout the whole Amazon valley is estimated by Reclus as “probably in excess of 2 metres” (78.7 in.), and the maximum rise of the great flood is about 45 ft. The prevailing winds in the Amazon valley are easterly and westerly (or south-westerly), the former warm and charged with moisture, the latter dry and cold. The easterly winds, which are deflections of the trade winds, blow upstream with great regularity and force, more especially in the winter or dry season, and are felt as far inland as the mouths of the Madeira and Negro. Above these they are less regular and are attracted northward by the heated *llanos* of Venezuela in winter, or southward by the heated *campos* of Matto Grosso in summer. The cold south-westerly winds are felt when the sun is north of the equator, and are most severe, for a few days,

in the month of May, when a *tempo da friagem* (cold period) causes much discomfort throughout the upper Amazon region. There are winter winds from the Andes, but in the summer season there are cold currents of air from up-river (*ventos da cima*) which are usually followed by downpours of rain.

The coastal plain as far south as Santos is a region of high temperatures and great humidity. The year is usually divided into a winter (*inverno*) and summer (*verão*), corresponding approximately to a dry and wet season. The “dry” season, however, is a season of moderate rainfall, except on the north-east coast where arid conditions prevail. Another exception is that of the Pernambuco coast, where the rainy season comes between March and August, with the heaviest rainfall from May to July, which is the time of the southern winter. Going southward there is also a gradual decrease in the mean annual temperature, the difference between Rio de Janeiro and the Amazon being about 5°. The north-east coast, which is sandy and barren, shows an average mean annual temperature (at Fortaleza) of nearly 80° F., which is slightly higher than those of Maranhão and Pará. At Pernambuco the mean summer temperature is 79.5° and that of winter 76.8°, which are about 3° lower than the mean temperature of Bahia in summer, and 5° higher than the Bahia mean in winter. South of Bahia there is a gradual increase in the rainfall, that of Rio de Janeiro exceeding 43 in. per annum. At Santos the rainfall is exceptionally heavy and the mean temperature high, but below that point the climatic conditions are considerably modified, the range in temperature being greater, the mean annual temperature lower, and the rainfall more evenly distributed throughout the year. The winds are more variable, and the seasons are more sharply defined. In Rio Grande do Sul the range in temperature is from 26° to 80°, the climate being similar to that of Uruguay. At Pelotas, a sea-level port on Lagôa dos Patos, the mean annual temperature is about 63° and the annual rainfall about 42 in. Extreme variations in temperature are often produced by cold south-west storms from the Argentine pampas, which sweep across southern Brazil as far north as Cape Frio, the fall in temperature sometimes being 22° to 27°. These storms usually last from two to three days and cause much discomfort. Winter rains are more frequent in southern Brazil, and violent storms prevail in August and September. At Blumenau, on the Santa Catharina coast, the annual rainfall is 53 in.



The climatic conditions of the Brazilian plateau are widely different from those of the coast in many respects. There is less uniformity in temperature, and the elevated *chapadas* are generally hotter during the day and cooler at night than are localities of the same latitude on the coast. The Brazilian Guiana plateau, lying immediately north of the equator, is in great part a hot, stony desert. Geographically it belongs to the Amazon basin, as its western and southern slopes are drained by tributaries of that great river. Climatically, however, it is a region apart. It lies in the north-east trade winds belt, but the mountain chain on its northern frontier robs these winds of their moisture and leaves the greater part of the Brazilian plateau rainless. Its eastern and western extremities, however, receive more rain, the former being well forested, while the latter is covered with grassy *campos*. South of the Amazon valley and filling a great part of the eastern projection of the continent, is another arid, semi-barren plateau, lying within the south-east trade winds belt, and extending from Piauhy southward to southern Bahia. It covers the state of Piauhy and the western or inland parts of the states of Ceará, Rio Grande do Norte, Parahyba, Pernambuco and Bahia. The year is divided into a dry and wet season, the first from June to December, when rain rarely falls, the streams dry up and the *campos* are burned bare, and the second from January to May when the rains are sometimes heavy and the *campos* are covered with luxuriant verdure. The rains are neither regular nor certain, however, and sometimes fail for a succession of years, causing destructive *sêccas* (droughts). The interior districts of Ceará, Pernambuco and Bahia have suffered severely from these *sêccas*. The sun temperature is high on these barren tablelands, but the nights are cool and refreshing. The prevailing winds are the south-east trades, which have lost some of their moisture in rising from the coastal plain. In summer, becoming warmed by the heated surface of the plateau, they sweep across it without a cloud or drop of rain. In winter the plateau is less heated, and cold currents of air from the west and south-west cause precipitation over a part if not all of this region. South and south-west of this arid plateau lie the inhabited tablelands of Rio de Janeiro, São Paulo and Minas Geraes, where the climate is greatly modified by a luxuriant vegetation and southerly winds, as well as by the elevation. Minas Geraes is forested along its water courses and along its southern border only; its sun temperature, therefore, is high and the rainfall in its northern districts is comparatively light. São Paulo is partly covered by open *campos*, and these also serve to augment the maximum temperature. In both of these states, however, the nights are cool, and the mean annual temperature ranges from 68° to 77°, the northern districts of Minas Geraes being much warmer than the southern. In São Paulo and southern Minas Geraes there are sometimes frosts. In the Parahyba valley, which extends across the state of Rio de Janeiro, the mean temperature is somewhat higher than it is in São Paulo and Minas Geraes, and the nights are warmer, but the higher valleys of the Serra do Mar enjoy a delightfully temperate climate. The rainfall throughout this region is abundant, except in northern Minas Geraes, where the climatic conditions are influenced to some extent by the arid eastern plateau. South of São Paulo the tablelands of Paraná, Santa Catharina and Rio Grande do Sul enjoy a temperate climate, with an abundant rainfall. There are occasional frosts, but snow is never seen. Of Goyaz and Matto Grosso very little can be said. The lower river valleys of the Tocantins-Araguaya, Xingú, Tapajós and Paraguay are essentially tropical, their climate being hot and humid like that of the Amazon. The higher valleys of the Paraná and its tributaries, and of the rivers which flow northward, are sub-tropical

in character, having high sun temperatures and cool nights. Above these, the *chapadas* lie open to the sun and wind and have a cool, bracing atmosphere even where high sun temperatures prevail. The mean annual temperature at Goyaz (city), according to a limited number of observations, is about 77°. There is no absolutely dry season in this part of the great Brazilian plateau, though the year is customarily divided into a dry and wet season, the latter running from September to April in Goyaz, and from November to April in Matto Grosso. The prevailing winds are from the north-west in this region, and westerly winds in the rainy season are usually accompanied by rain.

*Fauna.*—The indigenous fauna of Brazil is noteworthy not only for the variety and number of its genera and species, but also for its deficiency in the larger mammals. Of this, one of the best authorities on the subject (H.W. Bates in *The Naturalist on the River Amazons*) says: “Brazil, moreover, is throughout poor in terrestrial mammals, and the species are of small size.” It is noteworthy, also, for the large number of species having arboreal habits, the density and extent of the Amazon forests favouring their development rather than the development of those of terrestrial habits. Of Quadrumana there are about fifty species in Brazil, all arboreal, thirty-eight of which inhabit the Amazon region. They belong mostly to the *Cebidae* family, and are provided with prehensile tails. The Carnivora are represented by six species of the *Felidae*, the best known of which is the onça, or jaguar (*F. onça, L.*), and the cougar, or puma (*F. concolor*); three species of the *Canidae*, the South American wolf (*C. jubatus*), and two small jackals (*C. brasiliensis* and *C. vetulus*); and a few species of the Mustelina including two of the otter, two *Galictis* and one *Mephitis*. Of the plantigrades, Brazil has no bears, but has the related species of raccoon (*Nasua socialis* and *N. solitaria*), popularly called *coatis*. The opossum (*Didelphis*) is represented by three or four species, two of which are so small that they are generally called wood rats. The rodents are numerous and include several peculiar species. Only one species of hare is found in Brazil, the *Lepus brasiliensis*, and but one also of the squirrel (*Scyurus*). Of the amphibious rodents, the prêá (*Cavia aperea*), mocó (*C. rupestris*), paca (*Coelogenys paca*), cutia (*Dasyprocta aguti*) and capybara (*Hydrochoerus capybara*) are noteworthy for their size and extensive range. Their flesh is used as an article of food, that of the paca being highly esteemed. Of the Muridae there are several genera and a large number of species, some of them evidently importations from the Old World. Brazil has three groups of animals similar to the common rat—the *Capromydae*, *Loncheridae* and *Psammoryctidae*—the best known of which is the “tuco-tuco” (*Clenomys brasiliensis*), a small burrowing animal of Rio Grande do Sul which excavates long subterranean galleries and lives on roots and bulbs. One of the characteristic orders of the Brazilian fauna is that of the Edentata, which comprises the sloth, armadillo and ant-eater. These animals are found only in the tropical regions of South America. The range of the sloth is from the Guianas south into Minas Geraes, the armadillo as far south as the Argentine pampas and the ant-eater from the Amazon south to Paraguay, though it is found in the Amazon region principally. The sloth (*Bradypus*) is an arboreal animal which feeds almost exclusively on the foliage of the Cecropias. It includes two recognized genera and half a dozen species, the best known of which is *B. didactylus*. The common name in Brazil is *preguiça*, which is equivalent to its English name. Of armadillos, commonly called *tatú* in Brazil, the largest species is the *Dasypus gigas*, but the best known is the *tatú-été* (*D. octocinctus*), which is highly esteemed for its flesh. The ant-eaters (*Myrmecophaga*) are divided into three or four species, one of which (*M. jubata*) is exclusively terrestrial, and the others arboreal. The popular name for the animal is *tamanduá*. The *M. jubata*, or *tamanduá bandeira*, is sometimes found as far south as Paraguay. Of the ruminants, Brazil has only four or five species of *Cervidae*, which are likewise common to other countries of South America. The largest of these is the marsh deer (*C. paludosus*), which in size resembles its European congeners. The others are the *C. campestris*, *C. nemorivagus*, *C. rufus* and a small species or variety called *C. nanus* by the Danish naturalist Dr P.W. Lund. The pachyderms are represented by three species of the peccary (*Dicotyles*) and two of the anta, or tapir (*Tapirus*). The former are found over a wide range of country, extending into Bolivia and Argentina, and are noted for their impetuous pugnacity. The tapir also has an extensive range between the coast and the foothills of the Andes, and from northern Argentina to south-eastern Colombia. It is the largest of the Brazilian mammals, and inhabits densely forested tracts near river courses. The two species are *T. americanus*, which is the larger and best known, and the *anta chure*, found in Minas Geraes, which is said to be identical with the *T. Roulini* of Colombia. Perhaps the most interesting mammal of Brazil is the *manati*, or sea-cow (*Manatus americanus*), which inhabits the lower Amazon and sometimes reaches a length of 15 to 20 ft. It is taken with the harpoon and its oil is one of the commercial products of the Amazon valley.

The avifauna of Brazil is rich in genera, species and individuals, especially in species with brilliantly-coloured plumage. It is estimated that more than half the birds of Brazil are insectivorous, and that more than one-eighth are climbers. The range in size is a wide one—from the tiny humming-bird to the ema, rhea, or American ostrich. Although the order which includes song-birds is numerous in species and individuals, it is noticeably poor in really good songsters. On the other hand it is exceptionally rich in species having strident voices and peculiar unmusical calls, like the *pacô* (*Coracina scuttata*) and the *araponga* (*Chasmorhynchus nudicollis*). Two species of vultures, twenty-three of falcons and eight of owls represent the birds of prey. The best known vulture is the common *urubú* (*Cathartes foetens*, Illig), which is the universal scavenger of the tropics. The climbers comprise a large number of species, some of which, like those of the parrot (*Psittacidae*) and woodpecker (*Picus*), are particularly noticeable in every wooded region of the country. One of the most striking species of the former is the brilliantly-coloured *arara*

(*Macrocercus*, L.), which is common throughout northern Brazil. Another interesting species is the toucan (*Ramphastos*), whose enormous beak, awkward flight and raucous voice make it a conspicuous object in the great forests of northern Brazil. In strong contrast to the ungainly toucan is the tiny humming-bird, whose beautiful plumage, swiftness of flight and power of wing are sources of constant wonder and admiration. Of this smallest of birds there are fifty-nine well-known species, divided into two groups, the *Phaethorninae*, which prefer the forest shade and live on insects, and the *Trochilinae*, which frequent open sunny places where flowers are to be found. One of the Brazilian birds whose habits have attracted much interest is the *João de Barro* (Clay John) or oven bird (*Furnarius rufus*), which builds a house of reddish clay for its nest and attaches it to the branch of a tree, usually in a fork. The thrush is represented by a number of species, one of which, the *sabiá* (*Mimus*), has become the popular song-bird of Brazil through a poem written by Gonçalves Dias. The dove and pigeon have also a number of native species, one of which, the *pomba jurity* (*Peristera frontalis*), is a highly-appreciated table luxury. The gallinaceous birds are well represented, especially in game birds. The most numerous of these are the *perdiz* (partridge), the best known of which is the *Tinamus maculosa* which frequents the *campos* of the south, the *inhambú* (*Crypturus*), *capoeira* (*Odontophorus*), and several species of the penelope family popularly known as the *jacutinga, jacú* and *jacú-assú*. The common domesticated fowl is not indigenous. Among the wading and running birds, of which the *ema* is the largest representative, there are many species of both descriptions. In the Amazon lowlands are white herons (*Ardea candidissima*), egrets (*A. egretta*), bitterns (*A. exilis*), blue herons (*A. herodias*) scarlet ibises (*Ibis rubra*), roseate spoonbills (*Platalea ajaja*); on higher ground the beautiful peacock heron (*A. helias*) which is easily domesticated; and on the dry elevated *campos* the *ceriema* (*Dicholophus cristatus*) which is prized for its flesh, and the *jacamin* (*Psophia crepitans*) which is frequently domesticated. Prominent among the storks is the great black-headed white crane, called the *jaburú* (*Mycteria americana*), which is found along the Amazon and down the coast and grows to a height of 4½ ft. Of the swimmers, the number of species is smaller, but some of them are widely distributed and numerous in individuals. There are but few species of ducks, and they are apparently more numerous in southern Brazil than on the Amazon.

The reptilian fauna exhibits an exceptionally large number of interesting genera and species. A great part of the river systems of the country with their flooded areas are highly favourable to the development of reptilian life. Most prominent among these is the American alligator, of which there are, according to Netterer, two genera and eight species in Brazil. They are very numerous in the Amazon and its tributaries and in the Paraguay, and are found in all the rivers of the Atlantic coast. Three of the Brazilian species are voracious and dangerous. The largest of the Amazon species are the *jacaré-assú* (*Caïman niger*), *jacaré* (*C. fissipes*) and *jacaré-tinga* (*C. sclerops*). The Amazon is also the home of one of the largest fresh-water turtles known, the *Emys amazonica*, locally called the *jurará-assú* or *tartaruga grande*. These turtles are so numerous that their flesh and eggs have long been a principal food supply for the Indian population of that region. Another Amazon species, the *E. tracaxa*, is still more highly esteemed for its flesh, but it is smaller and deposits fewer eggs in the sandy river beaches. Lagartos (*Iguanas*) and lizards are common everywhere. The ophidians are also numerous, especially in the wooded lowlands valleys, and the poisonous species, though less numerous than others, include some of the most dangerous known—the rattlesnake *surucucú* (*Lachesis rhombeatus*), and *jararáca* (*Bothrops*). The Amazon region is frequented by the *giboia* (boa constrictor), and the central plateau by the *sucuriú* (*Eunectes murinus*), both distinguished for their enormous size. The batrachians include a very large number of genera and species, especially in the Amazon valley.

The fauna of the rivers and coast of Brazil is richer in species and individuals than that of the land. All the rivers are richly stocked, and valuable fishing grounds are to be found along the coast, especially that of southern Bahia and Espirito Santo where the *garoupa* (*Serranus*) is found in large numbers. Some of the small fish along the coast are highly esteemed for their flavour. Whales were once numerous between Capes St Roque and Frio, but are now rarely seen. Of the edible river fish, the best known is the *pirarucú* (*Sudis gigas*), a large fish of the Amazon which is salted and dried for market during the low-water season. Fish is a staple food of the Indian tribes of the Amazon region, and their fishing season is during the period of low water. The visit of Professor Louis Agassiz to the Amazon in 1865 resulted in a list of 1143 species, but it is believed that no less than 1800 to 2000 species are to be found in that great river and its tributaries.

In strong contrast to the poverty of Brazil in the larger mammals is the astonishing profusion of insect life in every part of the country. The Coleoptera and Lepidoptera are especially numerous, both in species and individuals. A striking illustration of this extraordinary profusion was given by the English naturalist H.W. Bates, who found 7000 species of insects in the vicinity of only one of his collecting places on the Amazon (Ega), of which 550 species were of butterflies. Within an hour’s walk of Pará are to be found, he says, about 700 species of butterflies, “whilst the total number found in the British Islands does not exceed 66, and the whole of Europe supports only 321.” (H.W. Bates, *The Naturalist on the River Amazons*.) One of the rare species of the Amazon *Morphos* (*M. hecuba*) measures 8 to 9 in. across its expanded wings. Dipterous insects are also very numerous in species, especially in those of sanguinary habits, such as the mosquito, *pium*, *maroim*, *carapanã*, *borochudo*, &c. In some places these insects constitute a veritable plague, and the infested regions are practically uninhabitable. The related species of the *Oestridae* family, which include the widely disseminated *chigoe* or *bicho do pé* (*Pulex penetrans*), and the equally

troublesome *berne* (*Cutiterebra noxialis*), which is so injurious to animals, are equally numerous. The most numerous of all, however, and perhaps the most harmful to civilized man, are the termites and ants, which are found everywhere in the uninhabited campo and forest regions, as well as in the cultivated districts. Nature has provided several species of animals, birds and reptiles, to feed upon these insects, and various poisonous and suffocating compounds are used to destroy them, but with no great degree of success. It is not uncommon to find once cultivated fields abandoned because of their ravages and to see large *campos* completely covered with enormous ant-hills. The termites, or "white ants," are exceptionally destructive because of their habit of tunnelling through the softer woods of habitations and furniture, while some species of ants, like the *saúba*, are equally destructive to plantations because of the rapidity with which they strip a tree of its foliage. Spiders are represented by a very large number of species, some of which are beautifully coloured. The largest of these is the *Mygale* with a body 2 in. in length and outstretched legs covering 7 in., a monster strong enough to capture and kill small birds. A large *Mygale* found on the island of Siriba, of the Abrolhos group, feeds upon lizards, and has been known to attack and kill young chickens. One of the most troublesome pests of the interior is a minute degenerate spider of the genus *Ixodes*, called *carrapato*, or bush-tick, which breeds on the ground and then creeps up the grass blades and bushes where it waits for some passing man or beast. Its habit is to bury its head in its victim's skin and remain there until gorged with blood, when it drops off. Scorpions are common, but are considered less poisonous than some European species.

*Flora.*—Brazil not only is marvellously rich in botanical species, but included at the beginning of the 20th century the largest area of virgin forest on the surface of the earth. The flora falls naturally into three great divisions: that of the Amazon basin where exceptional conditions of heat and moisture prevail; that of the coast where heat, varying rainfall, oceanic influences and changing seasons have greatly modified the general character of the vegetation; and that of the elevated interior, or *sertão*, where dryer conditions, rocky surfaces, higher sun temperatures and large open spaces produce a vegetation widely different from those of the other two regions. Besides these, the flora of the Paraguay basin varies widely from that of the inland plateau, and that of the Brazilian Guiana region is essentially distinct from the Amazon. The latter region is densely forested from the Atlantic to the Andes, but with a varying width of about 200 m. on the coast to about 900 m. between the Bolivian and Venezuelan *llanos*, and thus far civilization has made only a very slight impression upon it. Even where settlements have been located, constant effort is required to keep the vegetation down. Along the coast, much of the virgin forest has been cut away, not only for the creation of cultivated plantations, but to meet the commercial demand for Brazil-wood and furniture woods.

The chief characteristic of the Amazonian forest, aside from its magnitude, is the great diversity of genera and species. In the northern temperate zone we find forests of a single species, others of three or four species; in this great tropical forest the habit of growth is solitary and an acre of ground will contain hundreds of species—palms, myrtles, acacias, mimosas, cecropias, euphorbias, malvaceas, laurels, cedrellas, bignonias, bombaceas, apocyneas, malpigias, lecythises, swartzias, &c. The vegetation of the lower river-margins, which are periodically flooded, differs in some particulars from that of the higher ground, and the same variation is to be found between the forests of the upper and lower Amazon, and between the Amazon and its principal tributaries. The density of the forest is greatly augmented by the *cipós*, or lianas, which overgrow the largest trees to their tops, and by a profusion of epiphytes which cover the highest branches. As a rule the trees of the Amazon forest are not conspicuously high, a few species rarely reaching a height of 200 ft. The average is probably less than one-half that height. This is especially true of the flood plains where the annual inundations prevent the formation of humus and retard forest growth. The largest of the Amazon forest trees are the *massaranduba* (*Mimusops elata*), called the cow-tree because of its milky sap, the *samaúma* (*Eriodendron samauma*) or silk-cotton tree, the *páu d' arco* (*Tecoma speciosa*), *páu d' alho* (*Catraeva tapia*), *bacori* (*Symphonea coccinea*), *sapucaia* (*Lecythis ollaria*), and *castanheira* or brazil-nut tree (*Bertholletia excelsa*). The Amazon region has a comparatively narrow frontage on the Atlantic. In Maranhão, which belongs to the coast region, open spaces or *campos* appear, though the state is well wooded and its forests have the general characteristics of the lower Amazon. South-east of the Parnahyba the coast region becomes dryer and more sandy and the forests disappear. The coast and tide-water rivers are fringed with mangrove, and the sandy plain reaching back to the margin of the inland plateau is generally bare of vegetation, though the carnahuba palm (*Copernicia cerifera*) and some species of low-growing trees are to be found in many places. The higher levels of this plain are covered with shrubs and small trees, principally mimosas. The slopes of the plateau, which receive a better rainfall, are more heavily forested, some districts being covered with deciduous trees, forming *catingas* in local parlance. This dry, thinly-wooded region extends south to the states of Parahyba, where a more regular rainfall favours forest growth nearer the coast. Between Parahyba and southern Bahia forests and open plains are intermingled; thence southward the narrow coastal plain and bordering mountain slopes are heavily forested. The sea-coast, bays and tide-water rivers are still fringed with mangrove, and on the sandy shores above Cape Frio grow large numbers of the exotic cocoa-nut palm. Many species of indigenous palms abound, and in places the forests are indescribably luxuriant. These are made up, as Prince Max zu Neuwied found in southern Bahia in 1817, "of the genera *Cocos*, *Melastoma*, *Bignonia*, *Rhexia*, *Mimosa*, *Ingá*, *Bombax*, *Ilex*, *Laurus*, *Myrthus*, *Eugenia*, *Jacarandá*,

*Jatropha*, *Visinia*, *Lecythis*, *Ficus*, and a thousand other, for the most part, unknown species of trees." Further inland the higher country becomes more open and the forests are less luxuriant. Giant cacti and spiny scrub abound. Then come the *catinga* tracts, and, beyond these, the open *campos* of the elevated plateau, dotted with clumps of low growing bushes and broken by tracts of *carrasco*, a thick, matted, bushy growth 10 to 12 ft. in height. Formerly this coast region furnished large quantities of Brazil-wood (*Caesalpinia echinata*), and the river valleys have long been the principal source of Brazil's best cabinet-wood—rosewood (*Dalbergia nigra*), jacarandá (*Machaeriumfirmum*, Benth.), vinhatico (*Plathymenia foliosa*, Benth.), peroba (*Aspidosperma peroba*), cedro, &c. The exotic *mangabeira* (mango) is found everywhere along the coast, together with the bamboo, orange, lemon, banana, cashew, &c.

Of the great inland region, which includes the arid campos of the north, the partially-wooded plateaus of Minas Geraes, Goyaz and Matto Grosso, the temperate highlands of the south, and the tropical lowlands of the Paraguay basin, no adequate description can be given without taking each section in detail, which can be done to better advantage in describing the individual states. In general, the *carrasco* growth extends over the whole central plateau, and heavy forests are found only in the deep river valleys. Those opening northward have the characteristic flora of the Amazon basin. The Paraguay basin is covered with extensive marshy tracts and open woodlands, the palms being the conspicuous feature. The vegetation is similar to that of Paraguay and the Chaco, and aquatic plants are specially numerous and luxuriant. On the temperate uplands of the southern states there are imposing forests of South American pine (*Araucaria brasiliensis*), whose bare trunks and umbrella-like tops give to them the appearance of open woodland. These forests extend from Paraná into Rio Grande do Sul and smaller tracts are also found in Minas Geraes. Large tracts of *Ilex paraguayensis*, from which *maté*, or Paraguay-tea, is gathered, are found in this same region.

The economic plants of Brazil, both indigenous and exotic, are noticeably numerous. Coffee naturally occupies first place, and is grown wherever frosts are not severe from the Amazon south to Paraná. The states of São Paulo, Rio de Janeiro and Minas Geraes are the largest producers, but it is also grown for export in Espirito Santo, Bahia and Ceará. The export in 1905 was 10,820,604 bags of 132 lb each, with an official valuation of £21,420,330. Sugar cane, another exotic, has an equally wide distribution, and cotton is grown along the coast from Maranhão to São Paulo. Other economic plants and fruits having a wide distribution are tobacco, maize, rice, beans, sweet potatoes, bananas, cacáo (*Theobroma cacao*), mandioca or cassava (*Manihot utilitissima*), *aipim* or sweet mandioca (*M. aipi*), guavas (*Psidium guayava*, Raddi), oranges, lemons, limes, grapes, pineapples, *mamão* (*Carica papaya*), bread-fruit (*Artocarpus incisa*), jack fruit (*A. integrifolia*), and many others less known outside the tropics. Among the palms there are several of great economic value, not only as food producers but also for various domestic uses. The fruit of the *pupunha* or peach palm (*Guilielma speciosa*) is an important food among the Indians of the Amazon valley, where the tree was cultivated by them long before the discovery of America. Humboldt found it among the native tribes of the Orinoco valley, where it is called *pirijao*. The ita palm, *Mauritia*, *flexuosa* (a fan-leaf palm) provides an edible fruit, medullary meal, drink, fibre, roofing and timber, but is less used on the Amazon than it is on the lower Orinoco. The *assaí* (*Euterpe oleracea*) is another highly-prized palm because of a beverage made from its fruit along the lower Amazon. A closely-related species or variety (*Euterpe edulis*) is the well-known palmito or cabbage palm found over the greater part of Brazil, whose terminal phylophore is cooked and eaten as a vegetable. Another highly useful palm is the *carnauba* or *carnahuba* (*Copernicia cerifera*) which supplies fruit, medullary meal, food for cattle, boards and timber, fibre, wax and medicine. The fibre of the *piassava (Leopoldinia piassava*, or *Attalea funifera*) is widely used for cordage, brushes and brooms. There are many other palms whose fruit, fibre and wood enter largely into the domestic economy of the natives, but the list given shows how important a service these trees rendered to the aboriginal inhabitants of tropical America, and likewise how useful they still are to the people of tropical Brazil. Another vegetable product of the Amazon region is made from the fruit of the *Paullinia sorbilis*, Mart., and is known by the name of *guaraná*. It is largely consumed in Bolivia and Matto Grosso, where it is used in the preparation of a beverage which has excellent medicinal properties. The Brazilian flora is also rich in medicinal and aromatic plants, dye-woods, and a wide range of gum and resin-producing shrubs and trees. The best known of these are sarsaparilla, ipecacuanhá, cinchona, jaborandi and copaiba; vanilla, tonka beans and cloves; Brazil-wood and anatto (*Bixa orellana*); india-rubber and balata. India-rubber is derived principally from the *Hevea guayanensis*, sometimes called the *Siphonia elastica*, which is found on the Amazon and its tributaries as far inland as the foothills of the Andes. Other rubber-producing trees are the *maniçoba* (*Jatropha Glasiovii*) of Ceará, and the *mangabeira* (*Hancornia speciosa*), of the central upland regions.

*Population.*—The first explorers of Brazil reported a numerous Indian population, but, as the sea-coast afforded a larger and more easily acquired food supply than did the interior, the Indian population was probably numerous only in a comparatively small part of this immense territory, along the sea-coast. Modern explorations have shown that the unsettled inland regions of Brazil are populated by Indians only where the conditions are favourable. They are to be found in wooded districts near rivers, and are rarely found on the elevated *campos*. The immediate result of European colonization was the enslavement and extermination of the Indians along the coast and in all those favoured inland localities where the whites came into contact with them. The

southern districts and the Amazon and its tributaries were often raided by slave-hunting expeditions, and their Indian populations were either decimated, or driven farther into the inaccessible forests. But there is no record that the inland districts of western and north-western Brazil were treated in this manner, and their present population may be assumed to represent approximately what it was when the Europeans first came. According to the census of 1890 the Indian population was 1,295,796, but so far as the migratory tribes are concerned the figures are only guesswork. A considerable number of these Indians have been gathered together in *aldeas* under the charge of government tutors, but the larger part still live in their own villages or as nomads.

Down to the beginning of the 19th century the white colonists were almost exclusively Portuguese. The immigration from countries other than Portugal during the first half of that century was small, but before its close it increased rapidly, particularly from Italy. Fully nine-tenths of these immigrants, including those from the mother country, were of the Latin race. The introduction of African slaves followed closely upon the development of agricultural industries, and continued nominally until 1850, actually until 1854, and according to some authors until 1860. About 1826 it was estimated that the negro population numbered 2,500,000 or three times the white population of that period. The unrestricted intermixture of these three races forms the principal basis of the Brazilian population at the beginning of the 20th century. Brazil has never had a “colour line,” and there has never been any popular prejudice against race mixtures. According to the census of 1872 the total population was 9,930,478, of which 1,510,806 were slaves; the race enumeration gave 3,787,289 whites, 1,959,452 Africans, 386,955 Indians, and 3,801,782 mixed bloods. The Indian population certainly exceeded the total given, and the white population must have included many of mixed blood, the habit of so describing themselves being common among the better classes of South American mestizos. The census of 1890 increased the total population to 14,333,915, which, according to an unofficial analysis (*Statesman’s Year Book*, 1905), was made up of 6,302,198 whites, 4,638,495 mixed bloods, 2,097,426 Africans, and 1,295,796 Indians. This analysis, if correct, indicates that the vegetative increase of the whites has been greater than that of the Africans and mixed races. This is not the conclusion of many observers, but it may be due to the excessive infant mortality among the lower classes, where an observance of the simplest sanitary laws is practically unknown. The census of the 31st of December 1900 was strikingly defective; it was wholly discarded for the city of Rio de Janeiro, and had to be completed by office computations in the returns from several states. The compilation of the returns was not completed and published until May 1908, according to which the total population was 17,318,556, of which 8,825,636 were males and 8,492,920 females. Not including the city of Rio de Janeiro, whose population was estimated at 691,565 in conformity with a special municipal census of 1906, the total population was 16,626,991, of which 15,572,671 were Roman Catholics, 177,727 Protestants, 876,593 of other faiths. The returns also show a total of 3,038,500 domiciles outside the federal capital, which gives an average of 5.472 to the domicile. These returns will serve to correct the exaggerated estimate of 22,315,000 for 1900 which was published in Brazil and accepted by many foreign publications.



The racial character of the people is not uniform throughout the republic, the whites predominating in the southern states, the Indians in Amazonas and, probably, Matto Grosso, and the mixed races in the central and northern coast states. The excess of whites over the coloured races in the southern states is due to their smaller slave population and to the large number of immigrants attracted to them. Slavery was not abolished until the 13th of May 1888, but a number of successful colonies had already been founded in these states. Other colonies were founded in Bahia, Espirito Santo and Rio de Janeiro during the same period, but they were unsuccessful, partly because of the competition of slave labour. Since the abolition of slavery immigration has poured a large number of labourers into the coffee-producing states, and with beneficial results. This strengthening of the white population of the South with fresh European blood must eventually divide Brazil into two distinct sections: the white states of the south, and the mixed or coloured states of the north. The introduction of European immigrants dates from 1818 when a Swiss colony was located at Nova Friburgo, near Rio de Janeiro, and it was continued under the direction and with the aid of the imperial government down to the creation of the republic. Since then the state governments have assumed charge of immigration, and some of them are spending large sums in the acquisition of labourers. The old system of locating immigrants in colonies, or colonial nuclei, which involved an enormous outlay of money with but slight benefit to the country, has been superseded by a system of locating the immigrants on the large plantations under formal contracts. In some of the coffee districts these contracts have resulted very profitably to the Italian labourers. The total number of colonists and immigrants entering Brazil between 1804 and 1902, inclusive, according to official returns, was 2,208,353. The arrivals fluctuate greatly in number from year to year, influenced by the prevailing economic conditions in the country. At first the Portuguese outnumbered all other nationalities in the immigration returns, but since the abolition of slavery the Italians have passed all competitors and number more than one-half the total arrivals. Of the 700,211 immigrants located in the state of São Paulo from 1827 to the end of 1896, no less than 493,535 were Italians, and their aggregate throughout the republic was estimated in 1906 at more than 1,100,000. The German

immigration, of which so much has been written for political ends, has been greatly over-estimated; trustworthy estimates in 1906 made the German contingent in the population vary from 350,000 to 500,000. They are settled chiefly in colonies in the southern states, and form a most desirable body of settlers.

*Divisions and Towns.*—The republic is divided into twenty states and one federal district, which are the same as the provinces and "municipio neutro" of the empire. Their names also remain unchanged, except that of the federalized district in which the national capital is located, which is called the "districto federal." The republic has no territories, although Amazonas, Matto Grosso, Pará and Goyaz cover an immense region of uninhabited and only partially explored territory. The states are subdivided into *comarcas*, or judicial districts, and into *municipios*, or townships, which is the smallest autonomous division. The constitution provides for the autonomy of the municipalities in order to safeguard the permanence of representative institutions. The *parochia*, or parish, an ecclesiastical division, is often used for administrative purposes, but it has no political organization. The names, areas, and populations of the states, together with the names and populations of their capitals, are as follows:—

| States. | Area,[1] Sq. miles. | Population[2] | | State Capitals. | Population,[3] Census 1890. |
|---|---|---|---|---|---|
| | | Census 1890. | Census 1900. | | |
| Alagôas | 22,584 | 511,440 | 649,273 | Maceió | 31,498 |
| Amazonas | 742,123 | 147,915 | 249,756 | Manáos | 38,720 |
| Bahia | 164,650 | 1,919,802 | 2,117,956 | São Salvador[4] | 174,412 |
| Ceará | 40,253 | 805,687 | 849,127 | Fortaleza | 40,902 |
| Espirito Santo | 17,313 | 135,997 | 209,783 | Victoria | 16,887 |
| Federal District | 538 | 522,651 | 691,565 | Rio de Janeiro | 522,651 |
| Goyaz | 288,549 | 227,572 | 255,284 | Goyaz[4] | 17,181 |
| Maranhão | 177,569 | 430,854 | 499,308 | S. Luiz do Maranhão[4] | 29,308 |
| Matto Grosso | 532,370 | 92,827 | 118,025 | Cuyabá | 17,815 |
| Minas Geraes | 221,961 | 3,184,099 | 3,594,471 | Ouro Preto[5] | 59,249 |
| Pará | 443,922 | 328,455 | 445,356 | Belem[4] | 50,064 |
| Parahyba | 28,855 | 457,232 | 490,784 | Parahyba | 18,645 |
| Paraná | 85,455 | 249,491 | 327,136 | Curityba | 24,553 |
| Pernambuco | 49,575 | 1,030,224 | 1,178,150 | Recife[4] | 111,556 |
| Piauhy | 116,529 | 267,609 | 334,328 | Therezina | 31,523 |
| Rio de Janeiro | 26,635 | 276,884\| | 274,317 | Nictheroy | 34,269 |
| Rio Grande do Norte | 22,196 | 268,273 | 1,149,070 | Natal | 13,725 |
| Rio Grande do Sul | 91,337 | 897,455 | 926,035 | Porto Alegre | 52,421 |
| Santa Catharina | 28,633 | 283,769 | 320,289 | Desterro[6] | 30,637 |
| São Paulo | 112,312 | 1,384,753 | 2,282,279 | São Paulo | 64,934 |
| Sergipe | 15,093 | 310,926 | 356,264 | Ararajú | 16,336 |
| Brazil | 3,228,452 | 14,333,915 | 17,318,556 | | |

*Communications.*—Railway construction in Brazil dates from 1852, when work was initiated on the Mauá railway running from the head of the bay of Rio de Janeiro to the foot of the Serra where Petropolis is situated. The road is 10 m. long, and its first section was opened to traffic on April 30, 1854, and its second December 16, 1856. The mountain section, 5½ m. long, which uses the Riggenbach system from the terminal to Petropolis, was constructed between 1881 and 1883. The development of railway construction in Brazil has been impeded to a great extent by two unfavourable conditions—by the chain of mountains or plateau escarpments which follow the coast line and obstruct communication with the interior, and by the detached positions of the settlements along the Atlantic, which compel the building of lines from many widely separated points on the coast into a sparsely populated hinterland. A majority of the ports, from which these roads are built, are small and difficult of access, and the coasting trade is restricted to vessels carrying the Brazilian flag. The only ports having a rich and well-populated country behind them are Rio de Janeiro and Santos, and these are the terminals of long lines of railway which are being slowly extended farther into the interior.



The total mileage under traffic at the beginning of 1905 was 10,600 m., divided into 94 separate lines. There were also 745 m. under construction, 1740 m. under survey, and about 1600 m. projected. Of the 94 lines under traffic, 45 were operating by virtue of national and 49 by provincial and state concessions. They were grouped in the official reports of 1905 as follows:—

| | Miles. | |
|---|---|---|
| Government lines (21):— | | |
| Administered by the state (6) | 2228 | |
| Leased to private parties (15) | 2174 | |
| | —— | 4402 |
| Private lines (24)— | | |
| With national interest guarantees (12) | 1290 | |
| Without such guarantees (12) | 815 | |

| | |
|---|---|
| —— | 2105 |
| Private and state lines operated by virtue of state concessions, with and without interest guarantees (49) | 4093 |
| ——— | |
| | 10,600 |
| | ====== |

The policy of the national government has been gradually to lease all its lines except the Estrada de Ferro Central do Brazil, which is retained for sentimental reasons. This great railway runs from the city of Rio de Janeiro westward to the city of São Paulo and northward into the interior of Minas Geraes, with a total length at the beginning of 1905 of 1002 m., and an extension of about 104 m. to Pirapora, on the São Francisco river. It was formerly known as the "E. de F. Dom Pedro II.," in honour of the sovereign who encouraged its construction. The main line has a gauge of 63 in. (1.60 m.) and affords an outlet for a number of inland metre-gauge lines. The first two sections of this great railway, which carry it across the coast range, were opened to traffic in 1858 and 1864. The series of trunk lines terminating at the port of Santos are owned by private companies and are formed by the São Paulo, Paulista and Mogyana lines, the first owned by an English company, and the other two by Brazilian companies. The Mogyana carries the system entirely across the state of São Paulo into the western districts of Minas Geraes. The principal trunk lines (the São Paulo and Paulista) have a broad gauge, while their extensions and feeders have a narrow gauge. The comparatively short lines extending inland from the ports of São Salvador (Bahia), Pernambuco, Maceió, Victoria and Paranaguá serve only a narrow zone along the coast. To encourage the investment of private capital in the construction of railways, the general railway law of 1853 authorized the national government to grant guarantees of interest on the capital invested. Under this law companies were organized in England for building the São Paulo railway, and the lines running from Bahia and Pernambuco toward the São Francisco river. Political considerations also led to the construction of similar lines in the states of Rio Grande do Norte, Parahyba, Alagôas, Sergipe, Espirito Santo, Paraná, Santa Catharina and Rio Grande do Sul. The result was that the national treasury became burdened with a heavy annual interest charge, payable abroad in gold, which did not tend to diminish, and had a long period to run before the expiration of the contracts. The government finally determined to take over these guaranteed lines from the foreign companies owning them, and a statement issued in October 1902 showed that 1335 m. had been acquired at a cost of £14,605,000 in bonds, the interest on which is £584,200 a year against an aggregate of £831,750 in interest guarantees which the government had been paying. In addition to this economy it was calculated that the lines could be leased for £132,000 a year. The loan finally issued in London to cover the purchase of these railways aggregated £16,619,320. All but three of these lines had been leased in 1905.

The use of tramways for the transportation of passengers in cities dates from 1868, when the first section of the Botanical Garden line of Rio de Janeiro was opened to traffic. The line was completed with its surplus earnings and continued under the control of the American company which built it until 1882, when it was sold to a Brazilian company. Subsequently the tramways of the city have been mostly concentrated in the hands of a single Canadian company. All the large cities of Brazil are liberally provided with tramways, those of the city of São Paulo, where electric traction is used, being noticeably good. The substitution of electricity for animal traction was begun in São Salvador in 1906. Mules are universally employed for animal traction, and narrow gauge lines with single-mule trams are generally used where the traffic is light.

Brazil is lamentably deficient in steamship communication considering its importance in a country where the centres of population are separated by such distances of coasts and river. Previous to the creation of the republic, the coastwise service was performed by two national companies (now united), and partially by foreign lines calling at two or more ports. A considerable number of foreign sailing vessels also carried on an important coasting trade. The coastwise service centres at Rio de Janeiro, from which port the Lloyd Brazileiro sends steamers regularly south to Montevideo, and north to Pará and Manáos, calling at the more important intermediate ports. From Montevideo river steamers are sent up the Paraná and Paraguay rivers to Corumbá and Cuyabá, in the state of Matto Grosso. The company receives a heavy subsidy from the national government. Parts of this coastwise traffic are covered by other companies, two of which receive subsidies. There were also six lines of river steamers receiving subsidies from the national government in 1904, and the aggregate paid to these and the coastwise lines was 2,830,061 milreis. The largest of the river lines is the Amazon Steam Navigation Co. (an English corporation), whose service covers the main river and several of its principal tributaries. Two subsidized companies maintain services on the São Francisco river—one below the Paulo Affonso falls, and the other above, the latter covering 854 m. of navigable channel between Joazeiro and Pirapora. Besides these there are other companies engaged in the coasting and river traffic, either with subsidies from the state governments, as feeders for railway lines, or as private unsubsidized undertakings.

The telegraph lines, which date from 1852, are owned and operated by the national government, with the exception of the lines constructed by private railway companies, and the cable lines of the Amazon and the coast. The government lines extend from Pará to the Argentine

and Uruguayan frontiers, where they connect with the telegraph systems of those republics, and from Rio de Janeiro westward across country, in great part unsettled, to the capitals of Goyaz and Matto Grosso. At Pará connexion is made with the cable laid in the bed of the Amazon to Manáos, which is owned and operated by a subsidized English company. At Vizeu, Pará, connexion is made with a French cable to the West Indies and the United States, and at Pernambuco with two cable lines to Europe. A coastwise cable runs from Pará to Montevideo with double cables between Pernambuco and Montevideo. There were in 1903 a total of 15,150 m. of land lines, with 29,310 m. of wire and 1102 telegraph offices. The government maintains reciprocal rates with most of the private railway lines.

The Brazilian postal service is under the general supervision of the minister of communications and public works, and is administered by a director-general. Owing to the size of the country and the sparsely-populated state of a large part of the interior, the transportation of the mails is attended with much difficulty and expense. Although the postal rates are high, the service is not self-sustaining, the receipts for 1904 being 7,018,344 milreis, against a total expenditure of 10,099,545 milreis. There were 2847 post offices (*agencias*), of which 2166 were of the 4th or lowest grade. Brazil is a member of the Postal Union, and like Argentina exacts higher nominal rates of postage upon outgoing mail than those agreed upon to cover the depreciation in her own currency. The letter rate was at first 200 reis (nearly 5½ d.), but it has been increased to 300 reis, which is equivalent to 8 d. at par and 4½ d. at 15 d. exchange. An inland parcel post was in operation long before the overthrow of the monarchy, and a similar service with Portugal has been successfully maintained for a number of years, notwithstanding the difficulties interposed by customs regulations. National and international money order systems are also in operation.

The constitution of Brazil provides that the coastwise trade shall be carried on by national vessels, but this provision did not go into effect until 1896. And even then, because of the insufficient number of Brazilian vessels it was provided in the regulations that foreign vessels could be enrolled in that trade by using the Brazilian flag and employing a certain proportion of Brazilians on the crew. One of the purposes of this restrictive provision was that of creating a national merchant marine, but the disinclination of Brazilians for maritime pursuits has been a serious obstacle to its realization. In 1901 the merchant navy included 228 steamers of 91,465 tons net, and 343 sailing vessels of 76,992 tons net. These vessels are all engaged in the coasting and river trade of the country. Efforts have been made, however, to engage in foreign trade, and subsidies were offered for a passenger and freight service to the United States. On the 23rd of February 1906 the government completed a new contract with the Lloyd Brazileiro Company for its coastwise and river service, and included clauses providing for a line to the United States. This foreign service (monthly) began in August 1906.

Although the coast of Brazil shows a large number of bays and tide-water river channels which are apparently suitable for commercial ports, a close examination of them reduces the number of good ports to less than a dozen. The others are either difficult of access, or are rendered practically useless by dangerous reefs, sand bars and shoals. Important improvements have been undertaken in some of these ports. Those at Santos and Manáos, for example, have produced good results. In many cases, as at Rio de Janeiro, Santos and Manáos, the cost and maintenance of the new port-works are met by an additional tax on merchandise, though the immediate expenditures are met by advances from the national treasury, and at Rio de Janeiro by a foreign loan.

*Commerce.*—The imports, exports and domestic trade of Brazil are by reason of their magnitude and peculiar character the most important in South America, though the *per capita* aggregate is less than that of Argentina. Although an agricultural country, Brazil does not produce all its own bread and meat, and the imports of wheat, wheat flour, rice, fish, jerked beef and preserved meats, lard, butter, beans, potatoes, packed fruits and vegetables, Indian corn and other food-stuffs, are surprisingly large. Since the creation of the republic, extreme protective measures have caused the creation of a large number of cotton factories and other manufactures, but these are able to supply only a part of the consumption, and the importation of cotton and woollen fabrics, silks, ready-made clothing, boots and shoes, &c., is large. Modern industrial development in some of the states has greatly increased the importation of machinery, electric supplies, materials for construction, coal, &c. Kerosene oil also figures among the principal imports, and beef cattle are imported for consumption by some cities. The exports cover a wide range of agricultural, pastoral and natural productions, including coffee, rubber, sugar, cotton, cocoa, Brazil nuts, *maté* (Paraguay tea), hides, skins, fruits, gold, diamonds, manganese ore, cabinet woods and medicinal leaves, roots and resins. Coffee and rubber, however, represent from 80 to 90% of the official valuation of all exports. High import duties are imposed by the national government and export duties by the states. The exchange of domestic products between the states is greatly restricted through lack of cheap transportation facilities, and by the suicidal imposition of import and export duties by the states, either for revenue or for the protection of home industries.



According to a summary for the six years 1901 to 1906, derived from official sources and published in the annual *Retrospecto* of the *Jornal do Commercio*, of Rio de Janeiro, the values of the imports and exports for those years (exclusive of coin), reduced to pounds sterling at the average rate of exchange (or value of one milreis) for each year, were as follows:—

| Year. | Average Value of the Milreis in Pence. | Imports in Pounds Ster. | Exports in Pounds Ster. |
|---|---|---|---|
| | | £ | £ |
| 1901 | 11.33 | 21,377,270 | 40,621,993 |
| 1902 | 11.93 | 23,279,418 | 36,437,456 |
| 1903 | 11.99 | 24,207,811 | 36,883,175 |
| 1904 | 12.22 | 25,915,423 | 39,430,136 |
| 1905 | 15.94 | 29,830,050 | 44,643,113 |
| 1906 | 16.17 | 33,204,041 | 53,059,480 |

Nearly 76½% of the exports of 1906 were of coffee and rubber, the official valuations of these being: coffee 245,474,525 milreis gold (£27,615,884), and rubber (including maniçoba and mangabeira), 124,941,433 milreis gold (£14,055,911).

Brazil is essentially an agricultural country. No other country has been able to equal Brazil in the production of coffee, and under better labour conditions the country might compete with the foremost in the production of cane sugar, cotton and tobacco. Besides these it might easily excel in producing many of the tropical fruits for which there is a commercial demand. During the colonial period sugar cane was cultivated from Parahyba S. to the vicinity of Santos, and sugar was the principal export of the colony. Before the middle of the 19th century coffee became one of the leading exports, and its cultivation in the states of São Paulo, Rio de Janeiro and Minas Geraes has been so increased since that time that it represents over four-fifths in value of the total export of agricultural produce. The principal sugar-producing states are Alagôas, Sergipe, Pernambuco, Bahia and Rio de Janeiro, and the production is between 200,000 and 300,000 tons, the greater part of which is consumed in the country. Cotton has been widely cultivated since early colonial days, principally in the northern Atlantic states. Tobacco is also widely cultivated, and the product of some states, such as Bahia, Minas Geraes and Goyaz, has a high local reputation for its excellence. Cacáu (cocoa) is cultivated extensively in the Amazon Valley and along the coast as far south as southern Bahia, and forms one of the leading exports. In 1906 São Paulo offered premiums for its cultivation in the state. Rice has been cultivated in places, but without much success, although the quality produced compared favourably with the imported article. Indian corn grows luxuriantly everywhere, but it does not mature well in the humid regions of the Amazon region and the coast. The product of the elevated inland regions is good, but the costs of transportation and the small profits afforded have prevented its extensive cultivation, and it is imported from the La Plata republics for consumption along the coast. Much has been said in regard to the production of wheat, and efforts have been made in various places to promote its cultivation. It was once cultivated in Rio Grande do Sul with some success, and it has been grown in Minas Geraes and São Paulo, but in no case have the returns been sufficient to give it a permanent standing among the productions of the country. The great majority of the people are unused to wheaten bread, using the coarse flour of the mandioca root instead, consequently the demand for wheat and flour is confined to the large cities, which can obtain them from Argentina more cheaply than they can be produced in the country. One of the most common and important productions of Brazil is *mandioca* (*Manihot*), of which there are two well-known species, *M. utilissima* and *M. aipi*. The first named, which is poisonous in its native state, is the *cassava* of Spanish America. From it is made *farinha de mandioca*, which is the bread of the common people of Brazil, and tapioca. The poison is extracted by soaking the bruised or grated roots in water, after which the coarse flour is roasted. Mandioca was cultivated by the natives before the discovery of America, and the wide area over which it has been distributed warrants the conclusion that the discovery of its value as a food and the means of separating its poisonous properties must have occurred at a very remote period. The peanut, or ground-nut (*Arachis hypogaea*), is another widely-cultivated plant, dating from pre-Columbian times. Very little attention has thus far been given to the cultivation of fruit for exportation, the exceptions being bananas for the Argentine and Uruguayan markets, and oranges and pineapples for European markets. The coast region from Ceará to Rio de Janeiro is adapted to the cultivation of a great variety of fruits of a superior quality. Ceará, Bahia, and Rio de Janeiro are celebrated for their oranges, and Pernambuco for its delicious pineapples. Tangerines, lemons, limes, grapes, guavas, figs, cashews or cajús (*Anacardium occidentale*), mangabas (*Hancornia speciosa*), joboticabas (*Eugenia cauliflora* and *E. jaboticaba*, Mart.), cocoa-nuts, mangos, *fruitas de conde* (*Anona squamosa*), plantains, &c. are produced in abundance and with little labour. In some parts of southern Brazil the fruits and vegetables of the temperate zone do well, but within the tropics they thrive well only at a considerable elevation above sea-level. Apples, peaches, quinces, raspberries, strawberries, &c., are produced under such conditions, but the flavour of their kind grown in colder climates is usually wanting. The vegetable productions are less numerous, but they include sweet potatoes, cabbages, cauliflower, lettuce, beans, peas, onions, garlic, tomatoes, okra, radishes, cucumbers, couve, chuchu (*Sechium edule*), and aipim (*Manihot aipi*). The white potato, known as “batata inglez” (English potato), is grown in elevated localities, but it deteriorates so greatly after the first planting that fresh imported seed is necessary every second or third year.

The pastoral industries, which date from early colonial times, have suffered many vicissitudes,

and their development has failed to keep pace with the country's growth in population. Horses are used to some extent for riding, but very little for carriage and draught purposes, consequently there has been no great incentive for their breeding. They are largely used and raised in Rio Grande do Sul, but in the warmer regions of the north only to a limited extent. The hardier mules are generally employed for draught, carriage, and saddle purposes in every part of the country, and their breeding is a lucrative industry in the southern states. Cattle-raising is the principal industry in Rio Grande do Sul, and receives considerable attention in Minas Geraes, Matto Grosso, Santa Catharina, Paraná, Piauhy and Rio Grande do Norte. It was estimated that there were 30,000,000 head of cattle in the republic in 1904, but the estimate was unquestionably too large. A very large part of the jerked beef consumed in Brazil is imported from Argentina and Uruguay, and some beef cattle also are imported. These importations at Rio de Janeiro in 1906 were 12,464,170 kilograms of jerked beef and 12,575 head of cattle. In the Rio Branco region of Amazonas and in Piauhy, where the national government has long been the owner of extensive cattle ranges, the industry is in a state of decadence. This is partly due to such pests as the vampire bat and bush ticks (*carrapatos*), and partly to the unprogressiveness of the cattlemen. Cattle-raising was once a flourishing industry on the island of Marajó, at the mouth of the Amazon, and it is followed to some extent at Alemquer and other points along the Amazon, but the cattle are small, and commonly in bad condition. In southern Bahia the industry has been nearly extinguished through increasing aridity and droughts, but in the state of Rio de Janeiro the planters are increasing their herds. Minas Geraes produces cheese, butter and milk, as well as beef cattle for neighbouring cities. Matto Grosso classifies cattle-raising as a principal industry, but under present conditions the accessible markets are too small for any large development. In Rio Grande do Sul, where it has attained its greatest development, about 400,000 beeves are slaughtered annually for the manufacture of jerked beef (*xarque*), beef extract, &c. Little attention has been given to sheep in Brazil except in the southern states, and even there the flocks are small. They were to be found in Ceará and Piauhy in colonial times, and small flocks are still to be seen in the latter state, but no use is made of their wool, and the market for mutton is extremely limited because of popular prejudices. Woollen manufactures have been established in Rio de Janeiro, São Paulo and Rio Grande do Sul. The exportation of wool amounted to 1,130,160 ℔ in 1906. Goats have been found highly profitable in many of the middle Atlantic states, where the long dry seasons render the campos unsuitable for cattle pasturage. The export of goat skins from these states is large. Swine do well in all parts of the country, especially in Minas Geraes, São Paulo, Rio de Janeiro, Paraná and Rio Grande do Sul, and domestic pork and lard are slowly supplanting the heavily-taxed foreign products.

Although the coast and river fisheries of Brazil are numerous and valuable, cured fish is one of the staple imports, and foreign products are to be found even along the Amazon. In the Amazon valley fish is a principal article of food, and large quantities of *pirarucú* (*Sudis gigas*) are caught during the season of low water and prepared for storage or market by drying in the sun. This and the collection of turtle eggs for their oil, or butter, are chiefly Indian industries, and contribute largely to the support of the native population of that region. Along the coast the best known fisheries are among the Abrolhos islands and in the shallow waters of Espirito Santo, where the garoupa, pargo and vermelho (species of *Serranus*) abound in great numbers.



The extractive or forest industries of Brazil were among the first to engage the attention of Europeans, and have always been considered a principal source of colonial and national wealth. The varied uses of india-rubber in modern times, however, have given them a greatly enhanced importance and value. Of the exports of 1905, 36% were of this class, while those of the pastoral and mining industries combined were not quite 6½%. In 1906 the percentages were 31 and 6.67, showing a considerable loss for the former and a slight gain for the latter. The principal products of this class are india-rubber, maté, Brazil nuts, vegetable wax, palm fibre, cabinet woods, and medicinal leaves, roots, resins, &c. Before the discovery of the cheaper aniline colours, dye-woods were among the most valuable products of the country; in fact, Brazil derives her name from that of a dye-wood (Brazil-wood—*Caesalpinia echinata*), known as *bresill, brasilly, bresilji, braxilis*, or *brasile* long before the discovery of America (see Humboldt's *Géographic du nouveau continent*, tom. ii. p. 214), which for many generations was the most highly prized of her natural productions. Of the total exports of this group (1905) very nearly 90% was of india-rubber, which percentage was reduced to 85 in the following year. The exportation for 1906 was 69,761,123 ℔ of Hevea, 5,871,968 ℔ of maniçoba, and 1,440,131 ℔ of mangabeira rubber, the whole valued at 124,941,433 milreis gold. The dried leaves and smaller twigs of maté (Paraguayan tea—*Ilex paraguayensis*) are exported to the southern Spanish American republics, where (as in Rio Grande do Sul) the beverage is exceedingly popular. The export in 1906 amounted to 127,417,950 ℔, officially valued at 16,502,881 milreis gold. The collection of Brazil nuts along the Amazon and its tributaries is essentially a poor man's industry, requiring no other plant than a boat. The harvest comes in January and February, in the rainy season, and the nut-gatherers often come one or two hundred miles in their boats to the best forests. The nuts are the fruit of the *Bertholletia excelsa*, one of the largest trees of the Amazon forest region, and are enclosed, sixteen to eighteen in number, in a hard, thick pericarp. Another nut-producing tree is the *sapucaia* (*Lecythis ollaria*), whose nuts are enclosed in a larger pericarp, and are considered to be better flavoured than those first described. The crop is a variable one, the export in 1905 having been 198,226 hectolitres, while that of 1906 was 96,770 hectolitres. It could undoubtedly be largely increased. Vegetable wax, which is an excellent substitute for beeswax, is a product of the

*carnahuba* palm (*Copernicia cerifera*), and is an important export from Ceará. Palm, or piassava fibre, derived from the *piassava* palm, is used in the manufacture of brooms, brushes, &c. It is found as far south as southern Bahia, and the export could be very largely increased. The export of cabinet woods is not large, considering the forest area of Brazil and the variety and quality of the woods. This is principally due to the cost and difficulties of transporting timbers to the coast. The export is confined principally to rosewood. Of the medicinal plants, the best-known products are ipecacuanhá, sarsaparilla, copaiba, jaborandi and cinchona, but this is only a part of the list. Besides these, tonka beans, anatto, vanilla, and castor-oil seeds form a part of the exports.

The mineral exports are surprisingly small. Gold was discovered by the Portuguese soon after their settlement of the coast in the 16th century, but the washings were poor and attracted little attention. The richer deposits of Minas Geraes were discovered about 1693, and those of Matto Grosso early in the following century. Abandoned placer mines are to be found in every part of the unsettled interior, showing how thoroughly it had been explored by gold-hunters in those early days. Some good mines, like Morro Velho and the abandoned Gongo Soco, have been developed in Minas Geraes, but the great majority are small and not very productive. Diamonds were discovered in Minas Geraes, near the town now called Diamantina, during the first half of the 18th century, the dates given ranging from 1725 to 1746, but the productiveness of the district has greatly decreased. Diamonds have also been found in Bahia, Goyaz and Paraná. Other precious stones found in Brazil are the topaz, ruby aquamarine, tourmaline, chrysoberyl, garnet and amethyst. Among the minerals are silver, platinum, copper, iron, lead, manganese, chromium, quicksilver, bismuth, arsenic and antimony, of which only iron and manganese have been regularly mined. The copper deposits of Minas Geraes are said to be promising. Manganese is mined in Minas Geraes for export. Iron ores have been found in most of the states, and are especially abundant in Minas Geraes. The Ypanema mine and ironworks, near Sorocaba, São Paulo, which belong to the national government, have been in operation since 1810 and small charcoal forges were in operation in colonial times and supplied the mines with a considerable part of the iron needed by them. Many of the richer deposits have never been developed because of a lack of fuel and limestone. Bituminous coal of an inferior quality is mined to a limited extent in Rio Grande do Sul, and another mine has been opened in Santa Catharina. These coal deposits extend from Rio Grande do Sul north into the state of São Paulo. Salt, which does not figure in the list of exports, is produced along the coast between Pernambuco and Cape St Roque. The annual production is about 240,000 tons.

To illustrate the comparative productiveness and relationship of these sources of national wealth and industry, the following official returns of export for the years 1905 and 1906 are arranged in the four general classes previously discussed, the values being in Brazilian gold milreis, worth 2s. 3d. or 54.6 cents to the milreis:—

| | 1905. Milreis, gold. | 1906. Milreis, gold. |
|---|---|---|
| *Agricultural.* | | |
| Coffee | 190,404,576 | 245,474,525 |
| Cotton | 10,290,790 | 14,726,492 |
| Cacau | 9,240,313 | 12,323,922 |
| Tobacco | 7,335,163 | 8,283,150 |
| Sugar | 3,608,476 | 5,388,596 |
| Bran[7] | 1,490,312 | 1,128,761 |
| Cottonseed | 964,074 | 1,084,742 |
| Mandioca flour | 692,079 | 789,913 |
| Fruits | 606,678 | 714,332 |
| Castor-oil seeds | 214,016 | 333,250 |
| | 224,846,477 | 290,247,683 |
| *Natural and Forest.* | | |
| Rubber: | | |
| Mangabeira | 1,286,672 | 1,376,014 |
| Maniçoba | 7,418,559 | 7,335,870 |
| Hevea (Pará) | 119,434,947 | 116,229,549 |
| Maté (Paraguay tea) | 11,088,108 | 16,502,881 |
| Brazil nuts | 2,064,049 | 1,190,177 |
| Palm wax (Carnahuba) | 1,847,273 | 3,733,478 |
| Cabinet woods | 390,070 | 318,873 |
| Piassaya fibre | 336,668 | 347,323 |
| Medicinal leaves, roots, resins, &c | 191,534 | 263,137 |
| | 143,331,142 | 147,297,302 |
| *Pastoral and Animal.* | | |

| | | |
|---|---|---|
| Salted hides | 7,010,498 | 9,691,180 |
| Dry hides | 5,330,440 | 7,675,715 |
| Skins | 4,117,590 | 4,639,512 |
| Horse hair | 307,505 | 403,541 |
| Horns | 276,172 | 277,488 |
| Wool | 142,414 | 354,045 |
| Beef extract, &c | 81,607 | 110,925 |
| | 17,266,226 | 23,152,406 |
| *Mineral Products.* | | |
| Gold, in bars | 3,734,469 | 4,379,160 |
| Manganese ore | 2,958,462 | 1,594,486 |
| Monazite sand | 889,231 | 881,289 |
| Precious stones | 633,916 | 1,480,260 |
| | 8,216,078 | 8,335,195 |
| *Miscellaneous.* | | |
| Old metals[8]. 263,506 | 382,073 | |
| Sundry products | 2,177,512 | 2,225,163 |
| | 2,441,018 | 2,607,236 |
| Total, all products | 396,827,679 | 471,639,822 |

*Manufactures.*—Before the establishment of the republic very little attention had been given to manufacturing industries beyond what was necessary to prepare certain crude products for market. Sugar and rum were essentially plantation products down to the last ten years of the empire, when central usines using improved machinery and methods were introduced as a means of saving the sugar plantations from ruin. The crude methods of preparing jerked beef were also modified to some extent by better equipped abattoirs and establishments for preparing beef extract, preserved meats, &c. There were also mills for crushing the dried maté leaves, cigar and cigarette factories, small chocolate factories, hat factories, brick and tile yards, potteries, tanneries, saddleries, and many other small industries common to all large communities. Considerable protection was afforded to many of these industries by the customs tariff of that time, but protection did not become an acknowledged national policy until after 1889. After that time the duties on imports were repeatedly and largely increased, both as a means of raising larger revenues and as an encouragement to manufacturing enterprise. Although the protective tariffs thus imposed have resulted in a large increase in manufacturing industries, some of them have been antagonistic to the productive interests of the country, as in the case of weaving mills which use imported yarns. Other industries are carried on entirely with imported materials, and are national only in name. Among these are flour mills, factories for the cutting of wire nails and making hollow ware from sheet iron, and factories for the manufacture of umbrellas, boots and shoes, &c. The greatest progress has been made in the manufacture of cotton fabrics, principally of the plainer and coarser grades used by the common people. There were 155 of these factories in 1895, but in 1905 only 108 were in operation, with 715,000 spindles, and about 37,000 operatives. Nearly one-half of these were weaving mills, using imported yarn. The factories are widely distributed, and some are favoured by state legislation in addition to the national tariff. The largest and best equipped of them are located in the federal states of Rio de Janeiro and São Paulo, though the greater part of the raw cotton used comes from the northern states and pays high freight rates. The manufacture of woollen blankets, cashmeres, flannels, &c., had also undergone noteworthy development and is carried on in fifteen factories, located principally in Rio Grande do Sul, Rio de Janeiro and São Paulo. Biscuit-making is represented by a large number of factories, for the most part in Rio de Janeiro and São Paulo, and there are a number of breweries of the most modern type in the same two states. The manufacture of boots and shoes has also received much attention, but the materials used are for the most part imported. Among other manufactures are butter and cheese, canned fruits and vegetables, glass and earthenware, printing and wrapping paper, furniture, matches, hats, clothing, pharmaceutical products, soaps and perfumery, ice, artificial drinks, cigars and cigarettes, fireworks and candles.



*Government.*—The overthrow of the monarchy by a military revolt in Rio de Janeiro on 15th November 1889, resulted in the creation of a federal republic under the name of United States of Brazil (Estados Unidos do Brazil). The constitution under which the republic is governed was drafted by a constituent assembly convened on the 15th of November 1890, and was adopted on the 24th of February 1891. The supreme powers of the nation are vested in three partially independent branches of government—executive, legislative, and judicial—represented by the president and his cabinet, a national congress of two chambers, and a supreme tribunal. The states forming the federation consist of the twenty provinces and municipal district of the empire,

but the number may be increased or diminished by the states concerned with the approval of the national congress. The states are self-governed, and have exclusive control of the public lands, mines, industries, and all local affairs. They have the sole right also to impose duties on exports and taxes upon real estate, industries and professions, and transfers of property. Among other things they are charged with the supervision and support of primary education, with the maintenance of order, and with the organization and support of a system of state courts. Both the national and state governments exercise the right to impose stamp and consumption taxes, and the municipalities likewise are permitted to impose licence and consumption taxes. The national government reserves for itself the exclusive right to direct the foreign affairs of the republic, to maintain an army and navy, to impose duties on imports, to regulate foreign commerce, to collect port dues, to issue money and create banks of issue, and to maintain a postal and national telegraph service. It also supervises secondary and superior education, issues patents, and provides federal courts for the trial of cases amenable to federal laws. The national government is forbidden to interfere in the peculiar affairs of the states except to repel foreign invasion, to maintain a republican form of government, to re-establish order at the request of a state, or to enforce federal laws and sentences. The states are forbidden, likewise, to tax federal property, to tax inter-state commerce, to impose duties of their own on foreign imports, or to resist the execution of judicial sentences originating in other states. The separation of church and state is provided for by the constitution, and both the nation and the states are forbidden to establish, subsidize or restrict the exercise of any religious worship. Foreigners are eligible to Brazilian citizenship, and the right of suffrage is conferred upon all male citizens over twenty-one years of age, except beggars, illiterates, the rank and file of the armed forces, members of monastic orders, &c., bound by private vows, and all unregistered citizens.

The executive power of the nation is vested in a president, elected for a term of four years by a direct vote of the electors. He must be a native Brazilian over thirty-five years of age, in the full enjoyment of his political rights, and is ineligible for the next succeeding term. A vice-president is elected at the same time and under the same conditions, who is president of the senate *ex officio*, and succeeds to the presidency in case the office becomes vacant during the last two years of the presidential term. Should the vacancy occur during the first two years of the term, a new election must be held. The president receives a salary of 120,000 milreis and the vice-president of 36,000 milreis. The president is advised and assisted by a cabinet of six ministers, viz. foreign affairs; finance; agriculture, industry and commerce;[9] communications (*Viacao*) and public works;[9] war; and marine. The ministers are appointed and removed by the president, take no part in the sessions of congress, and are responsible to the president alone for their advisory acts. The president sanctions and promulgates, or vetoes, or ignores the laws, and resolutions voted by congress, and issues decrees and regulations for their execution. His veto may be over-ridden by a two-thirds vote in each chamber, and permitting ten days to pass without signing an act is considered as acquiescence and it is promulgated by congress. The president is charged with the duties (among others) of commanding the armed forces of the republic, appointing the prefect of the national capital, designating members of the supreme tribunal and diplomatic representatives for the approval of the senate, to negotiate treaties, &c., *ad referendum* to congress, and maintain relations with foreign powers, to declare war in case of invasion and to declare martial law in case of grave internal disorder, and to advise congress at the opening of the annual session of the progress and state of public affairs. He may be impeached before the senate for his official acts and suspended from office, or tried by the supreme tribunal for criminal offences.

The legislative power is vested in a national congress of two chambers, elected by direct suffrage, and convened on the 3rd of May each year. The regular annual sessions are of four months' duration, but they may be extended to complete necessary legislation. The senate consists of sixty-three members (three from each state and the federal district) elected for a period of nine years, one-third of each delegation being renewed every three years. The senators must be not less than thirty-five years of age, and are exempt from all legal processes not previously authorized by the senate during their term of office, except in cases of arrest *in flagrante delicto* for a capital crime. The chamber of deputies contains 212 members, the membership being distributed among the states on a basis of one for each 70,000 of population, but with a minimum representation of four for each state. The deputies are elected by direct suffrage for the legislative session of three years, and have the same immunities from legal process as the senators. The chamber has the right of initiative in the organization of the annual budget laws and those relative to the numerical strength of the army and navy. The members of both houses receive a *per diem* subsidy.

The judicial system of the republic consists of a supreme federal tribunal of fifteen judges in the national capital, and a district tribunal in the capital of each state, which forms a federal judicial district. The judges are appointed for life and can be removed only by judicial sentence and impeachment. One member of the supreme tribunal holds the position of solicitor-general of the republic. The judges and solicitor-general are appointed by the president with the approval of the senate, but the tribunal chooses its own presiding officers and secretaries and, nominally, is independent of executive control. The supreme tribunal has original and appellate jurisdiction,

but its power to pass on the constitutionality of federal laws and executive acts seems to fall short of that of the United States Supreme Court. It has authority, however, to review the acts and laws of state governments and to decide upon their constitutionality. The district federal court has but one judge (*juiz de secção*) and a solicitor of the republic, and has original jurisdiction in federal causes. Each state has its own local laws and courts, independent of federal control, but subject to the review of the supreme tribunal, and with rights of appeal to that tribunal in specified cases. The federal district, which has a municipal council instead of a legislature, has a system of municipal and higher courts peculiar to itself. Limited judicial powers are exercised by chiefs of police, and by certain department commissions, or boards, of an executive character. The members of the army and navy are governed by special laws, enjoy immunities from civil process, and are subject to the jurisdiction of military courts. The civil code of the republic is based upon Roman law.

*Army.*—The nominal strength of the army in 1906 was 29,489, including the officers of the general and subordinate staffs and the officers and cadets of the military schools. This total represents the nominal strength of the army in times of peace. Its actual strength, however, is about 15,000 men, some of the regimental and battalion organizations being skeletons. Its organization consists of 40 battalions of infantry with one transport and one depot company, 14 regiments of cavalry of 4 squadrons each, 6 regiments of field artillery with 24 batteries and 6 battalions of heavy artillery with 24 batteries, and two battalions of engineers. Efforts to organize a national guard have been unsuccessful, although officers have been appointed and the organization perfected, on paper. The police force, however, is organized on a military footing and armed, and is available for service in case of necessity. It is credited with 20,000 men. According to law military service is obligatory, but the government has been unable to enforce it. Impressment is commonly employed to fill the ranks, and in cases of emergency the prison population is drawn upon for recruits. The president is nominally commander-in-chief of the army, but the actual command is vested in a general staff in the national capital, and in the general commanding each of the seven military districts into which the republic is divided. The most important of these districts is that of Rio Grande do Sul, where a force of 11,226 men is stationed. The principal war arsenal is in Rio de Janeiro. The rifle used by the infantry is a modified Mauser of the German 1888 model. Military instruction is given at the Eschola Militar of Rio de Janeiro. The military organization is provided with an elaborate code and systems of military courts, which culminate in a supreme military tribunal composed of 15 judges holding office for life, of which 8 are general army officers, 4 general naval officers and 3 civil judges.

*Navy.*—The naval strength of the republic consisted in 1906 of a collection of armoured and wooden vessels of various ages and types of construction, of which three armoured vessels (including the two designed for coast defence), four protected cruisers, five destroyers and torpedo-cruisers, and half a dozen torpedo boats represented what may be termed the effective fighting force. The loss of the armoured turret ship “Aquidaban” by a magazine explosion in the bay of Jacarepagua, near Rio de Janeiro, in 1905, had left Brazil with but one fighting vessel (the “Reachuelo”) of any importance. Many of the wooden and iron vessels listed in the Naval Annual, 1906, though obsolete and of no value whatever as fighting machines, are used for river and harbour service, and in the suppression of trifling insurrections. The Annual describes 21 vessels of various types, and mentions 23 small gunboats used for river and harbour service. Besides these there are a number of practice boats (small school-ships), transports, dispatch boats and launches. A considerable part of the armament is old, but the more modern vessels are armed with Armstrong rifled guns. The naval programme of the republic for 1905 provided for the prompt construction of 3 battleships of the largest displacement, 3 armoured cruisers, 6 destroyers, 12 torpedo boats and 3 submarine boats; and by 1909 the reorganization of the navy was far advanced. The principal naval arsenal is located at Rio de Janeiro. The government possesses dry docks at Rio de Janeiro. The naval school, which has always enjoyed a high reputation among Brazilians, is situated on the island of Enxadas in the bay of Rio de Janeiro. There are smaller arsenals at Pará, Pernambuco, São Salvador and Ladario (Matto Grosso) and a shipbuilding yard of considerable importance at the Rio de Janeiro arsenal.

*Education.*—Education is in a backward condition, and it is estimated that 80% of the population can neither read nor write. The lowest rate of illiteracy is to be found in the southern half of the republic. Public instruction, is, by constitutional provision, under secular control, but religious denominations are permitted to have their own schools. Primary instruction is free but not compulsory, and the schools are supported and supervised by the states. An incomplete return in 1891 gave 8793 schools and 376,399 pupils. Secondary and higher education are under both federal and state control, the former being represented by lyceums in the state capitals, and by such institutions as the Gymnasio Nacional (formerly Collegio Dom Pedro II.) in Rio de Janeiro. Many of the states also maintain normal schools of an inferior type, that of São Paulo being the best and most modern of the number. Higher, or superior, instruction is confined almost exclusively to professional schools— the medical schools of Rio de Janeiro and Bahia, the law schools of São Paulo and Pernambuco, the polytechnic of Rio de Janeiro, and the school of mines of Ouro Preto. There are many private schools in all the large cities, from the primary schools

maintained by the church and various corporations and religious associations to schools of secondary and collegiate grades, such as the Protestant mission schools of Petropolis, Piracicaba, Juiz de Fóra, São Paulo and Paraná, the Lyceu de Artes e Ofiicios (night school) of Rio de Janeiro, and the Mackenzie College of São Paulo. Perhaps the best educational work in Brazil is done in these private schools. In addition to these there are a number of seminaries for the education of priests, where special attention is given to the classics and belles-lettres.

*Religion.*—The revolution of 1889 and the constitution adopted in 1891 not only effected a radical change in the form of government, but also brought about the separation of church and state. Before that time the Roman Catholic Church had been recognized and supported by the state. Not only are the national and state governments forbidden by the constitution to establish or subsidize religious worship, but its freedom is guaranteed by a prohibition against placing obstructions upon its exercise. The relations of the state with the disestablished church since 1889 have been somewhat anomalous, the government having decided to continue during their lives the stipends of the church functionaries at the time of disestablishment. The census of 1890 divided the population into 14,179,615 Roman Catholics, 143,743 Protestants, 3300 of all other faiths, 7257 of no religious profession, and 600,000 unchristianized Indians. The increase of population through immigration is overwhelmingly Catholic, and the nation must, therefore, continue Roman Catholic whether the church is subsidized by the state or not. The moral character of churchmen in Brazil has been severely criticized by many observers, and the ease with which disestablishment was effected is probably largely due to their failings. The church had exercised a preponderating influence in all matters relating to education and the social life of the people, and it was felt that no sweeping reforms could be secured until its domination had been broken. The immediate results of disestablishment were civil marriage, the civil registry of births and deaths, and the secularization of cemeteries; but the church retains its influence over all loyal churchmen through the confessional, the last rites of the church, and their sentiment against the profanation of holy ground. Formerly Brazil constituted an ecclesiastical province under the metropolitan jurisdiction of an archbishop residing at Bahia, with 11 suffragan bishops, 12 vicars-general and about 2000 curates. In 1892 the diocese of Rio de Janeiro was made an archbishopric, and four new dioceses were created. Three more have been added since, making twenty dioceses in all. In 1905 the archbishop of Rio de Janeiro was made a cardinal. The church has eleven seminaries for the education of priests, and maintains a large number of private schools, especially for girls, which are patronized by the better classes. The church likewise exercises a far-reaching influence over the people through the beneficent work of its lay orders, and through the hospitals and asylums under its control in every part of the country. A Misericordia hospital is to be found in almost every town of importance, and *recolhimentos* for orphan girls in all the large cities. In no country have these charities received more generous support than in Brazil. The Protestant contingent consists of a number of small congregations scattered throughout the country, a few Portuguese Protestants from the Azores, a part of the German colonists settled in the central and southern states, and a large percentage of the North Europeans and Americans temporarily resident in Brazil. The Positivists are few in number, but their congregations are made up of educated and influential people.



*Art, Science and Literature.*—The Brazilian people have the natural taste for art, music and literature so common among the Latin nations of the Old World. The emperor Dom Pedro II. did much to encourage these pursuits, and many promising young men received their education in Europe at his personal expense. Still earlier in the century (1815) the regent Dom John VI. brought out a number of French artists to educate his subjects in the fine arts, and the *Escola Real de Sciencias, Artes e Officios* was founded in the following year. From this beginning resulted the *Academia de Bellas Artes* of a later date, to which was added a conservatory of music in 1841. The institution is now called the *Escola Nacional de Bellas Artes*. Free instruction in the fine arts has been given in this school. The higher results of artistic training, however, are less marked than a widespread dilettantism. The Brazilian composer Carlos Gomes (1839-1896) is the best known of those who have adopted music as a profession, his opera *Il Guarani* having been produced at most of the European capitals. The most prominent among Brazilian painters is Pedro Americo, and in sculpture Rodolpho Bernardelli has done good work. In science Brazil has accomplished very little, although many eminent foreign naturalists have spent years of study within her borders. João Barbosa Rodrigues has done some good work in botany, especially in the study of the palms of the Amazon, and João Baptista de Lacerda has made important biological investigations at the national museum of Rio de Janeiro. There are several scientific societies and institutions in the country, but they rarely undertake original work. The most active are the geographical societies, but very little has been done in the direction of scientific exploration. Some interesting results have been obtained from the boundary surveys, from Dr E. Cruls's exploration of a section of the Goyaz plateau in 1892 in search of a site for the future capital of the republic, and from some of the river and railway surveys. In 1875 a geological commission was organized under the direction of Professor Charles Frederick Hartt, but it was disbanded two years later. In 1906 Congress resolved to undertake a national geological survey under the direction of Mr Orville A. Derby, one of Professor Hartt's assistants. The coal resources of the southern states were investigated in 1904, under the auspices of the national government, by Dr

J.C. White, of the U.S. Geological Survey, who found strata of fairly good coal at depths of 100 to 200 ft. extending from Rio Grande do Sul north to São Paulo. The more important contributions to our present knowledge of Brazil, however, have been obtained through the labours of foreign naturalists. Beginning with the German mineralogist W.L. von Eschwege, who spent nineteen years in Brazil (1809-1828), the list includes A. de Saint-Hilaire (1816-1820 and 1830), J.B. von Spix and C.F. von Martins (1817-1820), Prince Max zu Neuwied (1815-1817), P.W. Lund (1827-1830, and 1830 to 1880, the year of his death), George Gardner (1836-1841), A.R. Wallace (1848-1852), H.W. Bates (1848-1859), Hermann Burmeister (1850-1852), Louis Agassiz (1865-1866), Charles Frederick Hartt (1865-1866, 1872 and 1875-1878) and Karl von den Steinen (1884-1885 and 1887-1888). These explorations cover every branch of natural science and resulted in publications of inestimable scientific value. There should also be mentioned the monumental work of C.F.P. von Martius on the *Flora Braziliensis*, and the explorations of Agassiz and Lund. Among other scientists of a later date who have published important works on Brazil are the American geologists O.A. Derby and J.C. Branner, the Swiss naturalist E.A. Goeldi, the German botanist J. Huber, the German ethnologist H. von Ihring, and’the German geographer Fried. Katzer. The *Instituto Historico e Geographico Brazileiro*, though devoted chiefly to historical research, has rendered noteworthy service in its encouragement of geographical exploration and by its publication of various scientific memoirs. The Museu Nacional at Rio de Janeiro, which has occupied the imperial palace of São Christovão since the overthrow of the monarchy, contains large collections of much scientific value, but defective organization and apathetic direction have rendered them of comparatively slight service. The Observatorio Nacional at Rio de Janeiro is another prominent public institution. The botanical gardens of Brazil are developing into permanent exhibitions of the flora of the regions in which they are located. That of Rio de Janeiro is widely celebrated for its avenues of royal palms, but it has also rendered an important service to the country in the dissemination of exotic plants.

Brazilian literature has been seriously prejudiced by partisan politics and dilettantism. The colonial period was one of strict repression, the intellectual life of the people being jealously supervised by the church to protect itself against heresy, and their progress being restricted by the Portuguese crown to protect its monopoly of the natural resources of the country. The arrival of Dom John VI. in 1808 broke down some of these restrictions, and the first year of his residence in Rio de Janeiro saw the establishment of the first printing press in Brazil and the publication of an official gazette. There was no freedom of the press, however, until 1821, when the abolition of the censorship and the constitutional struggle in Portugal gave rise to a political discussion that marked the opening of a new era in the development of the nation, and aroused an intellectual activity that has been highly productive in journalistic and polemical writings. In no country, perhaps, has the press exercised a more direct and powerful influence upon government than in Brazil, and in no other country can there be found so high a percentage of journalists in official life. Some of the political writers have played an important part in moulding public opinion on certain questions, as in the case of A.C. Tavares Bastos, whose *Cartas do Solitario* were highly instrumental in causing the Amazon to be thrown open to the world’s commerce and also in preparing the way for the abolition of slavery; and in that of Joaquim Saldanha Marinho, whose discussions in 1874-1876 of the relations between church and state prepared the way for their separation. The personal element is conspicuous in the Brazilian journalism, and for a considerable period of its history libellous attacks on persons, signed by professional sponsors, popularly called *testas de ferro* (iron heads), were admitted at so much a line in the best newspapers.

The singular adaptability of the Portuguese language to poetical expression, coupled with the imaginative temperament of the people, has led to an unusual production and appreciation of poetry. The percentage of educated men who have written little volumes of lyrics is surprisingly large, and this may be accounted for by the old Portuguese custom of reciting poetry with musical accompaniment. The most popular of the Brazilian poets are Thomaz Antonio Gonzaga, Antonio Gonçalves Dias and Bernardo Guimarães. Among the dramatists and novelists may be mentioned Joaquim Manoel de Macedo, José Martiniano de Alencar, Bernardo Guimarães, A. de Escragnolle Taunay and J.M. Machado de Assis. José M. de Alencar is usually described as the greatest of Brazilian novelists. The most popular of his romances are *Iracema* and *O Guarany*. In historical literature Brazil has produced one writer of high standing—Francisco Adolpho Varnhagen (Visconde de Porto Seguro), whose *Historia Geral do Brazil* is a standard authority on that subject. The two English authorities, Robert Southey’s *History of Brazil*, covering the colonial period, and John Armitage’s *History of Brazil*, covering the period between the arrival of the Braganza family (1808) and the abdication of Dom Pedro I. (1831), have been translated into Portuguese. Another Brazilian historian of recognized merit is João Manoel Pereira da Silva, whose historical writings cover the first years of the empire, from its foundation to 1840. Among the later writers João Capistrano de Abren has produced some short historical studies of great merit. In the field of philosophic speculation, Auguste Comte has had many disciples in Brazil.



*Finance.*—The national revenue is derived largely from the duties on imports, the duties on exports having been surrendered to the states when the republic was organized. Other sources of

revenue are stamp taxes on business transactions, domestic consumption taxes (usually payable in stamps) on manufactured tobaccos, beverages, boots and shoes, textiles, matches, salt, preserved foods, hats, pharmaceutical preparations, perfumeries, candles, vinegar, walking sticks and playing cards, and taxes on lotteries, passenger tickets, salaries and dividends of joint-stock companies. Formerly import duties were payable in currency, but in 1899 it was decided to collect 10% of them in gold to provide the government with specie for its foreign remittances. The revenues and expenditures have since then been calculated in gold and currency together, to the complete mystification of the average citizen, and the gold percentage of the duties on imports has been increased to 35 and 50% (in 1907), the higher rate to apply to specified articles and rule when exchange on London is above 14 pence per milreis, and the lower when it is below. The service of the national debt absorbs a very large part of the expenditure, about 45% of the estimates for 1907 being assigned to the department of finance. The department of industry, communications and public works takes the next highest proportion, but about half its expenditures are met by special taxes, as in the case of port works and railway inspection, and by the revenues of the state railways, telegraph lines and post office. The depreciation and unstable character of the paper currency render it difficult to give a clear statement of receipts and expenditures for a term of years, the sterling equivalents often showing a decrease, through a fall in the value of the milreis, where there has been an actual increase in currency returns. This was most noticeable between 1889 and 1898, when exchange, which represents the value of the milreis, fell from a maximum of 27¾ pence (27d. being the par value of the milreis) to a minimum of 5⅝ pence. Since 1898 there has been an upward movement of exchange, the average rate for 1905 having been very nearly 16 pence. In this period the increase in the sterling equivalents would be proportionately greater than that of the currency values. The gold and currency receipts and expenditures for the six years 1900 to 1905, inclusive, according to official returns, were as follows:—

| Year. | Average Rate of Exchange. | Revenue. | | Expenditure. | |
|---|---|---|---|---|---|
| | Pence. | Gold Milreis. | Currency Milreis. | Gold Milreis. | Currency Milreis. |
| 1900 | 9.50 | 49,955,522 | 263,687,253 | 41,892,150 | 372,753,986 |
| 1901 | 11.38 | 44,041,302 | 239,284,702 | 40,493,241 | 261,629,212 |
| 1902 | 11.97 | 42,904,844 | 266,584,912 | 34,574,643 | 236,458,862 |
| 1903 | 12 | 45,121,844 | 327,370,063 | 48,324,642 | 291,198,960 |
| 1904 | 12.28 | 50,566,572 | 342,782,191 | 48,476,413 | 352,292,147 |
| 1905 | 15.89 | 64,207,004 | 243,355,396 | 51,606,272 | 265,699,281 |

Reducing gold to a currency basis at 15d. per milreis (the official valuation adopted in 1906), the budget for 1907 provided for a revenue of 353,590,593 milreis and an expenditure of 409,482,284 milreis, showing a deficit of 55,891,691 milreis. These deficits were common enough under the monarchy, but they have become still more prominent under the republic. According to the “Retrospecto Commercial” for 1906 of the *Jornal do Commercio* (Rio de Janeiro, March 5, 1907), the aggregate deficits for the eleven years 1891 to 1904 were 692,000,000 milreis, or, say, £43,250,000.

The natural result of such a regime is increasing indebtedness. In 1888, a year before the republic was proclaimed, the internal and external national debts amounted to £74,000,000 sterling, with the currency at par. Ten years later, when the currency had fallen to 5⅝ pence per milreis, the government found itself unable to meet the interest obligations on its debt and railway guarantees, and an arrangement was made with its creditors in London for the issue of a 5% funding loan to an amount not to exceed £10,000,000, and the suspension of all amortization for thirteen years. On the other hand the government agreed to withdraw currency, which had reached a total of 788,364,614 ½-milreis, *pari passu* with the issue of the loan, the milreis being computed at 18 pence. The purpose of this condition was in order to improve the value of the paper milreis in order to increase the specie value of the revenues. The scheme came into operation in June 1898, and not only was a complete suspension of payments avoided but the financial situation was greatly improved. The government even withdrew more of its currency issues than required by the agreement, and the value of the milreis steadily improved. At the same time the government carried out the forced conversion of the national loans into lower interest-bearing issues, which greatly reduced the annual interest charges. These measures would have put the financial affairs of the nation on a solid footing in a very few years had the government been able to keep its expenditure within its income. The naval revolt of 1893-1894, however, had aroused the spirit of militarism in the ruling classes, and the effort to perfect the organization and equipment of the army, strengthen the fortifications of Rio de Janeiro, and increase the navy, have kept expenditures in excess of the revenues. The purchase of guaranteed railways owned by foreign companies likewise added largely to the bonded indebtedness, though the onus was in existence in another form. The result of these measures was a large addition to the public debt, which on 31st December 1906 was approximately as follows (*apolices* being the name given to bonds inscribed to the holder):—

External debt: £ s. d.

| | |
|---|---|
| Loans of 1883, 1888 and 1889. | 26,478,500 |
| Oestede Minas R.R. loan | 3,388,100 |
| Loan of 1898 | 7,331,600 |
| Funding loan of 1898 | 8,613,717 9 9 |
| Railway rescission loan of 1901 | 15,467,015 16 1 |
| Port works loan of 1903 | 8,500,000 |
| | £69,778,933 5 10 |

| Internal debt, funded: | Milreis |
|---|---|
| 5 % apolices, Law of 1827 | 483,546,600 |
| 4½% ” ” 1879 | 20,548,000 |
| 6 % ” ” 1897 | 37,082,000 |
| 5 % ” ” 1903 | 17,300,000 |
| Total, funded | 558,476,600 |
| (at 15d. £34,904,787) | |
| Internal debt, not funded: | Milreis |
| Paper money | 664,792,960 |
| Savings bank and other deposits: | |
| In paper | 246,812,407 |
| In gold, 19,053,861 r (say) | 34,296,950 |
| Floating indebtedness (a/cs current, bills, &c.) | ? |
| Total, not funded, approx. | 945,902,317 |
| (at 15d. £59,118,895 stg.) | |
| Approximate total indebtedness | £163,802,675 |

In addition to these, the government was still responsible for interest guarantees on fourteen railways, or sections of existing lines, with an aggregate capital of about £4,900,000 held in Europe and 12,055,440 milreis held in Brazil, on which the national treasury paid in interest £191,324 and 1,398,493 milreis.

The paper currency of Brazil consists of both treasury issues and bank-notes, the latter issued under government supervision. Its fluctuations in value have been not only a serious inconvenience in commercial transactions, but also the cause of heavy loss to the people. Under the provisions of the funding loan of 1898 a scheme for the withdrawal of the paper money was carried into effect, and by the end of December 1906 the amount in circulation had been reduced from 788,364,614 ½-milreis (the outstanding circulation 31st August 1898) to 664,792,960 ½-milreis. Two funds were created for the redemption and guarantee of paper issues, the latter receiving 5% of the import duties payable in gold. Up to 1906 the Caixa da Amortisação (redemption bureau), which has charge of the service of the internal funded debt, superintended the redemption of the currency, but in that year (December 6, 1906) a Caixa de Conversão (conversion bureau) was created for this special service. It is modelled after the Argentine Conversion office, and is authorized to issue notes to bearer against deposits of gold at the rate of 15 pence per milreis although exchange was above 17d. when the scheme was proposed. The notes are to be redeemable in gold at sight, the Caixa de Conversão to keep the gold paid in for that express purpose. The coffee producers of São Paulo and other states found that the appreciation in value of the milreis was reducing their profits, and they advocated this measure (at first with a valuation of 12d.) to check the upward movement in exchange. Metallic money is limited to nickel and bronze coins, but in 1906 the government was authorized to purchase bar silver for the coinage of pieces of the denomination of two milreis, one milreis and 500 reis (½-milreis). Gold is the nominal standard of value, the monetary unit being the gold milreis worth 2s. 2½d. at par. The 10-milreis gold piece weighs 8.9648 grammes, 916 fine, and contains 8.2178 grammes of pure gold. There is no gold in circulation, however, and gold duties are paid with gold cheques purchased at certain banks with paper money. The banking facilities of the republic have undergone many changes under the new regime. A fruitful cause of disaster has been the practice of issuing agricultural and industrial loans under government authorization. Commercial business at the principal ports is largely transacted through foreign banks, of which there are a large number.



In addition to the indebtedness of the national government, the individual states have also incurred funded debts of their own. The aggregate of these debts in 1904 was £20,199,440, and the several loans made during the next two years, including those of the municipalities of Rio de Janeiro, Santos, Bahia and Manáos, add fully two and a half millions more to the total.

(A. J. L.)

## History

Brazil was discovered in February 1499 (o.s.) by Vicente Yañez Pinzon, a companion of Columbus. He descried the land near Cape St Augustine, and sailed along the coast as far as the river Amazon, whence he proceeded to the mouth of the Orinoco. He made no settlement, but

***The Portuguese in Brazil.***

took possession of the country in the name of the Spanish government, and carried home, as specimens of its natural productions, some drugs, gems and Brazil-wood. Next year the Portuguese commander, Pedro Alvares Cabral, appointed by his monarch to follow the course of Vasco da Gama in the East, was driven by adverse winds so far from his track, that he reached the Brazilian coast, April 24, and anchored in Porto Seguro (16° S. lat.) on Good Friday. On Easter day an altar was erected, mass celebrated in presence of the natives, the country declared an apanage of Portugal, and a stone cross erected in commemoration of the event. Cabral despatched a small vessel to Lisbon to announce his discovery, and, without forming any settlement, proceeded to India on the 3rd of May. On the arrival of the news in Portugal, Emanuel invited Amerigo Vespucci to enter his service, and despatched him with three vessels to explore the country. The navigator's first voyage was unsuccessful; but, according to his own account, in a second he discovered a safe port, to which he gave the name of All-Saints and where he erected a small fort. Vespucci's narrative is, however, suspected of being apocryphal (see VESPUCCI, AMERIGO).

The poor and barbarous tribes of Brazil, and their country, the mineral riches of which were not immediately discovered, offered but few attractions to a government into the coffers of which the wealth of India and Africa was flowing. For nearly thirty years the kings of Portugal paid no further attention to their newly-acquired territory than what consisted, in combating the attempts of the Spaniards to occupy it, and dispersing the private adventurers from France who sought its shores for the purposes of commerce. The colonization of Brazil was prosecuted, however, by subjects of the Portuguese monarchy, who traded thither chiefly for Brazil-wood. The government also sought to make criminals of some use to the state, by placing them in a situation where they could do little harm to society, and might help to uphold the dominion of their nation.

The first attempt on the part of a Portuguese monarch to introduce an organized government into his dominions was made by John III. He adopted a plan which had been found to succeed well in Madeira and the Azores,— dividing the country into hereditary captaincies, and granting them to such persons as were willing to undertake their settlement, with unlimited powers of jurisdiction, both civil and criminal. Each captaincy extended along fifty leagues of coast. The boundaries in the interior were undefined. The first settlement made under this new system was that of São Vicente Piratininga, in the present province of São Paulo. Martim Affonso de Sousa, having obtained a grant, fitted out a considerable armament and proceeded to explore the country in person. He began to survey the coast about Rio de Janeiro, to which he gave that name, because he discovered it on the 1st of January 1531. He proceeded south as far as La Plata, naming the places he surveyed on the way from the days on which the respective discoveries were made. He fixed upon an island in 24½° S. lat., called by the natives Guaibe, for his settlement. The Goagnazes, or prevailing tribe of Indians in that neighbourhood, as soon as they discovered the intentions of the new-comers to fix themselves permanently there, collected for the purpose of expelling them. Fortunately, however, a shipwrecked Portuguese, who had lived many years under the protection of the principal chief, was successful in concluding a treaty of perpetual alliance between his countrymen and the natives. Finding the spot chosen for the new town inconvenient, the colonists removed to the adjoining island of São Vicente, from which the captaincy derived its name. Cattle and the sugar-cane were at an early period introduced from Madeira, and here the other captaincies supplied themselves with both.

***First organization in Brazil.***

Pero Lopes de Sousa received the grant of a captaincy, and set sail from Portugal at the same time as his brother, the founder of São Vicente. He chose to have his fifty leagues in two allotments. That to which he gave the name of Santo Amaro adjoined São Vicente, the two towns being only three leagues asunder. The other division lay much nearer to the line between Parahyba and Pernambuco. He experienced considerable difficulty in founding this second colony, from the strenuous opposition of a neighbouring tribe, the Petiguares; at length he succeeded in clearing his lands of them, but not long afterwards he perished by shipwreck.

Rio de Janeiro was not settled till a later period; and for a considerable time the nearest captaincy to Santo Amaro, sailing along the coast northwards, was that of Espirito Santo. It was founded by Vasco Fernandes Coutinho, who having acquired a large fortune in India, sank it in this scheme of colonization. He carried with him no less than sixty fidalgos. They named their town by anticipation, Our Lady of the Victory (Victoria); but it cost them some hard fighting with the Goagnazes to justify the title.

Pedro de Campo Tourinho, a nobleman and excellent navigator, received a grant of the adjoining captaincy of Porto Seguro. This, it will be remembered, is the spot where Cabral first took possession of Brazil. The Tupinoquins at first offered some opposition; but having made peace, they observed it faithfully, notwithstanding that the oppression of the Portuguese obliged them to forsake the country. Sugar-works were established, and considerable quantities of the produce exported to the mother country.

Jorge de Figueiredo, *Escrivam da Fazenda*, was the first donatory of the captaincy Ilhéos, 140 m. south of Bahia. His office preventing him from taking possession in person, he deputed the

task to Francisco Romeiro, a Castilian. The Tupinoquins, the most tractable of the Brazilian tribes, made peace with the settlers, and the colony was founded without a struggle.

The coast from the Rio São Francisco to Bahia was granted to Francisco Pereira Coutinho; the bay itself, with all its creeks, was afterwards added to the grant. When Coutinho formed his establishment, where Villa Velha now stands, he found a noble Portuguese living in the neighbourhood who, having been shipwrecked, had, by means of his fire-arms, raised himself to the rank of chief among the natives. He was surrounded by a patriarchal establishment of wives and children; and to him most of the distinguished families of Bahia still trace their lineage. The regard entertained by the natives for Caramuru (signifying *man of fire*) induced them to extend a hospitable welcome to his countrymen, and for a time everything went on well. Coutinho had, however, learned in India to be an oppressor, and the Tupinambas were the fiercest and most powerful of the native tribes. The Portuguese were obliged to abandon their settlement; but several of them returned at a later period, with Caramuru, and thus a European community was established in the district.



Some time before the period at which these captaincies were established, a factory had been planted at Pernambuco. A ship from Marseilles took it, and left seventy men in it as a garrison; but she was captured on her return, and carried into Lisbon, and immediate measures were taken for reoccupying the place. The captaincy of Pernambuco was granted to Don Duarte Coelho Pereira as the reward of his services in India. It extended along the coast from the Rio São Francisco, northward to the Rio de Juraza. Duarte sailed with his wife and children, and many of his kinsmen, to take possession, of his new colony, and landed in the port of Pernambuco. To the town which was there founded he gave the name of Olinda. The Cabetes, who possessed the soil, were fierce and pertinacious; and, assisted by the French, who traded to that coast, Coelho had to gain by inches what was granted him by leagues. The Portuguese managed, however, to beat off their enemies; and, having entered into an alliance with the Tobayanes, followed up their success.

Attempts were made about this time to establish two other captaincies, but without success. Pedro de Goes obtained a grant of the captaincy of Parahyba between those of São Vicente and Espirito Santo; but his means were too feeble to enable him to make head against the aborigines, and the colony was broken up after a painful struggle of seven years. João de Barros, the historian, obtained the captaincy of Maranhão. For the sake of increasing his capital, he divided his grant with Fernão Alvares de Andrade and Aires da Cunha. They projected a scheme of conquest and colonization upon a large scale. Nine hundred men, of whom one hundred and thirteen were horsemen, embarked in ten ships under the command of Aires da Cunha. But the vessels were wrecked upon some shoals about one hundred leagues to the south of Maranhão; the few survivors, after suffering immense hardships, escaped to the nearest settlements, and the undertaking was abandoned.

By these adventures the whole line of Brazilian coast, from the mouth of La Plata to the mouth of the Amazon, had become studded at intervals with Portuguese settlements, in all of which law and justice were administered, however inadequately. It is worthy of observation, that Brazil was the first colony founded in America upon an agricultural principle, for until then the precious metals were the exclusive attraction. Sufficient capital was attracted between the year 1531 (in which De Sousa founded the first captaincy) and the year 1548 to render these colonies an object of importance to the mother country. Their organization, however, in regard to their means of defence against both external aggression and internal violence, was extremely defective. Their territories were surrounded and partly occupied by large tribes of savages. Behind them the Spaniards, who had an establishment at Asuncion, had penetrated almost to the sources of the waters of Paraguay, and had succeeded in establishing communication with Peru. Orellana, on the other hand, setting out from Peru, had crossed the mountains and sailed down the Amazon. Nor had the French abandoned their hopes of effecting an establishment on the coast.

The obvious remedy for these evils was to concentrate the executive power, to render the petty chiefs amenable to one tribunal, and to confide the management of the defensive force to one hand. In order to this the powers of the several captains were revoked, whilst their property in their grants was reserved to them. A governor-general was appointed, with full powers, civil and criminal. The judicial and financial functions in each province were vested in the *Ouvidor*, whose authority in the college of finance was second only to that of the governor. Every colonist was enrolled either in the *Milicias* or *Ordenanzas*. The former were obliged to serve beyond the boundaries of the province, the latter only at home. The chief cities received municipal constitutions, as in Portugal. Thome de Sousa was the first person nominated to the important post of governor-general. He was instructed to build a strong city in Bahia and to establish there the seat of his government. In pursuance of his commission he arrived at Bahia in April 1549, with a fleet of six vessels, on board of which were three hundred and twenty persons in the king’s pay, four hundred convicts and about three hundred free colonists. Care had been taken for the spiritual wants of the provinces by associating six Jesuits with the expedition.

Old Caramuru, who still survived, rendered the governor essential service by gaining for his

countrymen the goodwill of the natives. The new city, to which the name of São Salvador was given, was established on the heights above the Bay of All Saints (Todos os Santos), from which its later name of Bahia is taken. Within four months one hundred houses were built, and surrounded by a mud wall. Sugar plantations were laid out in the vicinity. During the four years of Sousa's government there were sent out at different times supplies of all kinds. Female orphans of noble families were given in marriage to the officers, and portioned from the royal estates, and orphan boys were sent to be educated by the Jesuits. The capital rose rapidly in importance, and the captaincies learned to regard it as a common head and centre of wealth. Meanwhile the Jesuits undertook the moral and religious culture of the natives, and of the scarcely less savage colonists. Strong opposition was at first experienced from the gross ignorance of the Indians, and the depravity of the Portuguese, fostered by the licentious encouragement of some abandoned priests who had found their way to Brazil. Over these persons the Jesuits had no authority; and it was not until the arrival of the first bishop of Brazil in 1552, that anything like an efficient check was imposed upon them. Next year Sousa was succeeded by Duarte da Costa, who brought with him a reinforcement of Jesuits, at the head of whom was Luis de Gran, appointed, with Nobrega the chief of the first mission, joint provincial of Brazil.

***First Jesuit missions.***

Nobrega's first act was one which has exercised the most beneficial influence over the social system of Brazil, namely, the establishment of a college on the then unreclaimed plains of Piratininga. It was named São Paulo, and has been at once the source whence knowledge and civilization have been diffused through Brazil, and the nucleus of a colony of its manliest and hardiest citizens, which sent out successive swarms of hardy adventurers to people the interior. The good intentions of the Jesuits were in part frustrated by the opposition of Costa the governor; and it was not until 1558, when Mem de Sa was sent out to supersede him, that their projects were allowed free scope.

Rio de Janeiro was first occupied by French settlers. Nicholas Durand de Villegagnon, a bold and skilful seaman, having visited Brazil, saw at once the advantages which might accrue his country from a settlement there. In order to secure the interest of Coligny, he gave out that his projected colony was intended to serve as a place of refuge for the persecuted Huguenots. Under the patronage of that admiral, he arrived at Rio de Janeiro in 1558 with a train of numerous and respectable colonists. As soon, however, as he thought his power secure, he threw off the mask, and began to harass and oppress the Huguenots by every means he could devise. Many of them were forced by his tyranny to return to France; and ten thousand Protestants, ready to embark for the new colony, were deterred by their representations. Villegagnon, finding his force much diminished in consequence of his treachery, sailed for France in quest of recruits; and during his absence the Portuguese governor, by order of his court, attacked and dispersed the settlement. For some years the French kept up a kind of bush warfare; but in 1567 the Portuguese succeeded in establishing a settlement at Rio.

***Settlement of Rio de Janeiro.***

Mem de Sa continued to hold the reins of government in Brazil upon terms of the best understanding with the clergy, and to the great advantage of the colonies, for fourteen years. On the expiration of his power, which was nearly contemporary with that of his life, an attempt was made to divide Brazil into two governments; but this having failed, the territory was reunited in 1578, the year in which Diego Laurenço da Veiga was appointed governor. At this time the colonies, although not yet independent of supplies from the mother country, were in a flourishing condition; but the usurpation of the crown of Portugal by Philip II. changed the aspect of affairs. Brazil, believed to be inferior to the Spanish possessions in mines, was consequently abandoned in comparative neglect for the period intervening between 1578 and 1640, during which it continued an apanage of Spain.



No sooner had Brazil passed under the Spanish crown, than English adventurers directed their hostile enterprises against its shores. In 1586 Witherington plundered Bahia; in 1591 Cavendish made an abortive attack on Santos; in 1595 Lancaster attacked Olinda. These exploits, however, were transient in their effects. In 1612 the French attempted to found a permanent colony in the island of Marajò, where they succeeded in maintaining themselves till 1618. This attempt led to the erection of Maranhão and Pará into a separate *Estado*. But it was on the part of the Dutch that the most skilful and pertinacious efforts were made for securing a footing in Brazil; and they alone of all the rivals of the Portuguese have left traces of their presence in the national spirit and institutions of Brazil.

***English and French aggressions.***

The success of the Dutch East India Company led to the establishment of a similar one for the West Indies, to which a monopoly of the trade to America and Africa was granted. This body despatched in 1624 a fleet against Bahia. The town yielded almost without a struggle. The fleet soon after sailed, a squadron being detached against Angola, with the intention of taking possession of that colony, in order to secure a supply of slaves. The fall of Bahia for once roused the Spaniards and Portuguese to joint

***Struggle with the Dutch.***

action, and a great expedition speedily sailed from Cadiz and Lisbon for Bahia. Once more, though strongly garrisoned, the town was retaken without any serious fighting in May 1625. The honours bestowed upon the Indian chiefs for their assistance in this war broke down in a great measure the barrier between the two races; and there is at this day a greater admixture of their blood among the better classes in Bahia than is to be found elsewhere in Brazil.

In 1630 the Dutch attempted again to effect a settlement; and Olinda, with its port, the Recife-Olinda, was destroyed, but the Recife was fortified and held, reinforcements and supplies being sent by sea from Holland. The Dutch were unable, however, to extend their power beyond the limits of the town, until the arrival of Count John Maurice of Nassau-Siegen in 1636. His first step was to introduce a regular government among his countrymen; his second, to send to the African coast one of his officers, who took possession of a Portuguese settlement, and thus secured a supply of slaves. In the course of eight years, the limited period of his government, he succeeded in asserting the Dutch supremacy along the coast of Brazil from the mouth of São Francisco to Maranhão. The Recife was rebuilt and adorned with splendid residences and gardens and received from its founder the name of Mauritstad. He promoted the amalgamation of the different races, and sought to conciliate the Portuguese by the confidence he reposed in them. His object was to found a great empire; but this was a project at variance with the wishes of his employers—an association of merchants, who were dissatisfied because the wealth which they expected to see flowing into their coffers was expended in promoting the permanent interests of a distant country. Count Maurice resigned his post in 1644. His successors possessed neither his political nor his military talents, and had to contend with more difficult circumstances.

***Dutch settlement in Brazil.***

In 1640 the revolution which placed the house of Braganza on the throne of Portugal restored Brazil to masters more inclined to promote its interests and assert its possession than the Spaniards. It was indeed high time that some exertion should be made. The northern provinces had fallen into the power of Holland; the southern, peopled in a great measure by the hardy descendants of the successive colonists who had issued on all sides from the central establishment of São Paulo, had learned from their habits of unaided and successful enterprise to court independence. They had ascended the waters of the Paraguay to their sources. They had extended their limits southwards till they reached the Spanish settlements of La Plata. They had reduced to slavery numerous tribes of the natives. They were rich in cattle, and had commenced the discovery of the mines. When, therefore, the inhabitants of São Paulo saw themselves about to be transferred, as a dependency of Portugal, from one master to another, they conceived the idea of erecting their country into an independent state. Their attempt, however, was frustrated by Amador Bueno, the person whom they had selected for their king. When the people shouted “Long live King Amador,” he cried out “Long live John IV.,” and took refuge in a convent. The multitude, left without a leader, acquiesced, and this important province was secured to the house of Braganza.

Rio and Santos, although both evinced a desire of independence, followed the example of the Paulistas. Bahia, as capital of the Brazilian states, felt that its ascendancy depended upon the union with Portugal. The government, thus left in quiet possession of the rest of Brazil, had time to concentrate its attention upon the Dutch conquests. The crown of Portugal was, however, much too weak to adopt energetic measures. But the Brazilian colonists, now that the mother country had thrown off the Spanish yoke, determined even without assistance from the homeland to rise in revolt against foreign domination. The departure of Count Maurice, moreover, had seriously weakened the position of the Dutch, for his successors had neither his conciliatory manners nor his capacity. João Fernandes Vieyra, a native of Madeira, organized the insurrection which broke out in 1645. This insurrection gave birth to one of those wars in which a whole nation, destitute of pecuniary resources, military organization and skilful leaders, but familiar with the country, is opposed to a handful of soldiers advantageously posted and well officered. But home difficulties and financial necessities prevented the West India Company from sending adequate reinforcements from Holland. In 1649 a rival company was started in Portugal known as the Brazil Company, which sent out a fleet to help the colonists in Pernambuco. Slowly the Dutch lost ground and the outbreak of war with England sounded the knell of their dominion in Brazil. In 1654 their capital and last stronghold fell into the hands of Vieyra. It was not, however, till 1662 that Holland signed a treaty with Portugal, by which all territorial claims in Brazil were abandoned in exchange for a cash indemnity and certain commercial privileges. After this, except some inroads on the frontiers, the only foreign invasion which Brazil had to suffer was from France. In 1710 a squadron, commanded by Duclerc, disembarked 1000 men, and attacked Rio de Janeiro. After having lost half of his men in a battle, Duclerc and all his surviving companions were made prisoners. The governor treated them cruelly. A new squadron with 6000 troops was entrusted to the famous admiral Duguay Trouin to revenge this injury. They arrived at Rio on the 12th of September 1711. After four days of hard fighting the town was taken. The governor retreated to a position out of it, and was only awaiting reinforcements from Minas to retake it;

***Revolt against the Dutch.***

***French expedition to Brazil, 1710.***

but, Duguay Trouin threatening to burn it, he was obliged on the 10th of October to sign a capitulation, and pay to the French admiral 610,000 crusados, 500 cases of sugar, and provisions for the return of the fleet to Europe. Duguay Trouin departed to Bahia to obtain fresh spoils; but having lost in a storm two of his best ships, with an important part of the money received, he renounced this plan and returned directly to France.

After this the Portuguese governed their colony undisturbed. The approach of foreign traders was prohibited, while the regalities reserved by the crown drained the country of a great proportion of its wealth.

The important part which the inhabitants of São Paulo have played in the history of Brazil has been already adverted to. The establishment of the Jesuit college had attracted settlers to its neighbourhood, and frequent marriages had taken place between the Indians of the district and the colonists. A hardy and enterprising race of men had sprung from this mixture, who, first searching whether their new country were rich in metals, soon began adventurous raids into the interior, making excursions also against the remote Indian tribes with a view to obtaining slaves, and from the year 1629 onwards repeatedly attacked the Indian reductions of the Jesuits in Paraguay, although both provinces were then nominally subject to the crown of Spain. Other bands penetrated into Minas and still farther north and westward, discovering mines there and in Goyaz and Cuyabá. New colonies were thus formed round those districts in which gold had been found, and in the beginning of the 18th century five principal settlements in Minas Geraes had been elevated by royal charter to the privileges of towns. In 1720 this district was separated from São Paulo, to which it had previously been dependent. As early as 1618 a code of laws for the regulation of the mining industry had been drawn up by Philip III., the executive and judicial functions in the mining districts being vested in a *provedor*, and the fiscal in a treasurer, who received the royal fifths and superintended the weighing of all the gold, rendering a yearly account of all discoveries and produce. For many years, however, these laws were little more than a dead letter. The same infatuated passion for mining speculation which had characterized the Spanish settlers in South America now began to actuate the Portuguese; labourers and capital were drained off to the mining districts, and Brazil, which had hitherto in great measure supplied Europe with sugar, sank before the competition of the English and French. A new source of wealth was now opened up; some adventurers from Villa do Principe in Minas, going north to the Seria Frio, made the discovery of diamonds about the year 1710, but it was not till 1730 that the discovery was for the first time announced to the government, which immediately declared them *regalia*. While the population of Brazil continued to increase, the moral and intellectual culture of its inhabitants was left in great measure to chance; they grew up with those robust and healthy sentiments which are engendered by the absence of false teachers, but with a repugnance to legal ordinances, and encouraged in their ascendancy over the Indians to habits of violence and oppression. The Jesuits from the first moment of their landing in Brazil had constituted themselves the protectors of the natives, and though strenuously opposed by the colonists and ordinary clergy, had gathered the Indians together in many *aldeas*, over which officials of their order exercised spiritual and temporal authority. A more efficacious stop, however, was put to the persecution of the Indians by the importation of large numbers of negroes from the Portuguese possessions in Africa, these being found more active and serviceable than the native tribes.



The Portuguese government, under the administration of Carvalho, afterwards marquis of Pombal, attempted to extend to Brazil the bold spirit of innovation which directed all his efforts.

***Reforms of Pombal.***

The proud minister had been resisted in his plans of reform at home by the Jesuits, and, determining to attack the power of the order, first deprived them of all temporal power in the state of Maranhão and Pará. These ordinances soon spread to the whole of Brazil, and a pretext being found in the suspicion of Jesuit influence in some partial revolts of the Indian troops on the Rio Negro, the order was expelled from Brazil under circumstances of great severity in 1760. The Brazilian Company founded by Vieyra, which so materially contributed to preserve its South American possessions to Portugal, had been abolished in 1721 by John V.; but such an instrument being well suited to the bold spirit of Pombal, he established a chartered company again in 1755, to trade exclusively with Maranhão and Pará; and in 1759, in spite of the remonstrance of the British Factory at Lisbon, formed another company for Parahyba and Pernambuco. Pombal's arrangements extended also to the interior of the country, where he extinguished at once the now indefinite and oppressive claims of the original donatories of the captaincies, and strengthened and enforced the regulations of the mining districts. The policy of many of Pombal's measures is more than questionable; but his admission of all races to equal rights in the eye of the law, his abolition of feudal privileges, and the firmer organization of the powers of the land which he introduced, powerfully co-operated towards the development of the capabilities of Brazil. Yet on the death of his king and patron in 1777, when court intrigue forced him from his high station, he who had done so much for his country's institutions was reviled on all hands.

The most important feature in the history of Brazil during the first thirty years following the retirement of Pombal was the conspiracy of Minas in 1789. The successful issue of the recent

revolution of the English colonies in North America had filled the minds of some of the more educated youth of that province; and in imitation, a project to throw off the Portuguese yoke was formed,—a cavalry officer, Silva Xavier, nicknamed Tira-dentes (tooth-drawer), being the chief conspirator. But the plot being discovered during their inactivity, the conspirators were banished to Africa, and Tira-dentes, the leader, was hanged. Thenceforward affairs went on prosperously; the mining districts continued to be enlarged; the trading companies of the littoral provinces were abolished, but the impulse they had given to agriculture remained.

Removed from all communication with the rest of the world except through the mother country, Brazil remained unaffected by the first years of the great revolutionary war in Europe. Indirectly, however, the fate of this isolated country was decided by the consequences of the French Revolution. Brazil is the only instance of a colony becoming the seat of the government of its own mother country, and this was the work of Napoleon. When he resolved upon the invasion and conquest of Portugal, the prince regent, afterwards Dom John VI., having no means of resistance, decided to take refuge in Brazil. He created a regency in Lisbon, and departed for Brazil on the 29th of November 1807, accompanied by the queen Donna Maria I., the royal family, all the great officers of state, a large part of the nobility and numerous retainers. They arrived at Bahia on the 21st of January 1808, and were received with enthusiasm. The regent was requested to establish there the seat of his government, but a more secure asylum presented itself in Rio de Janeiro, where the royal fugitives arrived on the 7th of March. Before leaving Bahia, Dom John took the first step to emancipate Brazil, opening its ports to foreign commerce, and permitting the export of all Brazilian produce under any flag, the royal monopolies of diamonds and Brazil-wood excepted. Once established in Rio de Janeiro, the government of the regent was directed to the creation of an administrative machinery for the dominions that remained to him as it existed in Portugal. Besides the ministry which had come with the regent, the council of state, and the departments of the four ministries of home, finances, war and marine then existing, there were created in the course of one year a supreme court of justice, a board of patronage and administration of the property of the church and military orders, an inferior court of appeal, the court of exchequer and royal treasury, the royal mint, bank of Brazil, royal printing-office, powder-mills on a large scale, and a supreme military court. The maintenance of the court, and the salaries of so large a number of high officials, entailed the imposition of new taxes to meet these expenses. Notwithstanding this the expenses continued to augment, and the government had recourse to the reprehensible measure of altering the money standard, and the whole monetary system was soon thrown into the greatest confusion. The bank, in addition to its private functions, farmed many of the *regalia*, and was in the practice of advancing large sums to the state, transactions which gave rise to extensive corruption, and terminated some years later in the breaking of the bank.

***Portuguese royal family in Brazil, 1807.***

***Reorganization on Portuguese model.***

Thus the government of the prince regent began its career in the new world with dangerous errors in the financial system; yet the increased activity which a multitude of new customers and the increase of circulating medium gave to the trade of Rio, added a new stimulus to the industry of the whole nation. Numbers of English artisans and shipbuilders, Swedish iron-founders, German engineers and French manufacturers sought fortunes in the new country, and diffused industry by their example.



In the beginning of 1809, in retaliation for the occupation of Portugal, an expedition was sent from Pará to the French colony of Guiana, and after some fighting this part of Guiana was incorporated with Brazil. This conquest was, however, of short duration; for, by the treaty of Vienna in 1815, the colony was restored to France. Its occupation contributed to the improvement of agriculture in Brazil; it had been the policy of Portugal up to this time to separate the productions of its colonies, to reserve sugar for Brazil, and spices to the East Indies, and to prohibit the cultivation of these in the African possessions. Now, however, many plants were imported not only from Guiana but from India and Africa, cultivated in the Royal Botanic Garden, and thence distributed. The same principle which dictated the conquest of French Guiana originated attempts to seize the Spanish colonies of Montevideo and Buenos Aires, Portugal being also at war with Spain. The chiefs of these colonies were invited to place them under the protection of the Portuguese crown, but these at first affecting loyalty to Spain declined the offer, then threw off the mask and declared themselves independent, and the Spanish governor, Elio, was afterwards defeated by Artigas, the leader of the independents.

The inroads made on the frontiers of Rio Grande and São Paulo decided the court of Rio to take possession of Montevideo; a force of 5000 troops was sent thither from Portugal, together with a Brazilian corps; and the irregulars of Artigas, unable to withstand disciplined troops, were forced, after a total defeat, to take refuge beyond the River Uruguay. The Portuguese took possession of the city of Montevideo in January 1817, and the territory of Misiones was afterwards occupied. The importance which Brazil was acquiring decided the regent to give it the title of kingdom, and by decree of the 16th January 1815, the Portuguese sovereignty thenceforward

***Brazil declared an integral portion of the monarchy.***

took the title of the United Kingdom of Portugal, Brazil and Algarves. Thus the old colonial government disappeared even in name. In March 1816 the queen Donna Maria I. died, and the prince regent became king under the title of Dom John VI.

Although Brazil had now become in fact the head of its own mother country, the government was not in the hands of Brazilians, but of the Portuguese, who had followed the court. The discontent arising among Brazilians from this cause was heightened by a decree assigning a heavy tax on the chief Brazilian custom houses, to be in operation for forty years, for the benefit of the Portuguese noblemen who had suffered during the war with France. The amiable character of the king preserved his own popularity, but the government was ignorant and profligate, justice was ill administered, negligence and disorder reigned in all its departments. Nor was the discontent less in Portugal on account of its anomalous position. These causes and the fermentation of liberal principles produced by the French Revolution originated a conspiracy in Lisbon in 1817, which was, however, discovered in time to prevent its success. A similar plot and rebellion took place in the province of Pernambuco, where the inhabitants of the important commercial city of Recife (Pernambuco) were jealous of Rio and the sacrifices they were compelled to make for the support of the luxurious court there. Another conspiracy to establish a republican government was promptly smothered in Bahia, and the outbreak in Pernambuco was put down after a republic had been formed there for ninety days. Still the progress of the republican spirit in Brazil caused Dom João to send to Portugal for bodies of picked troops, which were stationed throughout the provincial capitals. In Portugal the popular discontent produced the revolution of 1820, when representative government was proclaimed—the Spanish constitution of 1812 being provisionally adopted. In Rio, the Portuguese troops with which the king had surrounded himself as the defence against the liberal spirit of the Brazilians, took up arms on the 26th of February 1821, to force him to accept the system proclaimed in Portugal. The prince Dom Pedro, heir to the crown, who now for the first time took part in public affairs, actively exerted himself as a negotiator between the king and the troops, who were joined by bodies of the people. After attempting a compromise the king finally submitted, took the oath and named a new ministry. The idea of free government filled the people with enthusiasm, and the principles of a representative legislature were freely adopted, the first care being for the election of deputies to the Cortes of Lisbon to take part in framing the new constitution. As the king could not abandon Portugal to itself he determined at first to send the prince thither as regent, but Dom Pedro had acquired such popularity by his conduct in the revolution, and had exhibited such a thirst for glory, that the king feared to trust his adventurous spirit in Europe, and decided to go himself. The Brazilian deputies on arriving in Lisbon expressed dissatisfaction with the Cortes for having begun the framing of the constitution before their arrival, for Brazil could not be treated as a secondary part of the monarchy. Sharp discussions and angry words passed between the Brazilian and Portuguese deputies, the news of which excited great discontent in Brazil. An insulting decree was passed in the Cortes, ordering the prince Dom Pedro to come to Europe, which filled the Brazilians with alarm; they foresaw that without a central authority the country would fall back to its former colonial state subject to Portugal. The provisional government of São Paulo, influenced by the brothers Andrada, began a movement for independence by asking the prince to disobey the Cortes and remain in Brazil, and the council of Rio de Janeiro followed with a similar representation, to which the prince assented. The Portuguese troops of the capital at first assumed a coercive attitude, but were forced to give way before the ardour and military preparations of the Brazilians, and submitted to embark for Portugal. These scenes were repeated in Pernambuco, where the Portuguese, after various conflicts, were obliged to leave the country; in Bahia, however, as well as in Maranhão and Pará, the Portuguese prevailed. In the agitation for independence continued. The two brothers Andrada were called to the ministry; and the municipal council conferred upon the prince regent the title of Perpetual Defender of Brazil. With great activity he set off to the central provinces of Minas and São Paulo to suppress disaffected movements and direct the revolution. In São Paulo, on the 7th of September 1822, he proclaimed the independence of Brazil. On his return to Rio de Janeiro on the l2th of October he was proclaimed constitutional emperor with great enthusiasm.

***Pedro proclaims the independence of Brazil, 1822.***

The Cortes at Lisbon chose Bahia as a centre for resisting the independence, and large forces were sent thither. But the city was vigorously besieged by the Brazilians by land, and finally the Portuguese were obliged to re-embark on the 2nd of July 1823. A Brazilian squadron, under command of Lord Cochrane, attacked the Portuguese vessels, embarrassed with troops, and took several of them. Taylor, another Englishman in Brazilian service, followed the vessels across the Atlantic, and even captured some of the ships in sight of the land of Portugal. The troops in Montevideo also embarked for Portugal, and the Banda Oriental remained a part of Brazil with the title of the *Provincia Cisplatina*. Before the end of 1823 the authority of the new emperor and the independence of Brazil were undisputed throughout the whole country.

Republican movements now began to spread, to suppress which the authorities made use of the Portuguese remaining in the country; and the disposition of the emperor to consider these as his firmest supporters much influenced the course of his government and his future destiny. The two

Andradas, who imagined they could govern the young emperor as a sovereign of their own creation, encountered great opposition in the constitutional assembly, which had been opened in Rio in May 1823, to discuss the project of a new constitution. In July the emperor resolved to dismiss them and form a new ministry, but against this the brothers raised a violent opposition. In November the emperor put an end to the angry debates which ensued in the assembly by dissolving it, exiling the Andradas to France, and convoking a new assembly to deliberate on a proposed constitution more liberal than the former project. The proclamation of a republic in the provinces of Pernambuco and Ceará, with the rebellion of the Cisplatina province, favoured by Buenos Aires and its ultimate loss to Brazil, were the result of the *coup d'état* of November 1823. The Brazilians were universally discontented—on one side fearing absolutism if they supported the emperor, on the other anarchy if he fell. Knowing the danger of an undefined position, the emperor caused the councils to dispense with their deliberations, and adopt, as the constitution of the empire, the project framed by the council of state. Accordingly, on the 25th of March 1824, the emperor swore to the constitution with great solemnity and public rejoicings. By this stroke of policy he saved himself and Brazil. Negotiations were opened in London between the Brazilian and Portuguese plenipotentiaries, treating for the recognition of the independence of Brazil; and on the 25th of August 1825 a treaty was signed by which the Portuguese king, Dom John VI., assumed the title of emperor of Brazil, and immediately abdicated in favour of his son, acknowledging Brazil as an independent empire, but the treaty obliged Brazil to take upon herself the Portuguese debt, amounting to nearly two millions sterling.



***Constitution of 1824.***

The rebellion of the Banda Oriental was followed by a declaration of war with Buenos Aires which had supported it, and operations by sea and land were conducted against that republic in a feeble way. Meanwhile the well-deserved popularity of the emperor began to decline. He had given himself up to the influence of the Portuguese; the most popular men who had worked for the independence were banished; and a continual change of ministry showed a disposition on the part of the sovereign to prosecute obstinately measures of which his advisers disapproved. His popularity was regained, however, to some extent, when, on the death of his father, he was unanimously acknowledged king of Portugal, and especially when he abdicated that crown in favour of his daughter, Donna Maria; but his line of policy was not altered, and commercial treaties entered into with European states conceding them favours, which were popularly considered to be injurious to Brazilian trade, met with bitter censure.

During the year 1827 the public debt was consolidated, and a department was created for the application of a sinking fund.

The year 1828 was a calamitous one for Brazil. It began with the defeat of the Brazilian army by the Argentine forces, and this entirely through the incapacity of the commander-in-chief; and misunderstandings, afterwards compensated by humbling money-payments on the part of Brazil, arose with the United States, France and England on account of merchant vessels captured by the Brazilian squadron blockading Buenos Aires. Financial embarrassments increased to an alarming extent; the emperor was compelled by the British government to make peace with Buenos Aires and to renounce the Banda Oriental; and to fill the sum of disasters Dom Miguel had treacherously usurped the crown of Portugal. It was under these unlucky auspices that the elections of new deputies took place in 1829. As was expected the result was the election everywhere of ultra-liberals opposed to the emperor, and in the succeeding year people everywhere exhibited their disaffection. During the session of 1830 the chambers adopted a criminal code in which punishment by death for political offences was abolished. It was openly suggested in the journals to reform the constitution by turning Brazil into independent federal provinces, governed by authorities popularly elected, as in the United States. Alarmed at length at the ground gained by this idea in the provinces, the emperor set off to Minas to stir up the former enthusiasm in his favour from recollections of the independence, but was coldly received. On his return to Rio in March 1831 scenes of disorder occurred, and great agitation among the Liberal party. Imagining himself sure of a brilliant destiny in Europe if he lost his Brazilian crown, the emperor attempted to risk a decisive attack against the Liberals, and to form a new ministry composed of men favourable to absolutism. This step caused excited public meetings in the capital, which were joined in by the troops, and deputations went to ask the emperor to dismiss the unpopular ministry. He replied by dissolving the ministry without naming another, and by abdicating the crown in favour of the heir apparent, then only five years of age. Dom Pedro immediately embarked in an English ship, leaving the new emperor Dom Pedro II. and the princesses Januaria, Francisca and Paula. The subsequent career of this unfortunate prince belongs to the history of Portugal.

***Abdication of Pedro I., 1831.***

A provisional and afterwards a permanent regency, composed of three members, was now formed in Brazil, but scenes of disorder succeeded, and discussions and struggles between the republican party and the government, and a reactionary third party in favour of the restoration of Dom Pedro, occupied the succeeding years. In 1834 a reform which was well received consisted in the alteration of the regency, from that of three members elected by the legislative chambers,

to one regent chosen by the whole of the electors in the same manner as the deputies; and the councils of the provinces were replaced by legislative provincial assemblies. Virtually, this was a republican government like that of the United States, for no difference existed in the mode of election of the regent from that of a president. The ex-minister Feijoó was chosen for this office. With the exception of Pará and Rio Grande the provinces were at peace, but these were in open rebellion; the former was reduced to obedience, but in the latter, though the imperial troops occupied the town, the country was ravaged by its warlike inhabitants. The regent was now accused of conniving at this rebellion, and the opposition of the chamber of deputies became so violent as to necessitate his resignation. Araujo Lima, minister of the home department, who strove to give his government the character of a monarchical reaction against the principles of democracy, was chosen by a large majority in his stead. The experiment of republican government had proved so discreditable, and had so wearied the country of cabals, that men hitherto known for their sympathy with democratic principles became more monarchical than the regent himself; and under this influence a movement to give the regency into the hands of the princess Donna Januaria, now in her 18th year, was set on foot. It was soon perceived, however, that if the empire could be governed by a princess of eighteen it could be managed better by the emperor himself, who was then fourteen.

A bill was accordingly presented to the legislature dispensing with the age of the emperor and declaring his majority, which after a noisy discussion was carried. The majority of the emperor Dom Pedro II. was proclaimed on the 23rd of July 1840. Several ministries, in which various parties predominated for a time, now governed the country till 1848, during which period the rebellious province of Rio Grande was pacified, more by negotiation than force of arms. In 1848 hostilities were roused with the British government through the neglect shown by the Brazilians in putting in force a treaty for the abolition of the slave trade, which had been concluded as far back as 1826; on the other hand the governor of Buenos Aires, General Rosas, was endeavouring to stir up revolution again in Rio Grande. The appearance of yellow fever in 1849, until then unknown in Brazil, was attributed to the importation of slaves. Public opinion declared against the traffic; severe laws were passed against it, and were so firmly enforced that in 1853 not a single disembarkation took place. The ministry of the Visconde de Olinda in 1849 entered into alliances with the governors of Montevideo, Paraguay and the states of Entre Rios and Corrientes, for the purpose of maintaining the integrity of the republics of Uruguay and Paraguay, which Rosas intended to reunite to Buenos Aires, and the troops of Rosa’s which besieged Montevideo were forced to capitulate. Rosas then declared war formally against Brazil. An army of Correntine, Uruguayan and Brazilian troops, under General Urquiza, assisted by a Brazilian naval squadron, advanced on Buenos Aires, completely routed the forces of Rosas, and crushed for ever the power of that dictator. From 1844 Brazil was free from intestine commotions, and had resumed its activity. Public works and education were advanced, and the finances rose to a degree of prosperity previously unknown.

***Majority of Pedro II., 1840.***



In 1855 the emperor of Brazil sent a squadron of eleven men-of-war and as many transports up the Paraná to adjust several questions pending between the empire and the republic of Paraguay, the most important of which was that of the right of way by the Paraguay river to the interior Brazilian province of Matto Grosso. This right had been in dispute for several years. The expedition was not permitted to ascend the river Paraguay, and returned completely foiled in its main purpose. Though the discord resulting between the states on account of this failure was subsequently allayed for a time by a treaty granting to Brazil the right to navigate the river, every obstacle was thrown in the way by the Paraguayan government, and indignities of all kinds were offered not only to Brazil but to the representatives of the Argentine and the United States. In 1864 the ambitious dictator of Paraguay, Francisco Solano Lopez, without previous declaration of war, captured a Brazilian vessel in the Paraguay, and rapidly followed up this outrage by an armed invasion of the provinces of Matto Grosso and Rio Grande in Brazil, and that of Corrientes in the Argentine Republic. A triple alliance of the invaded states with Uruguay ensued, and the tide of war was soon turned from being an offensive one on the part of Paraguay to a defensive struggle within that republic against the superior number of the allies. So strong was the natural position of Paraguay, however, and so complete the subjection of its inhabitants to the will of the dictator, that it was not until the year 1870, after the republic had been completely drained of its manhood and resources, that the long war was terminated by the capture and death of Lopez with his last handful of men by the pursuing Brazilians. From its duration and frequent battles and sieges this war involved an immense sacrifice of life to Brazil, the army in the field having been constantly maintained at between 20,000 and 30,000 men, and the expenditure in maintaining it was very great, having been calculated at upwards of fifty millions sterling. Large deficits in the financial budgets of the state resulted, involving increased taxation and the contracting of loans from foreign countries.

***War with Paraguay.***

Notwithstanding this the sources of public wealth in Brazil were unaffected, and commerce continued steadily to increase. A grand social reform was effected in the law passed in

September 1871, which enacted that from that date every child born of slave parents should be free, and also declared all the slaves belonging to the state or to the imperial household free from that time. The same law provided an emancipation fund, to be annually applied to the ransom of a certain number of slaves owned by private individuals.

***Character of Pedro II.'s reign.***

Under the long reign of Dom Pedro II. progress and material prosperity made steady advancement in Brazil. Occasional political outbreaks occurred, but none of very serious nature except in Rio Grande do Sul, where a long guerrilla warfare was carried on against the imperial authority. The emperor occupied himself to a far greater extent with the economic development of his people and country than with active political life. Unostentatious in his habits, Dom Pedro always had at heart the true interests of the Brazilians. Himself a highly-educated man, he sincerely desired to further the cause of education, and devoted a large portion of his time to the study of this question. His extreme liberalism prevented his opposing the spread of Socialist doctrines preached far and wide by Benjamin Constant. Begun about 1880, this propaganda took deep root in the educated classes, creating a desire for change and culminating in the military conspiracy of November 1889, by which monarchy was replaced by a republican form of government.

At first the revolutionary propaganda produced no personal animosity against the emperor, who continued to be treated by his people with every mark of respect and affection, but this state of things gradually changed. In 1864 the princess Isabella, the eldest daughter of the emperor and empress, had married the Comte d'Eu, a member of the Orleans family. The marriage was never popular in the country, owing partly to the fact that the Comte d'Eu was a reserved man who made few intimate friends and never attempted to become a favourite. Princess Isabella was charitable in many ways, always ready to take her full share of the duties falling upon her as the future empress, and thoroughly realizing the responsibilities of her position; but she was greatly influenced by the clerical party and the priesthood, and she thereby incurred the hostility of the Progressives. When Dom Pedro left Brazil for the purpose of making a tour through Europe and the United States he appointed Princess Isabella to act as regent, and she showed herself so swayed in political questions by Church influence that Liberal feeling became more and more anti-dynastic. Another incident which gave strength to the opposition was the sudden abolition of slavery without any compensation to slave-owners. The planters, the principal possessors of wealth, regarded the measure as unnecessary in view of the act which had been passed in 1885 providing for the gradual freeing of all slaves. The arguments used were, however, of no avail with the regent, and the decree was promulgated on the 13th of May 1888. No active opposition was offered to this measure, but the feelings of unrest and discontent spread rapidly.

***Establishment of the Republic, 1889.***

Towards the close of 1888 the emperor returned and was received by the populace with every demonstration of affection and esteem. Even among the advocates of republicanism there was no intention of dethroning Dom Pedro, excepting a few extreme members of the party, now gained the upper hand. They argued that it would be much more difficult to carry out a successful coup *d'état* when the good-natured, confiding emperor had been succeeded by his more suspicious and energetic daughter. Discontented officers in the army and navy rallied to this idea, and a conspiracy was organized to depose the emperor and declare a republic. On the 14th of November 1889 the palace was quietly surrounded, and on the following morning the emperor and his family were placed on board ship and sent off to Portugal. A provisional government was then formed and a proclamation issued to the effect that the country would henceforth be known as the United States of Brazil, and that in due time a republican constitution would be framed. The only voice raised in protest was that of the minister of war, and he was shot at and severely wounded as a consequence. Dom Pedro, completely broken down by the ingratitude of the people whom he had loved so much and laboured for so strenuously, made no attempt at resistance. The republican government offered to compensate him for the property he had held in Brazil as emperor, but this proposal was declined. His private possessions were respected, and were afterwards still held by Princess Isabella.

The citizen named as president of the provisional government, was General Deodoro da Fonseca, who owed his advancement to the personal friendship and assistance of Dom Pedro. Second in authority was placed General Floriano Peixoto, an officer also under heavy obligations to the deposed monarch, as indeed were nearly all of those who took active part in the conspiracy.

***Brazil under the Republic.***

Though the overthrow of the imperial dynasty was totally unexpected throughout, the new regime was accepted without any disturbances. Under the leadership of General Deodoro da Fonseca a praetorian system of government, in which the military element was all-powerful, came into existence, and continued till February 1891, when a national congress assembled and formulated the constitution for the United States of Brazil. The former provinces were converted into states, the only right of the federal government to interfere in their administration being for the purposes of national defence, the maintenance of public order or the enforcement of the federal laws. The constitution

of the United States of America was taken as a model for drawing up that of Brazil, and the general terms were as far as possible adhered to (see above, section *Government*).

General da Fonseca and General Floriano Peixoto were elected to fill the offices of president and vice-president until the 15th of November 1894. This implied the continuance of praetorian methods of administration. The older class of more conservative Brazilians, who had formerly taken part in the administration under the emperor, withdrew altogether from public life. Many left Brazil and went into voluntary exile, while others retired to their estates. In the absence of these more respectable elements, the government fell into the hands of a gang of military adventurers and unscrupulous politicians, whose only object was to exploit the national resources for their own benefit. As a consequence, deep-rooted discontent rapidly arose. A conspiracy, of which Admiral Wandenkolk was the prime instigator, was discovered, and those who had taken part in it were banished to the distant state of Amazonas. Disturbances then broke out in Rio Grande do Sul, in consequence of disputes between the official party and the people living in the country districts. Under the leadership of Gumercindo Saraïva the country people broke into open revolt in September 1891. This outbreak was partially suppressed, but afterwards it again burst into flame with great vigour. In view of the discontent, conspiracies and revolutionary movements, President da Fonseca declared himself dictator. This act, however, met with such strong opposition that he resigned office on the 23rd of November 1891, and Vice-President Floriano Peixoto assumed the presidency.

Floriano Peixoto had been accustomed all his life to use harsh measures. For the first year of his term of office he kept seditious attempts in check, but discontent grew apace. Nor was this surprising to those who knew the corruption in the administration. Concessions and subsidies were given broadcast for worthless undertakings in order to benefit the friends of the president. Brazilian credit gave way under the strain, and evidences were not wanting at the beginning of 1893 that an outburst of public opinion was not far distant. Nevertheless President Peixoto made no effort to reform the methods of administration. Meanwhile, the revolution in Rio Grande do Sul had revived; and in July 1893 the federal government was forced to send most of the available regular troops to that state to hold the insurgents in check.

***Naval revolt and civil war, 1893.***

On the 6th of September prevailing discontent took definite shape in the form of a naval revolt in the Bay of Rio de Janeiro. Admiral Custodio de Mello took command of the naval forces, and demanded the resignation of the president. General Peixoto replied by organizing a defence against any attack from the squadron. Admiral Mello, finding that his demands were not complied with, began a bombardment of the city, but did not effect his purpose of compelling Peixoto to resign. The foreign ministers then arranged a compromise between the contending parties, according to which President Peixoto was to place no artillery in the city, while Admiral Mello was to refrain from bombarding the town, which was thus saved from destruction. Shortly afterwards the cruiser “Republica” and a transport ran the gauntlet of the government forts at the entrance of the bay, and proceeded south to the province of Santa Catharina, taking possession of Desterro, its capital. A provisional government was proclaimed by the insurgents, with headquarters at Desterro, and communication was opened with Gumercindo Saraïva, the leader of the insurrection in Rio Grande do Sul. It was proposed that the army of some 10,000 men under his command should advance northwards towards Rio de Janeiro, while the insurgent squadron threatened the city of Rio. In November Admiral Mello left Rio de Janeiro in the armoured cruiser “Aquidaban” and went to Desterro, the naval forces in Rio Bay being left in charge of Admiral Saldanha da Gama, an ardent monarchist, who had thrown in his lot with the insurgent cause. All was, apparently, going well with the revolt, Saraïva having invaded the states of Santa Catharina and Paraná, and defeated the government troops in several encounters. Meanwhile, President Peixoto had fortified the approaches to the city of Rio de Janeiro, bought vessels of war in Europe and the United States and organized the National Guard.

Early in 1894 dissensions occurred between Saraïva and Mello, which prevented any advance of the insurgent forces, and allowed Peixoto to perfect his plans. Admiral da Gama, unable to leave the Bay of Rio de Janeiro on account of lack of transport for the sick and wounded and the civilians claiming his protection, could do no more than wait for Admiral Mello to return from Desterro. In the meantime the ships bought by President Peixoto arrived off Rio de Janeiro and prevented da Gama from escaping. On the 15th of March 1894 the rebel forces evacuated their positions on the islands of Villegaignon, Cobras and Enxadas, abandoned their vessels, and were received on board two Portuguese warships then in the harbour, whence they were conveyed to Montevideo. The action of the Portuguese commander was prompted by a desire to save life, for had the rebels fallen into the hands of Peixoto, they would assuredly have been executed.

When the news of the surrender of Saldanha da Gama reached Gumercindo Saraïva, then at Curitiba in Paraná, he proceeded to retire to Rio Grande do Sul. Government troops were despatched to intercept his retreat, and in one of the skirmishes which followed Saraïva was killed. The rebel army then dispersed. Admiral Mello made an unsuccessful attack on the town of Rio Grande, and then sailed to Buenos Aires, there surrendering the rebel squadron to the

Argentine authorities, by whom it was immediately delivered to the Brazilian government. After six months of civil war peace was once more established, but there still remained some small rebel groups in Rio Grande do Sul. These were joined by Admiral da Gama and a number of the naval officers, who had escaped from Rio de Janeiro; but in June 1895 the admiral was killed in a fight with the government troops. After the cessation of hostilities, the greatest barbarities were practised upon those who, although they had taken no part in the insurrection, were known to have desired the overthrow of President Peixoto. The baron Cerro Azul was shot down without trial; Marshal de Gama Eza, an old imperial soldier of eighty years of age, was murdered in cold blood, and numerous executions of men of lesser note took place, among these being two Frenchmen for whose death the Brazilian government was subsequently called upon to pay heavy compensation.

General Peixoto was succeeded as president on the 15th of November 1894 by Dr Prudente de Moraes Barros. It was a moot question whether Peixoto, after the revolt was crushed, would not declare himself dictator; certainly many of his friends were anxious that he should follow this course, but he was broken down by the strain which had been imposed upon him and was glad to surrender his duties. He did not recover his health and died shortly afterwards.

From the first day that he assumed office, President Moraes showed that he intended to suppress praetorian systems and reduce militarism to a minimum. This policy received the approval and sympathy of the majority of Brazilians, but naturally met with bitter opposition from the military element. The president gradually drew to him some members of the better conservative class to assist in his administration, and felt confident that he had the support of public opinion. Early in 1895 murmurings and disorderly conduct against the authorities began to take place in the military school at Rio de Janeiro, which had always been a hotbed of intrigue. Some of the officers and students were promptly expelled, and the president closed the school for several months. This salutary lesson had due effect, and no more discontent was fomented from that quarter. Two great difficulties stood in the way of steering the country to prosperity. The first was the chaotic confusion of the finances resulting from the maladministration of the national resources since the deposition of Dom Pedro II., and the corruption that had crept into every branch of the public service. Much was done by President Moraes to correct abuses, but the task was of too herculean a nature to allow of accomplishment within the four years during which he was at the head of affairs. The second difficulty was the war waged by religious fanatics under the leadership of Antonio Maciel, known as “Conselheiro,” against the constituted authorities of Brazil.



The story of Conselheiro is a remarkable one. A native of Pernambuco, when a young man he married against the wishes of his mother, who took a violent dislike to the bride. Shortly after the marriage the mother assured her son that his wife held clandestine meetings with a lover, and stated that if he would go to a certain spot not far from the house that evening he would himself see that her assertion was true. The mother invented some plea to send the wife to the trysting-place, and then, dressing herself in male clothing, prepared to come suddenly on the scene as the lover, trusting to be able to make her escape before she was recognized. The three met almost simultaneously. Conselheiro, deeming his worst suspicions confirmed, shot and killed his wife and his mother before explanations could be offered. He was tried and allowed to go at liberty after some detention in prison. From that time Conselheiro was a victim of remorse, and to expiate his sin became a missionary in the *sertao* or interior of Brazil among the wild Jagunço people. He built places of worship in many different districts, and at length became the recognized chief of the people among whom he had thus strangely cast his lot. Eventually he formed a settlement near Canudos, situated about 400 m. inland from Bahia. Difficulty arose between the governor of Bahia and this fanatical missionary, with the result that Conselheiro was ordered to leave the settlement and take away his people. This order was met with a sturdy refusal to move. Early in 1897 a police force was sent to eject the settlers, but encountered strong resistance, and suffered heavy loss without being able to effect the purpose intended. In March 1897 a body of 1500 troops, with four guns, was despatched to bring the Jagunçoes to reason, but was totally defeated. An army comprising some 5000 officers and men was then sent to crush Conselheiro and his people at all costs. Little progress was made, the country being difficult of access and the Jagunçoes laying ambuscades at every available place. Finally strong reinforcements were sent forward, the minister of war himself proceeding to take command of the army, now numbering nearly 13,000 men. Canudos was besieged and captured in September 1897, Conselheiro being killed in the final assault. The expense of these expeditions was very heavy, and prevented President Moraes from carrying out many of the retrenchments he had planned.

Soon after the Canudos affair a conspiracy was hatched to assassinate the president. He was watching the disembarkation of some troops when a shot was fired which narrowly missed him, and killed General Bitencourt, the minister of war. The actual perpetrator of the deed, a soldier, was tried and executed, but he was apparently ignorant of the persons who procured his services. Three other men implicated in the conspiracy were subsequently sentenced to imprisonment for a term of thirty years. The remainder of the presidency of Dr Moraes was uneventful; and on the 15th of November 1898 he was succeeded by Dr Campos Salles, who had previously been

governor of the state of São Paulo. President Salles publicly promised political reform, economy in the administration, and absolute respect for civil rights, and speedily made efforts to fulfil these pledges.

The difficulties in the reorganization of the finances of the state, which Dr Campos Salles had to face on his accession to power, were very great. The heavy cost involved in the suppression of internal disorders, maladministration, and the hindrances placed in the way of economical development by the semi-independence of the federal states had seriously depreciated the national credit. The president-elect accordingly undertook with the full approval of Dr Moraes, who was still in office, the task of visiting Europe with the object of endeavouring to make an arrangement with the creditors of the state for a temporary suspension of payments. He was successful in his object, and an agreement was made by which bonds should be issued instead of interest payments from the 1st of July 1898, the promise being given that every effort should be made for the resumption of cash payments in 1901. President Campos Salles entered upon his tenure of office on the 15th of November 1898, and at once proceeded to initiate fiscal legislation for the purpose of reducing expenditure and increasing the revenue. He had to face opposition from sectional interests and from the jealousy of interference with their rights on the part of provincial administrations, but he was able to achieve a considerable measure of success and to lay the foundation of a sounder system under which the financial position of the republic has made steady progress. The chief feature of the administration of Dr Campos Salles was the statesmanlike ability with which various disputes with foreign powers on boundary questions were seriously taken in hand and brought to a satisfactory and pacific settlement. There had for a long period been difficulties with France with regard to the territory which lay between the mouth of the Amazon and Cayenne or French Guiana. The language of various treatises was doubtful and ambiguous, largely owing to the ignorance of the diplomatists who drew up the articles of the exact geography of the territory in question. Napoleon had forced the Portuguese government to cede to him the northernmost arm of the mouth of the Amazon as the southern boundary of French Guiana with a large slice of the unexplored interior westwards. A few years later the Portuguese had in their turn conquered French Guiana, but had been compelled to restore it at the peace of Paris. The old ambiguity attaching to the interpretation of earlier treaties, however, remained, and in April 1899 the question by an agreement between the two states was referred to the arbitration of the president of the Swiss confederation. The decision was given in December 1900 and was entirely in favour of the Brazilian contention. A still more interesting boundary dispute was that between Great Britain and Brazil, as to the southern frontier line of British Guiana. The dispute was of very old standing, and the settlement by arbitration in 1899 of the acute misunderstanding between Great Britain and Venezuela regarding the western boundary of British Guiana, and the reference to arbitration in that same year of the Franco-Brazilian dispute, led to an agreement being made in 1901 between Brazil and Great Britain for the submission of their differences to the arbitration of the king of Italy. The district in dispute was the site of the fabled Lake of Parima and the Golden City of Manoa, the search for which in the early days of European settlement attracted so many adventurous expeditions, and which fascinated the imagination of Raleigh and drew him to his doom. The question was a complicated one involving the historical survey of Dutch and Portuguese exploration and control in the far interior of Guiana during two centuries; and it was not until 1904 that the king of Italy gave his award, which was largely in favour of the British claim, and grants to British Guiana access to the northern affluents of the Amazon. Before this decision was given Senhor Rodrigues Alves had been elected president in 1902. Dr Campos Salles had signalized his administration, not only by the settlement of disputes with European powers, but by efforts to arrive at a good understanding with the neighbouring South American republics. In July 1899 President Roca had visited Rio de Janeiro accompanied by an Argentine squadron, this being the first official visit that any South American president had ever paid to one of the adjoining states. In October 1900 Dr Campos Salles returned the visit and met with an excellent reception at Buenos Aires. The result was of importance, as it was known that Brazil was on friendly terms with Chile, and this interchange of courtesies had some effect in bringing about a settlement of the controversy between Chile and Argentina over the Andean frontier question without recourse to hostilities. This was indeed a time when questions concerning boundaries were springing up on every side, for it was only through the moderation with which the high-handed action of Bolivia in regard to the Acré rubber-producing territory was met by the Brazilian government that war was avoided. Negotiations were set on foot, and finally by treating the matter in a give-and-take spirit a settlement was reached and a treaty for an amicable exchange of territories in the district in question, accompanied by a pecuniary indemnity, was signed by President Alves at Petropolis on the 17th of November 1903. During the remainder of the term of this president internal and financial progress were undisturbed save by an outbreak in 1904 in the Cunani district, the very portion of disputed territory which had been assigned to Brazil by the arbitration with France. This province, being difficult of access, was able for a time to assert a practical independence. In 1906 Dr Affonso Penna, three times minister under Pedro II., and at that time governor of the state of Minas-Geraes, of which he had founded the new

***Reform under President Campos Salles.***

capital, Bello Horizonte, was elected president, a choice due to a coalition of the other states against São Paulo, to which all the recent presidents had belonged. Penna's presidency was distinguished by his successful efforts to place the finances on a sound basis. He died in office on the 14th of June 1909.

(K. J.; C. E. A.; G. E.)

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1 The areas are reduced from the planimetrical calculations made at Gotha and used by A. Supan in *Die Bevölkerung der Erde* (1904). They are corrected to cover all boundary changes to 1906.

2 The census of 1890 is the last one of which complete returns are published. That of 1900 was notoriously inaccurate in many instances.

3 The census returns are for municipalities, and not for cities proper. As a municipality covers a large extent of country, the population given is larger than that of the urban parishes, and is therefore not strictly correct according to European practice.

4 The Brazilian official titles are given for the state capitals: Belem for Pará; São Luiz for Maranhão; São Salvador for Bahia; and Recife for Pernambuco.

5 The capital of Minas Geraes in 1890 was Ouro Preto; it has since been transferred to Bello Horizonte, or Cidade de Minas, which has an estimated population of 25,000.

6 Since the naval revolt of 1893-1894 the name of the capital of Santa Catharina has been changed from Desterro to Florianopolis in honour of President Floriano Peixoto.

7 The "bran" exported is from imported wheat and cannot be considered a national product.

8 The "old metals" consist of old iron, brass, &c., derived from railway material, machinery, &c., all imported, and should not be considered a Brazilian product.

The "sundry products" would probably be included in the four general classes were the items given.

9 Previous to 1907 these two departments were united in one under the designation of "Industry, Communications and Public Works." The division was decreed December 29, 1906.

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**BRAZIL,** a city and the county-seat of Clay county, Indiana, U.S.A., situated in the west central part of the state, about 16 m. E. of Terre Haute and about 57 m. W.S.W. of Indianapolis. Pop. (1890) 5905; (1900) 7786 (723 foreign-born); (1910) 9340. It is served by the Central Indiana, the

Chicago & Eastern Illinois, the Evansville & Indianapolis and the Vandalia railways, and is connected with Indianapolis, Terre Haute and other cities by an interurban electric line. The principal business thoroughfare is part of the old National Road. Brazil's chief industrial importance is due to its situation in the heart of the "Brazil block" coal (so named because it naturally breaks into almost perfect rectangular blocks) and clay and shale region; among its manufactures are mining machinery and tools, boilers, paving and enamelled building bricks, hollow bricks, tiles, conduits, sewer-pipe and pottery. The municipality owns and operates its water-works. The first settlement here was in 1844; and Brazil was incorporated as a town in 1866, and was chartered as a city in 1873.

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**BRAZIL NUTS,** the seeds of *Bertholletia excelsa*, a gigantic tree belonging to the natural order Lecythidaceae, which grows in the valleys of the Amazons and generally throughout tropical America. The tree attains an average height of 130 ft., having a smooth cylindrical trunk, with a diameter of 14 ft. 50 ft. from the ground, and branching at a height of about 100 ft. The lower portion of the trunk presents a buttressed aspect, owing to the upward extension of the roots in the form of thin prop-like walls surrounding the stem. The fruit of the tree is globular, with a diameter of 5 or 6 in., and consists of a thick hard woody shell, within which are closely packed the seeds which constitute the so-called nuts of commerce. The seeds are triangular in form, having a hard woody testa enclosing the "kernel"; and of these each fruit contains from eighteen to twenty-five. The fruits as they ripen fall from their lofty position, and they are at the proper season annually collected and broken open by the Indians. Brazil nuts are largely eaten; they also yield in the proportion of about 9 oz. to each lb of kernels a fine bland fluid oil, highly valued for use in cookery, and used by watchmakers and artists.

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**BRAZIL WOOD,** a dye wood of commercial importance, obtained from the West Indies and South America, belonging to the genera *Caesalpinia* and *Peltophorum* of the natural order Leguminosae. There are several woods of the kind, commercially distinguished as Brazil wood, Nicaragua or Peach wood, Pernambuco wood and Lima wood, each of which has a different commercial value, although the tinctorial principle they yield is similar. Commercial Brazil wood is imported for the use of dyers in billets of large size, and is a dense compact wood of a reddish brown colour, rather bright when freshly cut, but becoming dull on exposure. The colouring-matter of Brazil wood, brazilin, $C_{16}H_{14}O_5$, crystallizes with 1½ $H_2O$, and is freely soluble in water; it is extracted for use by simple infusion or decoction of the coarsely-powdered wood. When freshly prepared the extract is of a yellowish tint; but by contact with the air, or the addition of an alkaline solution, it develops a brick-red colour. This is due to the formation of brazilein, $C_{16}H_{12}O_5 \cdot H_2O$, which is the colouring matter used by the dyer. Brazilin crystallizes in hexagonal amber yellow crystals, which are soluble in water and alcohol. The solution when free of oxygen is colourless, but on the access of air it assumes first a yellow and thereafter a reddish yellow colour. With soda-ley it takes a brilliant deep carmine tint, which colour may be discharged by heating in a closed vessel with zinc dust, in which condition, the solution is excessively sensitive to oxygen, the slightest exposure to air immediately giving a deep carmine. With tin mordants Brazil wood gives brilliant but fugitive steam reds in calico-printing; but on account of the loose nature of its dyes it is seldom used except as an adjunct to other colours. It is used to form lakes which are employed in tinting papers, staining paper-hangings, and for various other decorative purposes.

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**BRAZING AND SOLDERING,** in metal work, termed respectively hard and soft soldering, are processes which correspond with soldering done at high and at low temperatures. The first embraces jointing effected with soldering mixtures into which copper, brass, or silver largely enter, the second those in which lead and tin are the only, or the principal, constituents. Some metals, as aluminium and cast iron, are less easily soldered than others. Aluminium, owing to its high conductivity, removes the heat from the solder rapidly. Aluminium enters into the composition of most of the solders for these metals, and the "soldering bit" is of pure nickel.

The hard solders are the spelter and the silver solders. Soft spelter solder is composed of equal parts of copper and zinc, melted and granulated and passed through a sieve. As some of the zinc volatilizes the ultimate proportions are not quite equal. The proportion of zinc is increased if the solder is required to be softer or more fusible. A valuable property of the zinc is that its volatilization indicates the fusing of the solder. Silver solder is used for jewelry and other fine metal work, arid has the advantage of high fusing points. The hardest contains from 4 parts of silver to 1 of copper; the softest 2 of silver to 1 of brass wire. Borax is the flux used, with silver solder as with spelter.



The soft solders are composed mainly of tin and lead. They occur in a large range. Common tinner's solder is composed of equal parts of tin and lead, and melts at 370° Fah. Plumber's solder has 2 of lead to 1 of tin. Excess of lead in plumber's solder renders the solder difficult to work, excess of tin allows it to melt too easily. Pewterers add bismuth to render the solder more fusible, *e.g.* lead 4, tin 3, bismuth 2; or lead 1, tin 2, bismuth 1. Unless these are cooled quickly the bismuth separates out.

The essentials of a soldered joint are the contact of absolutely clean surfaces, free from oxide and dirt. The surfaces are therefore scraped, filed and otherwise treated, and then, in order to cleanse and preserve them from any trace of oxide which might form during subsequent manipulation, a fluxing material is used. The soldering material is compelled to follow the areas prepared for it by the flux, and it will not adhere anywhere else. There is much similarity between soldering and welding in this respect. A weld joint must as a rule be fluxed, or metal will not adhere to metal. There is not, however, the absolute need for fluxing that there is in soldered joints, and many welds in good fibrous iron are made without a flux. But the explanation here is that the metal is brought to a temperature of semifusion, and the shapes of joints are generally such that particles of scale are squeezed out from between the joint in the act of closing the weld. But in brazing and soldering the parts to be united are generally nearly cold, and only the soldering material is fused, so that the conditions are less favourable to the removal of oxide than in welding processes.

Fluxes are either liquid or solid, but the latter are not efficient until they fuse and cover the surfaces to be united. Hydrochloric acid (spirits of salts) is the one used chiefly for soft soldering. It is "killed" by the addition of a little zinc, the resulting chloride of zinc rendering its action quiet. Common fluxes are powdered resin, and tallow (used chiefly by plumbers for wiped joints). These, with others, are employed for soft solder joints, the temperature of which rarely exceeds about 600° Fah. The best flux for zinc is chloride of zinc. For brazed joints, spelter or powdered brass is employed, and the flux is usually borax. The borax will not cover the joint until it has been deprived of its water of crystallization, and this is effected by raising it to a full red heat, when it swells in bulk, "boils," and afterwards sinks quietly and spreads over, or into the joint. There are differences in details of working. The borax is generally powdered and mixed with the spelter, and both with water. But sometimes they are applied separately, the borax first and over this the particles of spelter. Another flux used for copper is sal ammoniac, either alone or mixed with powdered resin.

As brazed joints often have to be very strong, other precautions are frequently taken beyond that of the mere overlapping of the joint edges. In pipes subjected to high steam pressures, and articles subjected to severe stresses, the joints are "cramped" before the solder is applied. That is, the edges are notched in a manner having somewhat the appearance of the dovetails of the carpenter; the notched portions overlap the opposite edges, and on alternate sides. Such joints when brazed are stronger than plain overlapping joints would be. Steam dome coverings are jointed thus longitudinally as cylinders, and the crown is jointed thereto, also by cramping. Another common method of union is that of flanges to copper pipes. In these the pipe passes freely within a hole bored right through the flange, and the solder is run between. The pipe is suspended vertically, flange downwards, and the spelter run in from the back of the flange. The fused borax works its way in by capillary action, and the spelter follows.

The "copper bit" is used in soft soldering. Its end is a prismatic pyramid of copper, riveted to an iron shank in a wooden handle. It is made hot, and the contained heat is sufficient to melt the solder. It has to be "tinned," by being heated to a dull red, filed, rubbed with sal ammoniac, and then rubbed upon the solder. It is wiped with tow before use. For small brazed work the blow-pipe is commonly employed; large works are done on the brazier's hearth, or in any clear coke fire. If coal is used it must be kept away from the joint.

In "sweating on," a variation in soldering, the surfaces to be united are cleaned, and solder melted and spread over them. They are then brought together, and the temperature raised sufficiently to melt the solder.

A detail of first importance is the essential difference between the melting points of the objects to be brazed or soldered, and that of the solder used. The latter must always be lower than the former. This explains why soldering materials are used in a large range of temperatures. A few will melt at the temperature of boiling water. At the other extreme 2000° Fah. is required to melt

a solder for brazing. If this point is neglected, it will often happen that the object to be soldered will fuse before the solder melts. This accident may occur in the soft Britannia and white metals at the one extreme, and in the softer brasses at the other. It would not do, for example, to use flanges of common brass, or even ordinary gun-metal, to be brazed to copper pipe, for they would begin to fuse before the joint was made. Such flanges must be made of nearly pure copper, to withstand the temperature, usually 98 of copper to 2 of tin (brazing metal). A most valuable feature in solder is that by varying the proportions of the metals used a great range in hardness and fusibility is obtainable. The useful solders therefore number many scores. This is also a source of danger, unless regard be had to the relative fusing points of solders, and of the parts they unite.

(J. G. H.)

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**BRAZZA, PIERRE PAUL FRANÇOIS CAMILLE SAVORGNAN DE,** Count (1852-1905), French explorer and administrator, founder of French Congo, was born on board ship in the harbour of Rio de Janeiro on the 26th of January 1852. He was of Italian parentage, the family name being de Brazza Savorgnani. Through the instrumentality of the astronomer Secchi he was sent to the Jesuit college in Paris, and in 1868 obtained authorization to enter as a foreigner the marine college at Brest. In the Franco-Prussian War of 1870-71 he took part in the operations of the French fleet. In 1874 when the warship on which he was serving was in the Gabun, Alfred Marche and the marquis de Compiègne arrived at Libreville from an expedition in the lower Ogowé district. Interested in the reports of these travellers, de Brazza conceived the idea of exploring the Ogowé, which he thought might prove to be the lower course of the Lualaba, a river then recently discovered by David Livingstone. Having meantime been naturalized as a Frenchman, de Brazza in 1875 obtained permission to undertake his African scheme, and with the naval doctor, Noel Ballay, he explored the Ogowé river. Penetrating beyond the basin of that river, he discovered the Alima and Likona, but did not descend either stream. Thence turning northwards the travellers eventually regained the coast at the end of November 1878, having left Paris in August 1875. On arrival in Paris, de Brazza learned of the navigation of the Congo by H.M. Stanley, and recognized that the rivers he had discovered were affluents of that stream.

De Brazza was anxious to obtain for France some part of the Congo. The French ministry, however, determined to utilize his energies in another quarter of Africa. Their attention had been drawn to the Niger through the formation of the United African Company by Sir George Goldie (then Mr Goldie Taubman) in July 1879, Goldie’s object being to secure Nigeria for Great Britain. A new expedition was fitted out, and de Brazza left Paris at the end of 1879 with orders to go to the Niger, make treaties, and plant French flags. When on the point of sailing; from Lisbon he received a telegram cancelling these instructions, and altering his destination to the Congo. This was a decision of great moment. Had the Nigerian policy of France been maintained the International African Association (afterwards the Congo Free State) would have had a clear field on the Congo, while the young British Company would have been crushed out by French opposition; so that the two great basins of the Niger and the Congo would have had a vastly different history.

Acting on his new instructions, de Brazza, who was again accompanied by Ballay, reached the Gabun early in 1880. Rapidly ascending the Ogowé he founded the station of Franceville on the upper waters of that river and pushed on to the Congo at Stanley Pool, where Brazzaville was subsequently founded. With Makoko, chief of the Bateke tribe, de Brazza concluded treaties in September and October 1880, placing the country under French protection. With these treaties in his possession Brazza proceeded down the Congo, and at Isangila on the 7th of November met Stanley, who was working his way up stream concluding treaties with the chiefs on behalf of the International African Association. De Brazza spent the next eighteen months exploring the hinterland of the Gabun, and returned to France in June 1882. The ratification by the French chambers in the following November of the treaties with Makoko (described by Stanley as worthless pieces of paper) committed France to the action of her agent.



Furnished with funds by the French government, de Brazza returned in 1883 to the Congo to open up the new colony, of which he was named commissioner-general in 1886. This post he held until January 1898, when he was recalled. During his period of office the work of exploration was systematically carried out by numerous expeditions which he organized. The incessant demands on the resources of the infant colony for these and other expeditions to the far interior greatly retarded its progress. De Brazza’s administration was severely criticized; but that its comparative failure was largely due to inadequate support from the home authorities was recognized in the grant to him in 1902 of a pension by the chambers. Both as explorer and administrator his dealings with the natives were marked by consideration, kindness and patience, and he earned

the title of “Father of the Slaves.” His efforts to connect the upper Congo with the Atlantic by a railway through French territory showed that he understood the chief economic needs of the colony. After seven years of retirement in France de Brazza accepted, in February 1905, a mission to investigate charges of cruelty to natives brought against officials of the Congo colony. Having concluded his inquiry he sailed for France, but died at Dakar, Senegal, on the 4th of September 1905. His body was taken to Paris for burial, but in 1908 was reinterred at Algiers.

See D. Neuville et Ch. Bréard, *Les Voyages de Savorgnan de Brazza, Ogooué et Congo, 1875-1882* (Paris, 1884), and *Conférences et lettres de P. Savorgnan de Brazza sur ses trois explorations dans l’ouest africain de 1875 à 1886* (Paris, 1887); A.J. Wauters, “Savorgnan de Brazza et la conquête du Congo français,” in *Le Mouvement geographique*, vol. xxii., No. 39 (Brussels, 1905). Giacomo or Jacques de Brazza (1859-1883), a younger brother of Savorgnan, and one of the men he employed in the work of exploration, published in collaboration with his companion A. Pecile, *Tre Anni e mezzo nella regione del Congo e dell’ Ogowe* (Rome, 1887).

(G. T. G.)

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**BRAZZA** (Serbo-Croatian, *Brač;* Lat. *Brattia*), an island in the Adriatic Sea, forming part of Dalmatia, Austria. Pop. (1900) 24,408. With an area of 170 sq. m. Brazza is the largest of the Dalmatian Islands; it is also the most thickly populated, and one of the most fertile. Its closely cultivated surface though ragged and mountainous yields an abundance of olives, figs, almonds and saffron, while its wines are of good quality. The corn-crop, however, barely suffices for three months’ food. Other local industries are fishing and silkworm-rearing. The most important among twenty small villages on the island is Milná (pop. 2579), a steamship station, provided with shipwrights’ wharves. The early history of Brazza is obscure. In the first years of the 13th century it was ruled by the piratical counts of Almissa; but after a successful revolt and a brief period of liberty it came under the dominion of Hungary. From 1413 to 1416 it was subject to Ragusa; and in 1420 it passed, with the greater part of Dalmatia, under Venetian sovereignty.

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**BREACH** (Mid. Eng. *breche*, derived from the common Teutonic root *brec*, which appears in “break,” Ger. *brechen*, &c.), in general, a breaking, or an opening made by breaking; in law, the infringement of a right or the violation of an obligation or duty. The word is used in various phrases: *breach of close*, the unlawful entry upon another person’s land (see Trespass); *breach of covenant or contract*, the non-fulfilment of an agreement either to do or not to do some act (see Damages); *breach of the peace*, a disturbance of the public order (see Peace, Breach of); *breach of pound*, the taking by force out of a pound things lawfully impounded (see Pound); *breach of promise of marriage*, the non-fulfilment of a contract mutually entered into by a man and a woman that they will marry each other (see Marriage); *breach of trust*, any deviation by a trustee from the duty imposed upon him by the instrument creating the trust (*q.v.*).

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**BREAD,** the name given to the staple food-product prepared by the baking of flour. The word itself, O. Eng. *bréad*, is common in various forms to many Teutonic languages; cf. Ger. *Brot*, Dutch, *brood*, and Swed. and Dan. *bröt*; it has been derived from the root of “brew,” but more probably is connected with the root of “break,” for its early uses are confined to “broken pieces, or bits” of bread, the Lat. *frustum*, and it was not till the 12th century that it took the place, as the generic name of bread, of *hlaf*, “loaf,” which appears to be the oldest Teutonic name, cf. Old High Ger. *hleib*, and modern Ger. *Laib*.

*History.*—Bread-baking, or at any rate the preparation of cakes from flour or parched grain by means of heat, is one of the most ancient of human arts. At Wangen and Robenhausen have been found the calcined remains of cakes made from coarsely-ground grain in Swiss lake-dwellings that date back to the Stone Age. The cakes were made of different kinds of grain, barley and one-grained wheat (*Triticum monococcum*) being among the ingredients. This bread was made, not from fine meal, but from grain crushed between some hard surfaces, and in these lake-dwellings many round-shaped stones have been found, which were evidently used for pounding or crushing

grain against the surface, more or less concave, of another stone (see FLOUR AND FLOUR MANUFACTURE). Perhaps the earliest form of bread, if that word may be used, was prepared from acorns and beech nuts. To this day a sort of cake prepared from crushed acorns is eaten by the Indians of the Pacific slopes. The flour extracted from acorns is bitter and unfit to eat till it has been thoroughly soaked in boiling water. The saturated flour is squeezed into a kind of cake and dried in the sun. Pliny speaks of a similar crude process in connexion with wheat; the grain was evidently pounded, and the crushed remnant, soaked into a sort of pulp, then made into a cake and dried in the sun. Virgil (*Georgics*, i. 267) refers to the husbandman first torrefying and then crushing his grain between stones:—"*Nunc torrete igni fruges, nunc frangite saxo.*"

The question naturally arises, how did the lake-dwellers bake their cakes of bruised grain? Probably the dough was laid on a flat or convex-shaped stone, which was heated, while the cake was covered with hot ashes. Stones have been found among prehistoric remains which were apparently used for this purpose. In ancient Egyptian tombs cakes of durra have been found, of concave shape, suggesting the use of such baking-slabs; here the cake was evidently prepared from coarsely-cracked grain. In primitive times milling and baking were twin arts. The housewife, and the daughters or handmaids, crushed or ground the grain and prepared the bread or cakes. When Abraham entertained the angels unawares (Genesis xviii.) he bade his wife Sarah "make ready quickly three measures of fine meal, knead it, and make cakes upon the hearth." Professor Maspero says that an oven for baking bread was to be found in the courtyard of every house in Chaldaea; close by were kept the grinding stones. That bread prepared by means of leaven was known in the days of the patriarchs may be fairly inferred from the passage in Genesis ML, where it is said of Lot that he "made a feast, and did bake unleavened bread." Whether the shew-bread of the Jewish tabernacle was leavened is an open question, but it is significant that the Passover cakes eaten by Jews to-day, known as Matzos, are innocent of leaven. Made from flour and water only, they are about 12 in. in diameter, and have somewhat the look of water biscuits.

The ancient Egyptians carried the art of baking to high perfection. Herodotus remarks of them, "dough they knead with their feet, but clay with their hands." The practice of using the feet for dough kneading, however repulsive, long persisted in Scotland, if indeed it is yet defunct. The Egyptians used for their bread, wheat, spelt, barley and durra (sorghum). In the opinion of Dr Wallis Budge, barley was in Egypt the grain of most primitive culture. However that may be, it is certain that even in ancient Egypt white bread made from wheat was used by the rich. The form of the bread is revealed by ancient monuments. A common shape was a small, round loaf, something like the muffin of to-day. Other loaves were elongated rolls, and curiously enough were sprinkled on the top with seeds like modern Vienna bread.



The history of baking in classical Greece and Italy can be clearly traced. Athenaeus in his *Deipnosophists* minutely describes many different kinds of bread, which may be assumed to have been currently used in Greece. According to Pliny (*Nat. Hist*, xviii. II. § 28) Rome had no public bakers till after the war with Perseus (171-168 B.C.). That long after public bakehouses came into use the Romans and other urban dwellers in Italy continued to make a great deal of bread at home is certain. In Pompeii several private houses had their own mill and bakehouse. That city must also have possessed bakers by trade, as loaves of bread have been found, round in form, and stamped with the maker's name, possibly to fix responsibility for weight and purity. In the time of the Republic, public bakehouses were under the control of the aediles. Grain was delivered to the public granaries by the *Saccarii*, while another body called *Catabolenses* distributed the grain to the bakers. The latter were known as *Pistores* or "pounders," a reminiscence no doubt of the primitive time when grain was pounded by a pestle in a mortar. Slaves were largely employed in the irksome work of grinding, and when Constantine abolished slavery the staff of the *pistrinae* was largely recruited from criminals. The emperor Trajan incorporated about A.D. 100 the college of *Pistores* (millers and bakers), but its members were employers, not operatives. The work of a bakery is depicted in a set of bas-reliefs on the tomb of a master Pistor named Eurysaces, who flourished about a century before the foundation of the college. Here the grain is being brought and paid for; mills driven by horse and ass (or mule) power are busy; men are sieving out the bran from the flour by hand (bolters); bakers are moulding loaves on a board; an oven of domelike shape is being charged by means of a shovel (peel); and baskets of bread are being weighed on the one hand and carried off on men's backs on the other.

*Regulation of Sale.*—In the middle ages bakers were subjected to special regulations in all European lands. These regulations were supposed to be conceived in the interests of bread consumers, and no doubt were intended to secure fair dealing on the part of bread vendors. The legislators appear, however, to have been unduly biased against the baker, who was often beset by harassing restrictions. Bakers were formed into gilds, which were under the control, not only of their own officials, but of the municipality. In London the bakers formed a brotherhood as early as 1155, and were incorporated in 1307. There were two distinct corporate bodies concerned with bread-making, the Company of White Bakers and the Company of Brown Bakers; these were nominally united in 1509, but the union did not become complete till the middle of the 17th century. In Austria, bakers who offended against police regulations respecting the sale of bread

were liable, until comparatively recent times, to fine, imprisonment and even corporal punishment. In Turkey the lot of the baker was very hard. Baron de Tott, writing of Constantinople in the 18th century, says that it was usual, when bread went to famine prices, to hang a baker or two. He would have us believe that it was the custom of master bakers to keep a second hand, who, in consideration of a small increase of his weekly wage, was willing to appear before the cadi in case a victim were wanted. A barbarous punishment, inflicted in Turkey and in Egypt on bakers who sold light or adulterated bread, consisted in nailing the culprit by his ear to the door-post of his shop. In France a decree of 1863 relieved bakers from many of the restrictions under which they previously suffered, but it did not touch the powers of the municipalities to regulate the quality and sale of bread. It left them the right conferred in 1791, to enforce the *taxe du pain*, the object of which was to prevent bakers from increasing the price of bread beyond a point justified by the price of the raw materials; but the right was exercised on their own responsibility, subject to appeal to higher authorities, and by a circular issued in 1863 they were invited to abolish this *taxe officielle*. In places where it exists it is fixed every week or fortnight, according to the average price of grain in the local markets.

In England an act of parliament was passed in 1266 for regulating the price of bread by a public assize, and that system continued in operation till 1822 in the case of the city of London, and till 1836 for the rest of the country. The price of bread was determined by adding a certain sum to the price of every quarter of flour, to cover the baker’s expenses and profit; and for the sum so arrived at tradesmen were required to bake and sell eighty quartern loaves or a like proportion of other sizes, which it was reckoned each quarter of flour ought to yield. The acts now regulating the manufacture and sale of bread in Great Britain are one of 1822 (Sale of Bread in the City of London and within 10 m. of the Royal Exchange), and the Bread Act of 1836, as to sale of bread beyond 10 m. of the Royal Exchange. The acts require that bread shall be sold by weight, and in no other manner, under a penalty not exceeding forty shillings. This does not, however, mean that a seller is bound to sell at any particular weight; the words quartern and half-quartern, though commonly used and taken to indicate a 4-lb and 2-lb loaf respectively, have no legal sanction. That is to say, a baker is not bound to sell a loaf weighing either 4 lb or 2; all he has to do, when a customer asks for a loaf, is to put one on the scale, weigh it, and declare the weight. When bread is sold over the counter it is usual for the vendor to cut off and tender a piece of bread to make up any deficiency in the loaf. This is known as the “overweight.” There is little doubt the somewhat misty wording of the bread acts lends itself to a good deal of fraudulent dealing. For instance, when bread is sold over the counter, two loaves may be 5 or 6 oz. short, while the piece of makeweight may not reach an ounce. The customer sees the bread put on the scale, but in ninety-nine cases out of a hundred does not trouble to verify the weight, and unless he expressly asks for 2 lb or some specific weight of bread, it is very doubtful whether the seller, having satisfied the letter of the law by placing the bread on the scales, could be convicted of fraud. The provision as to selling by weight does not apply to fancy bread and rolls. No exact definition of “fancy bread” has ever been laid down, and it must be largely a question of fact in each particular case. All bakers or sellers of bread must use avoirdupois weight, and must provide, in a conspicuous place in the shop, beams, scales and weights, in order that all bread there sold may from time to time be weighed in the presence of the purchaser. The penalty for using any other weight than avoirdupois is a sum not exceeding £5 nor less than forty shillings, and for failing to provide beams and scales a sum not exceeding £5. Also every baker and seller of bread, delivering by cart or other conveyance, must be provided with scales and weights for weighing bread; but since the Weights and Measures Act 1889, no penalty is incurred by omission to weigh, unless there has been a request on the part of the purchaser. The acts also define precisely what ingredients may be employed in the manufacture of bread, and impose a penalty not exceeding £10 nor less than £5 for the adulteration of bread. (See further under Adulteration.)

Although the act of 1836 extends to the whole of the United Kingdom (Ireland excepted) out of the city of London and beyond 10 m. of the Royal Exchange, yet in many Scottish burghs this act is replaced by local acts on the sale of bread. These are in all cases of a much more stringent nature, requiring all batch or household bread to be stamped with the reputed weight. Any deficiency within a certain time from the withdrawal of the bread from the oven is an offence. The London County Council desired to introduce a similar system into the area under their jurisdiction, and promoted a bill to that effect in 1905, but it fell through. The bill was opposed not only by the National Association of Master Bakers, the London Master Bakers’ Protection Society, and by the West End metropolitan bakers in a body, but also by the Home Office, which objected to what it termed exceptional legislation.



It may be noted that the acts of 1822 and 1836 define precisely what may and may not be sold as bread. It is laid down in section 2 that “it shall and may be lawful ... to make and sell ... bread made of flour or meal of wheat, barley, rye, oats, buckwheat, Indian corn, peas, beans, rice or potatoes, or any of them, and with any (common) salt, pure water, eggs, milk, barm, leaven, potato or other yeast, and mixed in such proportions as they shall think fit, and with no other ingredients or matter whatsoever.”

*Sanitation of Bakehouses.*—The sanitary arrangements of bakehouses in England were first regulated by the Bakehouse Regulation Act 1863, which was repealed and replaced by the Factory and Workshop Act 1878; this act, with various amending acts, was in turn repealed and replaced by the Factory and Workshop Act 1901. By the act of 1901 a bakehouse is defined as a place in which are baked bread, biscuits or confectionery, from the baking or selling of which a profit is derived. The act of 1863 placed the sanitary supervision of bakehouses in the hands of local authorities; from 1878 to 1883 supervision was in the hands of inspectors of factories, but in 1883 the supervision of retail bakehouses was placed in the hands of local authorities. Under the act of 1901 the supervision of bakehouses which are "workshops" is carried out by local authorities, and for the purposes of the act every bakehouse is a workshop unless within it, or its close or curtilage or precincts, steam, water or other mechanical power is used in aid of the manufacturing process carried on there, in which case it is treated as a non-textile factory, and is under the supervision of factory inspectors.

> The more important regulations laid down by the act are: (1) No water-closet, &c., must be within or communicate directly with the bakehouse; every cistern for supplying water to the bakehouse must be separate and distinct from any cistern supplying a water-closet; no drain or pipe for carrying off sewage matter shall have an opening within the bakehouse. (2) The interior of all bakehouses must be limewashed, painted or varnished at stated periods. (3) No place on the same level with a bakehouse or forming part of the same building may be used as a sleeping place, unless specially constructed to meet the requirements of the act. (4) No underground bakehouse (one of which the floor is more than 3 ft. below the surface of the footway of the adjoining street) shall be used unless certified by the district council as suitable for the purpose (see Redgrave, *Factory Acts*; Evans Austin, *Factory Acts*).

*Bread Sluffs.*—As compared with wheat-flour, all other materials used for making bread are of secondary importance. Rye bread is largely consumed in some of the northern parts of Europe, and cakes of maize meal are eaten in the United States. In southern Europe the meal of various species of millet is used, and in India and China durra and other cereal grains are baked for food. Of non-cereal flour, the principal used for bread-making is buckwheat (*Fagopyrum esculentum*), extensively employed in Russia, Holland and the United States. The flour of pease, beans and other leguminous seeds is also baked into cakes, and in South America the meal of the tapioca plant, *Jatropha Manihot*, is employed. But, excepting rye, none of these substances is used for making vesiculated or fermented bread.

***Quality of flour.***

A normal sample of wheat-flour consists roughly of 10 parts of moisture, 72 of starch, 14 of nitrogenous matter, 2.25 of fatty matters, and 1.75% of mineral matter. Starch is thus the predominating component; it is not, however, the dough-forming ingredient. By itself, starch, when saturated with water, forms a putty-like mass devoid of coherence, and it is the gluten of the nitrogenous matter which is the binding constituent in dough-making, because when wetted it forms a more or less elastic body. The proportion of gluten in wheat-flour varies from 7 to 15%, but the mere quantity of gluten is by no means the only standard of the commercial value of the flour, the quality also counting for much. One of the functions of gluten is to produce a high or well-piled loaf, and its value for this purpose depends largely on its quality. This is turn depends largely on the variety of wheat; certain races of wheat are much richer in nitrogenous elements than others, but such wheats usually only flourish in certain countries. Soil and climate are undoubtedly factors in modifying the character of wheat, and necessarily therefore of the flour. The same wheat grown in the same soil will show very varying degrees of strength (*i.e.* of gluten) in different seasons. For instance, the north-western districts of America grow a hard spring wheat which in a normal season is of almost unequalled strength. In 1904 an excess of moisture and deficiency in sun in the Red River Valley during the critical months of June and July caused a serious attack of red and black rust in these wheat fields, the disease being more virulent in the American than the Canadian side of the valley. The result was that the quality of the gluten of that season's American spring wheat was most seriously affected, its famed strength being almost gone. Wheat from the Canadian side was also affected, but not nearly to so great an extent. Flour milled from hard winter wheat in the American winter districts is sometimes nearly as strong as the spring wheat of the North-west. Hungarian flour milled from Theis wheat is also very strong, and so is the flour milled from some south Russian spring wheats. But here again the degree of strength will vary from season to season in a remarkable manner. In the main each land has its own clearly marked type of wheat. While the United States, Canada, Hungary and Russia are each capable of growing strong wheat, Great Britain, France and Germany produce wheat more or less weak. It follows that the bread baked from flour milled from wheat from British, French or German wheat alone would not make a loaf of sufficient volume, judged by present British standards. As a matter of fact, except in some country districts, British bakers either use strong foreign flour to blend with English country flour, or, more frequently, they are supplied with flour by British millers milled from a blend in which very often English wheat has a small, or no place at all. If the baker's trade calls for the making of household bread, especially of the London type, he must use a strong flour, with plenty of staple gluten in it, because it is this element which supplies the driving or lifting force, without which a high, bold loaf cannot be produced. If the

demand is for tin or (as it is called in many parts of the north of England) pan bread, a weaker flour will suffice, as the tin will keep it up. A Vienna loaf should be made with at least a certain proportion of Hungarian patent flour, which is normally the highest-priced flour in the market, though probably the bulk of the Vienna rolls made in London contain no Hungarian flour. A cake of flat shape can be very well made with a rather weak flour, but any cake that is required to present a domed top cannot be prepared without a flour of some strength.

***Flavour of flour.***

It is a general opinion, though contested by some authorities, that soft, weak flours contain more flavour than strong, harsh flours. The strong wheats of the American and Canadian North-West make less flavoury flour than soft red winter from the American South-West. It would not, however, be correct to say that all strong wheats are necessarily less full of flavour than weak wheats. Hungarian wheat, for instance, is one of the strongest wheats of the world, but has a characteristic and pleasant flavour of its own. Indian wheats, on the other hand, are not particularly strong, but are liable to give a rather harsh flavour to the bread. English, French and German wheats, when harvested in good condition, produce flour of more or less agreeable flavour. None of these wheats could be classified as strong, though from each of those lands wheat of fair strength may be obtained under favourable meteorological conditions. The Australasian continent raises white wheat of fine quality which has much affinity with British wheat—it is the descendant in many cases of seed wheats imported from England—but it is occasionally stronger. The resultant flour is noted for its sweetness. Both millers and bakers who are concerned with the supply of high-class bread and flour make free use of what may be termed flavoury wheats. The proportion of English wheat used in London mills is very small, but millers who supply West-End bakeries with what is known as top-price flour are careful to use a certain amount of English wheat, if it is to be had in prime condition. They term this ingredient of their mixture “sugar.” London bakers again, with customers who appreciate nicely flavoured bread, will “pitch” into their trough a certain proportion of English country flour, that is, flour milled entirely or chiefly from English wheat, which under such conditions is strengthened by a blend of strong flour, a patent flour for choice. It has been objected that as English wheat contains a large proportion of starch, and as starch is admittedly destitute of flavour, there is no reason why flour milled from English wheat should possess a sweeter flavour than any other starchy wheat flour. Experience, however, has amply proved that well-ripened English wheat produces bread with an agreeable flavour, though it does not follow that all English wheat is under all conditions capable of baking bread of the highest quality. But it would be as fallacious to hold that weak flour is necessarily flavoury, as that all strong flour is insipid and harsh. Different wheats are undoubtedly possessed of different flavours, but not all these flavours are of a pleasing character. In some cases the very reverse is true. Californian and Australian wheats have occasionally aromatic odours, due to the presence of certain seeds, that will impart an objectionable flavour to the resultant bread.



While the essential character of particular wheats will account for a good deal of the flavour that may be detected in the bread made from them, the baking process must also be responsible to some extent for flavour. The temperature of the oven and the degree of fermentation must be factors in the question. It has been asserted that the same flour will bake into bread of very different flavour according as the fermentation is carried out slowly or quickly, or as the oven is hot or the reverse. A high temperature seems to have the effect of quickly drawing out the subtle essences which go to give flavour to the bread, but it is a question whether they are not subsequently rapidly volatilized and partially or wholly lost. The rapid formation of a solid crust is no doubt likely to retain some of these flavouring essences. A moist, or “slack,” sponge, or dough, appears distinctly favourable to the retention of flavour, the theory being that under such conditions the yeast, having more room to “breathe,” works more easily, and is therefore less likely to convert into food those soluble constituents of the flour which give flavour.

***Colour of flour.***

The colour of flour is a valuable, though not an infallible, index to its baking qualities. Thus, a flour of good colour, by which bakers mean a flour of bright appearance, white, but not a dull dead white, will usually bake into a loaf of good appearance. At the same time, a flour of pronounced white tint may bake into a dirty grey loaf. This has been particularly noted in the case of flours milled in Argentina. The colour of flour will vary from a rich, creamy white to a dull grey, according to its quality. The different shades are many and various, but the prevailing tints are comparatively few. Perhaps Blandy’s classification of the colours as white, yellow, red, brown and grey is as serviceable as any. Each of these tints is directly caused by the presence of certain substances. White denotes the presence of a considerable proportion of starch, while a pronounced yellow tint proclaims gluten of more or less good quality. Red and brown are tints only found in flours of low grade, because they are sure proofs of an undue proportion of branny or fibrous particles. A greyish flour invariably contains impurities, such as crease dirt, from the wheat, the intensity of the tint varying in proportion to their amount. With regard to a yellow tint, though this always denotes the presence of gluten, it is difficult to estimate the baking quality of the flour by the shade of yellow. In the best Hungarian patent flour the whole sample will be suffused by an amber tint, known to Budapest and Vienna bakers as *gelblicher Stich*. Rolls baked from the best Hungarian

flour will not infrequently cut yellow as if eggs had been used in making them up, though nothing more than flour, yeast and water has been employed. Strong flour milled from American or Canadian spring wheat is also yellowish in colour, but the tint is not so deep as with Hungarian flour. On the other hand, there are flours of no great strength, such as those from some Australian wheats, which are apt to look yellow. When the colour of flour is not maintained in the bread, the reason is generally to be found in the baking process employed. Colour is a fairly trustworthy, but not an absolute guide to the chemical composition of flour.

***Damp and flour.***

Unfortunately not all flour of good colour is sound for bread-making purposes. Wheat which has been harvested in a damp condition, or has been thoroughly soaked, by drenching showers previous to cutting, or has got wet in the stook, is liable, unless carefully handled, to produce flour that will only bake flat, sodden loaves. Wheat which has received too much rain as it is approaching maturity, and has then been exposed to strong sunlight, is peculiarly liable to sprout. This seems to happen not infrequently to La Plata wheat, and though wheat shippers in that country are usually careful to clean off the little green spikes, this outward cleansing does not remedy the mischief wrought to the internal constitution of the berry. Such wheat makes flour lacking in strength and stability. Its gluten is immature and low in percentage, while the soluble albuminoids are in high percentage and in a more or less active diastasic state. The starch granules are liable to have weakened or fissured walls, and the proportion of moisture and of soluble extract will be high. With regard to the beneficial action of kiln or other drying on damp flour, William Jago was convinced by a series of experiments that the gentle artificial drying of flour increases its water-absorbing capacity to about three times the amount of water lost by evaporation. On the other hand, a damp flour dried too quickly and at too great a heat is liable to be made more instead of less susceptible to diastasic changes.

*Alum.*—Strictly speaking, when employed with weak and unstable flours alum is a remedial agent. The popular idea that it acts as a kind of bleacher of flour, having the faculty of converting flour that is dark-coloured through containing a sensible proportion of branny particles and woody fibre, into white-coloured loaves, is erroneous. Its action as a producer of white bread is indirect, not direct, though it is none the less effective. It seems to act as a brace to or steadier of unstable gluten. If from the same wheat a certain proportion of gluten be extracted and divided into two parts, of which one is placed in a glass of water containing a strong solution of alum, and the other in a glass of plain water, the gluten in the latter case will become spent days and perhaps weeks before the sample in the alumed water is disintegrated. The place of alum in the process of fermentation is well marked. By holding together unstable gluten, it checks the diastasic action, and the proportion of starch converted into glucose (grape sugar) is reduced, with the result that a whiter and more porous loaf is produced. It is generally admitted that by the use of alum more or less eatable bread may be baked from flour which otherwise could hardly be made into bread at all. Strictly, therefore, this substance is not an adulterant, inasmuch as it is not a substitute in any sense for flour. But it is admittedly unwholesome, and therefore its legal interdiction for alimentary purposes is quite justifiable. Another aspect of the use of alum is that it is employed for the purpose of enabling bakers to use poor flour.

A fairly satisfactory test for alum in bread (or flour) is afforded by an alkaline solution of logwood and a saturated solution of ammonium carbonate. The presence of alum is shown by a lavender or full blue colour. The depth of the tint is said to be a rough guide to the quantity of alum present. According to Jago this test is so sensitive that it has resulted in the detection of 7 grains of alum in a 4-lb loaf.

Besides alum, small quantities of copper sulphate have been used for checking diastasis and retarding fermentation. This substance has the same effect as alum, but as all copper salts are active poisons, the employment of copper sulphate is most strongly to be condemned.

*Lime-water.*—The object of using either alum or copper sulphate is to check over-rapid diastasis during fermentation. Baron Liebig pointed out a much less objectionable means of attaining the same end by means of lime-water, about 1½ oz. of fresh quicklime being dissolved in the water used for doughing one sack of flour. Bread made in this way is said to be spongy in texture, of agreeable flavour, and perfectly free from acidity. In the baked loaf the lime is transformed into calcium carbonate (chalk) by the carbon dioxide resulting from the panary fermentation. It is said that an increased yield of bread may be obtained by the use of lime-water; the explanation may be that lime-water, by retarding the degradation of the gluten and the diastasis of the starch, increases the water-retaining power of the flour, so that the same weight of flour yields a greater volume of bread.

*Unvesiculated and Vesiculated Bread.*—Wheaten bread may be divided into two main divisions, unvesiculated and vesiculated. The term vesiculated simply means provided with vesicles, or small membranous cavities, such as are found in all bread that has been treated by yeast, leaven or any other agent for rendering it spongiform in structure by the action of carbonic acid gas. Nearly all bread eaten by civilized folk is vesiculated, though there are different methods and processes for attaining this result. Into the category of unvesiculated bread enter such products as the Australian damper, a flat cake prepared from flour, water and salt, and baked in the hot

ashes of a wood fire. The dough is spread on a flat stone and covered with a tin plate, while the hot ashes are heaped around and over it; the heat should not be much in excess of 212° Fahr. The scone, the bannock and other similar cakes, still much appreciated in Scotland and the north of England, are also examples of unvesiculated bread. They are baked on hot plates or "griddles," on hearths, and sometimes in ovens. Biscuits differ from these cakes in the fact that they are baked by a high instead of a moderate heat. But they enter so far into the class of unvesiculated bread that they are generally prepared without the aid of any such aerating agent as carbon dioxide. (See Biscuit.)

Vesiculated bread is now the only article of diet made from flour to which the term bread is applied, and there are various ways of producing the spongiform texture by which it is characterized. The ordinary and doubtless the most satisfactory way is by developing the carbon dioxide within the dough itself by the use of yeast (*q.v.*) or leaven, which sets up alcoholic fermentation, splitting up the saccharine matters in the flour into alcohol and carbon dioxide. The latter is retained by the dough and distends it, causing the bread to "rise." Or the carbon dioxide may be artificially introduced, as in the so-called "aerated" bread (see below), or it may be produced by the agency of certain chemicals, as for instance of baking powders.

***Baking powders.***

Such powders are mixtures which, under the influence of either water or heat, evolve carbon dioxide. These powders have been divided by Jago into three groups:—(1) *Tartrate* powders, in which the acid constituent is either free or partly combined tartaric acid; (2) *Phosphate* powders, in which the acid is some form of phosphoric acid; (3) *Alum* powders. All these powders have a more or less aperient action on the human system. Tartrate powders have the disadvantage that both commercial tartaric acid and cream of tartar frequently contain lead, a poisonous substance. Phosphate powders are less open to objection, as they are more easy to obtain free from lead and other metallic impurities. Alum powders contain potassium bisulphate and alum. It is somewhat remarkable that while the presence of alum in bread is regarded by the law of England as adulteration, its use in baking powder was pronounced legal in *James* v. *Jones*, 1894, 1, Q.B. 304, on the ground that baking powder is not food within the meaning of the Sale of Food and Drugs Act 1875. In making wholemeal bread, hydrochloric acid and sodium bicarbonate are often used in such proportions that they neutralize each other. Carbon dioxide is evolved and raises the dough. In preparing wholemeal bread the use of this combination has the advantage that the acid acting rapidly on the sodium bicarbonate soon produces enough carbon dioxide to aerate the dough, and thus hasten its entry into the oven. Wholemeal flour contains so large a proportion of cerealin that diastasis is apt to proceed rapidly, the result being a clammy, sodden loaf. For this reason, perhaps the so-called aerated process is even more suitable for making wholemeal than white bread.

***Methods of making dough.***

Methods of dough-making differ in different countries, and even in different parts of the same land. In the *off hand* method the dough is made right off, without any preliminary stages of ferment or sponge. This plan is sometimes adopted for making tin bread, and occasionally for crusty loaves. For tin bread a strong flour would be used and made into a slack dough, and about 1½ ℔ to 2 ℔ of distillers' yeast would be used for the sack (280 ℔) of flour, occasionally with the addition of a little brewers' yeast. Salt is used in the proportion of 3 ℔ to 3½ ℔ per sack. Formerly also it was the custom to add 10-14 ℔ of boiled potatoes, but the use of potatoes has greatly decreased. A tin-bread dough would be made slack, with about 70 quarts of water to the sack, and after being mixed, would be fermented at a temperature of 76-80° Fahr. It should lie for about ten hours. A dough for crusty bread such as cottage loaves, would be made much tighter, not more than 60 quarts of water being allowed to the sack. It would be fermented at a higher temperature, and would not lie more than about six hours. A slack dough is much less laborious to work (when the dough is hand-made) than a tight dough, for which a mechanical kneader is very suitable, but as a matter of fact the use of machinery (see below) is still the exception, not the rule. When a stiff dough is made by hand, it is usually made somewhat slack to begin with, and then "cut back" and "dusted" at regular intervals, that is to say, more and more flour is added till a dough of the required consistency has been obtained. (In the British baker's vocabulary "dust" means flour, and good dust stands for good flour.) This system, on the one hand, saves the labour involved for "sponging" and other operations, and the bread is produced in less time; but on the other hand more yeast is used, and bakers generally hold that the system sacrifices the colour and texture of the loaf to convenience of working and yield. The high porportion of yeast enables the dough to carry a large quantity of water, and about 104 4-℔ loaves to the sack is said by Jago to be a not unusual yield in the case of slack doughs. But such a result would only be possible with very strong flour. In an ordinary way 96 loaves to the sack is a very high yield, unattainable except with strong flour, and probably the average yield is not more than 90 loaves to the sack. In London the manager of a "tied" shop is usually held to account for 92 loaves to the sack.

In the *ferment and dough* system, the ferment usually consists of 10 to 14 ℔ of potatoes to the sack of flour, boiled or steamed, and mashed with water, so as to yield about 3 gallons of liquor.

There are several substitutes for potatoes, including raw and scalded flour, malt, malt extracts, &c.; brewers' or distillers' yeast may also be used. A ferment should contain saccharine matters and yeast stimulants in such a form as to favour the growth and reproduction of yeast in a vigorous condition. Hence it should not be too concentrated. About six hours are required for its preparation. It is added, together with 2 to 3 ℔ of salt, to the dough, which is prepared with about 56 quarts of water to the sack, and worked at a temperature of 80-84° Fahr. The dough is allowed to lie from two to five hours according to the flour used, the character of the ferment, and the working temperature. In this system the proportion of strong flour is usually reduced to 40% of the dough, and no doubt in some cases only soft or weak flours are used. Naturally the yield of bread is not so high as in the case of an off hand dough made entirely from strong flour, and it will probably not exceed 90 loaves to the sack. This method has many advantages. After the ferment is made the labour required is not much greater than with the off hand doughs, and less yeast is required, while potatoes, which are somewhat troublesome, from the necessary cleaning, can be replaced by the substitutes already mentioned. The method produces good-looking and palatable bread, though the loaves should be eaten within some twelve hours of leaving the oven.

The *sponge and dough* system, which is probably in widest use in England, is adapted to almost every kind of bread, and has the advantage that any kind of flour can be employed. The stronger flours which need long fermentation can be and usually are used in the "sponge" stage, while soft flours are utilized in the dough. (The sponge is a certain proportion, varying from a quarter to one-half, of the flour necessary for making the batch.) In London the baker often uses for the sponge a bag (140 ℔) of American spring wheat flour, and for the dough a sack (280 ℔) of British milled flour, which, whether it be country flour milled largely from English wheat or London milled, is always softer and weaker than that used for the sponge. The sponge is made very slack, 26 to 32 quarts of water being used to say 100 ℔ of flour. Yeast, either distillers' or brewers', must be added, in proportions varying according to its character and strength. Of distillers' yeast 6 to 10 oz. may be used for 280 ℔ of flour (including sponge and dough). Salt is added to the sponge sparingly, at the rate of about ½ ℔ to the sack of 280 ℔ The object of making the sponge so slack is to quicken the fermentation. When set the sponge is allowed to ferment from six to ten hours, according to temperature and other conditions. Sometimes all the water it is intended to use is put into the sponge, which is then known as a "batter" sponge. The sponge, when ready, is incorporated with the rest of the flour to which the necessary amount of water and salt is added. The whole mass is then doughed up into the requisite consistency, the dough being allowed to lie for about two hours. Bread made by this method, always assuming that over-fermentation has been avoided, is of good appearance, presenting a bold loaf, with even texture and a nice sheen. Owing to the use of soft flours, the flavour should be agreeable, and the loaves ought to keep much longer than bread made by ferment and dough. The yield may rise as high as 96 loaves per sack, if strong flour has been used in the sponge.



A combination of the above two methods, known as the *ferment, sponge and dough* system, is often used with brewers' yeast. In this case the yeast is not added to the sponge direct, but goes into the ferment. This method is rather in favour with bakers who make their own yeast.

The system of bread-making generally used in Scotland is known as the *flour barm, sponge and dough*. The barm is a combination of a malt and hop yeast, with a slow, scalded flour ferment. To make the so-called "virgin" barm a Scottish baker would use a 30-gallon tub; a smaller vessel for malt-mashing; 10 ℔ malt; 3 oz. hops and a jar for infusing them; 40 lb flour; 2 to 3 oz. malt; 8 to 12 oz. sugar, and 18 gallons of boiling water. With these materials a powerful ferment is produced, which it is considered best to use in the sponge the fourth or fifth day after brewing. The sponges used in Scotland are "half" or "quarter." About 6 ℔ of malt go to the sack, one-sixth going into the sponge. As in England, strong flours are used for the sponge, but rather stronger flours are used for the dough than is usual in England. Scottish loaves are largely of the "brick" type, high and narrow. Such bread has an attractive appearance and keeps well. It has a rather sharp flavour, approaching acidity but avoiding sourness, while the large quantity of malt used adds a characteristic taste. The yield rises in some Glasgow bread factories to 100 loaves to the sack.

***Leavened bread.***

In many parts of Europe bread is still made from leaven, which, properly speaking, consists of a portion of dough held over from the previous baking. This substance, known to French bakers as *levain*, is called in Germany *Sauerteig* (*anglice* "sour dough"). The lump of old dough, placed aside in a uniform temperature for some eight hours, swells and acquires an alcoholic odour, becoming the *levain de chef* of the French bakers. It is then worked up with flour and water to a firm paste double its original volume, when it becomes the *levain de première*. Six hours later, by the addition of more flour and water its amount is again doubled, though its consistency is made rather softer, and it becomes the *levain de seconde*. Finally, by another addition of flour and water, the amount is again doubled, and the *levain de tous points* is obtained. This mass is divided into two parts; one is baked yielding rather dark sour bread, while the other is mixed with more flour and water. This second portion is in turn halved, part is baked, and part again mixed with more flour, this last batch yielding the best and whitest bread. In North Germany leaven is generally used for making rye

bread, and loaves baked from a mixture of wheat and rye flour. In the bakery of the Krupp works at Essen, each batch of the so-called Paderborn bread is prepared entirely with leaven from 270 kilos of rye flour (patent quality), 100 of wheat flour (seconds), 2 of buckwheat meal, 6 of salt, 5 of leaven, and one litre of oil. In Vienna leaven is never used for making the rolls and small goods for which that city is famous. Viennese bakers use either brewers' yeast or a ferment, prepared by themselves, of which the basis is an infusion of hops. Brewers' yeast is added to the ferment, which takes the form of a very slack dough. With 100 kilos (220.46 lb) of flour about 17 litres or nearly 2 gallons of ferment are used.

***Aerated bread.***

In the original Dauglish process for the manufacture of aerated bread, which was brought into operation in Great Britain in 1859, carbonic acid gas was evolved in a generating vessel by the action of sulphuric acid on chalk, and after purification was forced at high pressure into water, which was then used for doughing the flour. In this process the flour that had to be made into bread was submitted to the action of the super-aerated water by direct transference. It was found, however, in practice that much difficulty occurred in making the gas admix readily with the flour and water, great pressure being required, and to lessen the difficulties a new process, called the "wine whey," was introduced. To carry this out, a vat placed on the upper storey of the factory is charged with a portion of malt and flour, which is mashed and allowed to ferment until a weak and slightly acid thin wine is produced; this after passing through the coolers is stored until it is transformed into a vinous whey. This whey is then introduced into a strong cylinder partly filled with water, and is aerated by letting in the gas (now stored in a highly compressed form in bottles), the pressure required being only a quarter of that necessary with the original method. The flour having been placed in the mixers, which are of globular form containing revolving arms, the aerated fluid is admitted, and in a short period the flour and fluid are completely incorporated. By means of an ingenious appliance termed a dough cock, the exact amount of dough for a single loaf of bread is forced out under the pressure of the gas, and by reversing the lever the dough, which expands as it falls into a baking tin, is cut off. Two sacks of flour can be converted with ease into 400 2-lb loaves in forty minutes, whereas the ordinary baker's process would require about ten hours. At first a difficulty was encountered in the fact that the dough became discoloured by the action of the "wine whey" on the iron, but it was overcome by Killingworth Hedges, who discovered a non-poisonous vitreous enamel for coating the interior of the mixers, &c. It has been claimed for the Dauglish process that it saves the baker risks attendant on the production of carbon dioxide by the ordinary process of fermentation, in that he is no longer liable to have his dough spoilt by variations of temperature and other incalculable factors, the results being certain and uniform. A further claim is the saving of the proportion of starch consumed by conversion into glucose during the process of fermentation. The original objection, that, by the absence of fermentation, those subtle changes which help to produce flavour are lost, is annulled by the use of the wine whey process. The Dauglish process is well suited for producing small goods, such as cakes and scones, where flavour can be artificially imparted by means of currants, flavouring essences, &c. An undoubted advantage of the aerating process of bread-making is adaptability for utilizing flour with unstable gluten, which can thus be made into an excellent quality of bread. For wholemeal bread, too, there is probably no more suitable process than the Dauglish. The strong diastasic action of the cerealin, inevitable in fermentation, is entirely avoided. The Aerated Bread Company have about a hundred depots in London, which are supplied from a central factory.

***Apostolov process.***

The essence of the bread-making process recently invented by Serge Apostolov is the combination of a flour mill and bakery. The wheat, after a preliminary cleaning, is ground into flour by a mill composed of metal disks dressed, that is furrowed, very much like the surfaces of a pair of mill-stones. The disks are not set to grind very close, because it is desired, by minimizing friction, to keep the meal cool. From the middlings obtained by this milling process about 10% of bran is separated, and the remainder of the middlings is treated by a peculiar process, akin to mashing, termed "lixiviation." The middlings are saturated with tepid water containing a small proportion of yeast, which causes a certain amount of fermentation. It is claimed that by this process a solution is obtained of the floury constituents of the middlings. From the vats the solution is poured on an inclined sieve which has a gentle reciprocating motion. The floury particles pass through the meshes, while the bran tails over the sieve; the proportion of the wheat berry thus rejected is given as about 2½%. On the other hand, the milky-looking solution, called "lactus," is caught in a special vessel, and delivered by a shoot into a trough, which may be either a mechanical kneader of an ordinary trough. This lactus takes the place of the ordinary sponge. The flour is added in the proportion necessary to make the required batch and the whole mass is doughed, either by hand or power. The resultant dough is moulded in the ordinary way into loaves, which are baked in due course. The advantages claimed for the process are that it permits of the utilization in bread-making of about 87½% of the wheat berry, that the resultant bread is fairly white in colour and is agreeable in flavour, and that it is extremely simple and provides a ready and cheap means of flour-making.



*Machine Bakeries.*—Bread-baking, though one of the most important of human industries, was

long carried out in a most primitive manner, and machinery is still practically unknown in the bulk of British bakehouses. The reasons for this apparently anomalous condition of things are not very far to seek. Bread, unlike biscuits, is a food quite unfitted for long storage, and must be consumed within a comparatively short time of being drawn from the oven. Hence the bread-baker's output is necessarily limited to a greater or lesser degree. This will be the more apparent when it is considered that the cost of distributing bread is high relatively to the profits to be realized. A baker's bread trade is therefore usually limited to local requirements, and trading on a small scale he has less inducement to lay out capital on the installation of machinery than other classes of manufacturers. But there are now many machine bakeries (known in Scotland as bread factories), both in London and in other parts of Great Britain, where the manufacture of bread is carried out more or less on a large scale. The evolution of the machine bakery has been slow, and the mechanical operations of the bakehouse were long limited to the mixing of the sponge and the kneading of the dough, but now the work of the bakery engineer extends over almost every operation of bread-making.

A bread-baking plant should be installed in a building of at least two storeys. The ground floor may be used for the shop, with possibly a bread-cooling and delivery room at the rear. The flour may be hoisted to an attic at the top of the building, or to the top floor; in any case there must be sufficient floor space to accommodate the flour sacks and bags. Underneath the floor of the flour store should be installed a flour sifter, a simple apparatus consisting essentially of a hopper through which the flour enters a cylinder with a spiral brush, by which it is thoroughly agitated previously to passing through one or more sieves placed under the brush. A sack of flour may be passed through this sifter in a couple of minutes, the operation freeing the flour from lumps and pieces of string or other foreign substances which may have found their way into the sack. The sifter may also be combined with a blender or mixer, so that the baker may by its means thoroughly blend different flours in any desired proportion. The operation of blending is usually effected by a revolving blade of suitable design or by a worm conveyor placed underneath the sieve or sleeve. From the sifter and blender the flour descends by a sleeve into the dough kneading machine on the floor below. But in cases where it is desired merely to sift and blend flour ready for future use, it may be received in a worm and elevated again to the storage floor by an ordinary belt and bucket elevator. The water required for doughing purposes is contained in an iron tank, fixed to the wall in convenient proximity to the dough kneader. This tank, known as a water attemperating and measuring tank, is provided with a gauge and thermometer, and from it the exact quantity of water needed for doughing can be rapidly drawn off at the desired temperature. The cold water supply may be let into the tank at the top, and the hot water supply at the bottom, the idea being that each supply shall permeate the whole mass by gravity, the hot water ascending and the cold descending. The chief types of dough kneader will be described subsequently, but here it should be noted that not only have machines been devised for cutting out the exact sizes of dough required for small goods, such as buns and tartlets, but that the operations of weighing and dividing dough for quartern and half-quartern loaves can also be neatly and economically effected by machinery. Further, at least two machines have been built which successfully mould loaves (of simple shape), and the problem of moulding household bread by machinery has certainly been solved, but whether delicate twists and other fancy shapes could be equally well moulded mechanically is less certain.

The machine bakery, however complete, is not likely ever to be quite automatic and continuous like a modern flour mill, where the plant is connected throughout and virtually forms one machine (see Flour and Flour Manufacture), and though the engineer has at least managed to effect every operation of the bakehouse by mechanical means, it is not yet possible to shoot a sack of flour into the hopper of the sifter on the top floor, and to turn it into bread, without any human intervention whatever, though as things are, the moulded dough can be put into the oven without undergoing actual contact with human hands. In practice, some of the machines mentioned above are often dispensed with, even in so-called machine bakeries. The flour sifter and blender is indeed found in many bakeries where mechanical kneaders are unknown, while not in all machine bakeries would be found dough weighers and dividers, still less moulding machines. The economical side of the argument on behalf of machinery is presented in the familiar shape that a properly equipped machine bakery can turn out better work at a lower cost (by dispensing with labour), or at any rate can carry on a bigger trade with the same staff. There is plausibility in this argument, but it must be admitted that innumerable bakeries of capacities varying from 10 to 20 sacks per week are carried on more or less successfully without machinery of any kind, beyond perhaps a sifter or blender. Moreover, some of these bakehouses produce bread which can hardly be improved on.

One advantage claimed for flour sifters, besides removing the impurities, is that by thoroughly aerating flour they cause it to become more "lively," in which condition it kneads more readily. It is also quite possible that the air which is thus incorporated with the dough has a stimulating effect on the yeast, causing a more energetic fermentation. A strong argument in favour of dough kneaders is their hygienic aspect. It is agreed that the operation of dough stirring by hand, since it involves severe labour conducted in a heated atmosphere, must be liable to cause contamination of the dough through emanations from the bodies of the operatives. In well-managed bakeries the utmost personal cleanliness on the part of the staff is exacted, but the unpleasant contingency alluded to is certainly possible. It is also contended that the use of

machinery for dough kneading and batter whisking will ensure better work, in the sense that the mass under treatment will be more thoroughly worked by mechanically driven arms of iron or steel than by human limbs, liable to weariness and fatigue. The better worked the dough, the greater its power of expansion, and consequently the greater its bread-making value.

The most widely known machine used in connexion with bread-baking, next to the sifter, is the dough kneadcr. The dough kneader is no new invention. As far back as 1760, a kind of dough kneader was constructed in France by one Salignac. It is described as consisting of a trough, inside which the dough was agitated by arms shaped somewhat like harrows. This machine is said to have been tested before a committee of the Academy of Sciences, who reported that in their presence dough had been prepared in fourteen to fifteen minutes. The bread baked from this dough is said to have been most satisfactory, but for some reason the machine never came into general use. For one thing, the power problem would have been almost insuperable to a baker in the France of those days. In general design this kneader approximated to the machines which have since done good work in bakeries all the world over. Salignac was quickly followed by another inventor, Cousin, also a Frenchman, who brought out in 1761, or thereabouts, a dough-kneading machine, which, however, had no better success than its predecessor. The first kneading machine which appears to have been in actual use in a bakery was constructed by a Paris baker of the name of Lembert, after whom it was called the Lembertine. Lembert is said to have been experimenting with this apparatus as early as 1796. Be that as it may, it was not brought out till 1810, when a prize of 1500 francs (£60) was offered by the Société d'Encouragement pour l'Industrie Nationale. This reward was won by Lembert, and his machine thereupon came into a certain amount of use in France. It is remarkable that France long remained the only country in which dough kneaders were employed, but even there their use was limited.

***Dough kneaders.***

The Fontaine, another French kneader, called after its inventor, was first made in 1835. It had a certain success, but has long passed out of use. It appears to have been a copy to a great extent of the Lembertine. The objection against both these machines was that their blades, while exercising a mixing action, were deficient in kneading effect. Probably the first machine which achieved the task of efficiently replacing the work of human arms in sponge breaking and dough kneading was the Boland kneader. This was also a French machine, and dates back to about the middle of the 19th century. It is believed to have been first used in the Scipion bakery in Paris. It consists essentially of a trough, inside which revolve a pair of blades so arranged as to work somewhat like alternate screws: it is claimed for these blades that their action has the effect of tossing the dough backwards and forwards when it is slack, and of drawing it out when it happens to be stiff. It is further claimed that the blades are so shaped that their revolution has the effect of moving the dough from right to left and left to right in the trough. The machine is geared to give two speeds, the faster being suitable for sponge setting, while the slow and most powerful speed is intended for the doughing. The Boland machine has been widely adopted in other countries than France, and was certainly one of the first dough kneaders to be used in the United Kingdom. It was installed in the great Boland bakery in Dublin, where it proved a great success. The proprietor of this bakery, with which was also connected a flour mill, is said to have had his attention first drawn to this machine by the fact that its inventor was his namesake, though no relative.

The Deliry-Desboves dough kneader, also of French origin, and in general use in France, consists essentially of a cast iron trough, shaped somewhat like a basin, and turning on a vertical axis. The kneading arms inside the trough are shaped after the pattern of a lyre, and have the effect of first working up and then dividing the dough right through the kneading process. Two helical blades, which also form part of the mechanism, serve to draw out and aerate the dough, as effectively, it is claimed, as can be done by the most skilled operative. The force of the kneading operations can be regulated without stopping the machine. A thoroughly kneaded dough can, it is said, be made in this machine in twelve to fifteen minutes.



In Great Britain the type of machine that used to be most in favour was the trough within which the kneading arms worked on horizontal axis. The trough was either open or provided with a lid. The kneading blades were variously shaped, but generally were more or less straight, and were designed to both mix and aerate the dough. In some cases the kneading blades were worked on a single axis, in others two different sets of arms worked on two axes running parallel to one another. Generally the kneader was geared to two speeds, the fast motion being most suitable for sponge setting, and the earlier stages of dough-making, while the slower motion was intended to draw out and thoroughly aerate the dough. To discharge the dough, the trough was tilted by means of a worm and worm wheel, the latter being secured to the trough. Several variations of this type of kneader are still in use. The machine known as the "Universal" kneader consists of a trough set horizontally, within which rotate on horizontal axes a pair of blades lying in the same plane. These blades are curved and are geared together by means of differential spur wheels, with the object of running the two spindles at unequal speeds. The bottom of the trough is divided into two semi-cylindrical cavities, separated by a ridge. Each blade plunges into its own cavity, and the action of these arms tends, while pressing the dough against the sides and base of the trough, to bring it quickly back towards the centre. The differential speed has the advantage of effecting a more thorough mixing of the dough, as it brings together pieces of dough which have not yet been mingled, the blades pushing the dough from one cavity to the other. To hasten the

kneading process it is desirable occasionally to reverse the motion by a turn of a hand wheel on the same shaft as the two pulleys. This wheel governs all the motions of the blades. The trough, which is set low, is tilted over, when the dough is ready, by an endless chain operated by a hand winch. The effort required for this operation is very slight, as the trough is balanced by two weights. The action of tilting does not interfere with the blades, which continue rotating until stopped by the hand wheel. The Universal kneader was designed to imitate as closely as possible the action of a pair of skilled human arms and hands, but of course works at a much greater speed.

Another form of dough mixer which is extensively used consists simply of a drum made of sheet steel supported by two A-shaped standards at a sufficient height from the floor to allow a trough to be run underneath to receive the dough when ready for the moulding board. In this drum are two tight-fitting doors. The interior is fitted with no blades or knives, but presents a free cylindrical space, with the sole exception that, set not very far from the circumference, there are several fixed rods passing from one side of the drum to the other. These act as mixers of the dough. The door is opened and the flour and water poured in, whereupon the door is again fastened and the drum is made to rotate. As the rotation proceeds, the dough begins to form, and being lifted up by the revolving drum falls by its own weight. In this process, which is repeated again and again, the dough is caught by and tumbled over by the rods, which act as mixers and take the place of the revolving arms of the trough kneader. The kneading action of the rotating arms is absent, but the steady tumbling over these rods appears to have a thorough mixing effect, and the dough is discharged from the drum in good condition for moulding. The time occupied for making a dough by this apparatus varies from four to six minutes. The advantages claimed for this machine are that it consumes comparatively little power, and that there is not so much danger of “felling” or over-kneading dough as in some of the machines with revolving blades. The compactness of this rotating drum mixer, often known as the Rotary mixer, recommends it on shipboard and in other places where space is limited.

***Dough dividers and moulders.***

In the earlier days of machine bakeries the accurate dividing of dough, and still more the moulding of loaves by mechanical means, was considered an unattainable ideal. The first step in this direction was made by the Lewis-Pointon dough divider and weigher, which was intended for dividing and weighing out dough ready for the moulding table. In an ordinary way a baker who wishes to bake a batch of half-quartern or 2-lb. loaves scales off 2 lb. 2 oz. of dough for each loaf. The 2 oz. are a sort of insurance against light weight. The evaporation of moisture from dough in the oven is bound to reduce to some extent the weight of the baked loaf, but with normally baked bread, 2 lb. 2 oz. in the case of half-quarterns, and 4 lb. 4 oz. in the case of quartern loaves, is sufficient to ensure full weight. As the accurate scaling of dough requires some pains and trouble, it would be surprising if hand scaling were always accurate. The Lewis-Pointon machine can, it is claimed, be set to turn out lumps of dough of the exact weight required either for 1-lb., 2-lb., or 4-lb. loaves. The apparatus does not measure the dough by weight but by volume by an ingenious piston arrangement. The machine when first put on the market was a little complicated, but its mechanism has since been simplified. It has been successfully worked on doughs of all descriptions, ranging from the tightest to those made with 20 gallons of water to the sack. The same firm which brought out this dough divider has also produced a dough-moulding machine, which has a wide range of work. In this apparatus the dough is introduced between a trough and a revolving table at a point on the outer periphery of the latter. The order of things observed in hand moulding is here reversed, as the trough, unlike the hand, is fixed, while the table revolves around a vertical axis. This table is sharply coned, and can be made to work the dough as much or as little as may be required. In working dough for tin or Coburg loaves only one trough is used, but for cottage loaves two parallel troughs are fitted, one taking the lower and the other the upper half of the loaf. In the latter case, a single piece of dough is fed into the machine and passed through an automatic splitter, the two portions being automatically carried into the troughs and simultaneously delivered at the other side of the machine ready to be put together. With doughs which require “handing-up,” two machines may be used for moulding, the dough being automatically fed from the divider to the handing-up machine, and after a short proof passed through the finisher. But the moulding machine may also be used as a “hander-up.”

Another ingenious dough moulder, known as the Baker-Callow, works on a rather different principle. Here the pieces of dough coming from the divider are fed into the moulder by a canvas band, and are worked between a large cylindrical roller and a vertically running canvas and leather belt. To prevent pieces from dropping through, and to assist the moulding process, a smaller roller is placed under and between the cylindrical roller and canvas belt. A wooden puncher also assists in working the loaves, which are finished by being rolled between a band and a special shaped wooden moulding. This machine delivers the dough in spherical shaped pieces. If intended for cottage bread they are at once placed on the dough table at the side, and one piece is put on the top of the other ready for the oven. It is claimed the machine will deal equally well with large and small pieces at the same time, so that the tops and bottoms can be made together. Should the machine be intended for tinned bread, a special attachment is used, into which the spherical pieces are delivered from the machine and rolled into cylindrical shapes, ready to be dropped into the pan. A capacity of sixty loaves per minute is claimed for this moulder.

*Ovens.*—The ordinary baker’s oven is a vaulted chamber, about 10 ft. in length, by 8 ft. in width

and 30 in. in height; it is constructed of brick or stone, and has a small door in front through which the oven is charged (by means of a “peel” or long wooden shovel) and the batch withdrawn. The furnace and fire-grate are often placed at the side of the oven door, but with the oldest ovens, which were heated by wood, there generally was only one door for the fuel and for the bread. Whether the furnace is heated by coal, as is usual in England, or by coke, as is often the case in Scotland, the oven mouth remains in the bakehouse itself; hence the stoking and scuffling must be carried out within the bakehouse. This is in many ways objectionable. For one thing, the fuel must almost of necessity be kept in the bakehouse itself, and it is obvious that the products of combustion are liable to get into the oven. In the old type of oven a flue was frequently placed on the other side of the furnace door, both furnace and flue being on the front of the oven. After firing the furnace, the oven is allowed to “lie down” for a certain time, and secure an even distribution of heat. The furnace and flue are then shut, and the oven charged, the batch being baked by the heat stored within the oven chamber. With ovens of this type, each batch of bread requires a separate firing. This kind of oven has undergone several improvements of detail, but the principle of internal heating, that is, of firing the furnace inside the bakehouse, has remained unchanged.

A new era in bakers’ ovens began about the middle of the 19th century with the introduction of the “Perkins” oven, a system which, with slight modifications, has persisted till to-day. In this oven the baking chamber is heated by steam pipes. The latter consist of tubes of iron or mild steel which are partly filled with water and are hermetically sealed by welded ends. The pipes are arranged in two parallel rows, the one at the crown and the other at the sole of the oven. The pipes project at one end into the furnace, which is set at the back of the oven and is usually outside the bakehouse. This is termed an externally heated oven. As the ends of the pipes get red hot the water is converted into superheated steam, which being under high pressure soon raises the chamber to baking heat, say 450° to 500° F. In an oven of this description the heat can be continuously maintained, and batch after batch can be baked without refiring. The only drawback is that a flash heat cannot be raised. In another type of externally fired oven the heat is conveyed by flues placed at the bottom and top of the oven, which discharge into a chimney. Excellent results have been attained with ovens of this kind. The distribution of the heat can be well regulated; for instance, it is quite possible to build ovens to be cooler at the back than front, an arrangement which is useful when the bread is withdrawn by means of a hand peel. As the baker has to withdraw each loaf one at a time, it is clear that the withdrawal of the batch through the oven door must take time, probably not less than half-an-hour. Hence the bread drawn from near the oven’s mouth may be underbaked as compared with that at the back of the chamber. The latter, on the other hand, may be overbaked and deficient in weight.

By means of a draw-plate, however, an oven can be expeditiously charged. This appliance consists of a sliding plate or tray, mounted on wheels running on rails, which is drawn out of the oven loaded with bread, and then returned. The plate itself is often made of iron, but one well-known oven is fitted with a withdrawable iron frame, in which are laid, edge to edge, tiles of a special make, which are cemented in place, and form a continuous baking surface. This seems an excellent arrangement, as the baker has all the advantages of a brick oven, that is to say, his bread is baked both on top and bottom by heat evolved from tiled surfaces, and the undoubted drawbacks incidental to baking bread on an iron surface are avoided. A draw-plate fitted to an oven capable of baking a batch made from a sack (280 lb) of flour can be run out, charged and run in again, in about two minutes. The draw-plate has the incidental advantage, by expediting the loading and discharge of the oven, of ensuring a more uniform baking of the batch, and therefore of minimizing the loss of weight. Some bakers have gone so far as to estimate the saving in this respect from the use of a draw-plate at half an ounce per 2-lb loaf. With decker ovens a double draw-plate may be used, the feet of the pedestal supporting the upper draw-plate running on a rail outside, but parallel to the rail on which the lower draw-plate runs. This arrangement, however, is more applicable to small than large ovens. Or the lower oven may be fitted with a draw-plate while the upper oven is served with a peel. The draw-plate being at a lower level than the sole of an ordinary oven, the upper deck may be worked with a peel without much difficulty.



The *decker* oven is, as its name implies, an oven built over another oven: in fact, sometimes a tier of three ovens is employed, placed one above the other. The object is to secure a double or treble baking surface without a very much larger outlay on fuel than would be necessary for one oven. It is easy to understand that a double or three decker oven might be constructed under conditions where it would be impossible to place two or three ordinary ovens side by side. Practical bakers are somewhat divided as to the actual economy of the decker system; possibly it is a question of management. The upper oven is heated by the gases which have passed under the oven beneath. A double-decker oven on the flue principle could be heated by three flues, one beneath the lower oven, another passing between the crown of the lower and the sole of the top oven, and the third over the crown of the upper oven. If a third oven were built over the second, then a fourth flue would pass over the crown of the third and top oven. In such an arrangement of flues the distribution of heat to the ovens would be fairly equal, but no doubt the lower oven would be the hottest. In addition to the flues, which should be straight and accessible for cleaning, there ought also to be auxiliary flues by which heat may be allowed to pass dampers to the upper portions of the series of ovens. In this way the heat of the upper oven or ovens can be regulated independently to a great extent of the bottom oven. The power of regulating the heat of

the ovens is very necessary, because a baker doing what is called a mixed trade, that is to say, producing cakes and pastry in addition to bread, must work his ovens at varying temperatures. Cakes cannot be baked at the heat (about 450° F.) required by a batch of household bread. The richest fancy goods, such as wedding and Christmas cakes, require the coolest ovens. Flue ovens are best worked with coke, as coal is apt to choke the flues; retort coke is recommended in place of oven coke. An oven should be fitted with some kind of thermal register, and both high-temperature thermometers and pyrometers are used for this purpose.

(G. F. Z.)

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**BREADALBANE, JOHN CAMPBELL,** 1st Earl of (*c.* 1636-1717), son of Sir John Campbell of Glenorchy, Bart., and of the Lady Mary Graham, daughter of William, earl of Airth and Menteith, was born about 1636. He took part in the abortive royalist rising under Glencairn in 1654, and was one of those who urged Monk to declare a free parliament in England to facilitate the restoration. He sat in the Scottish parliament as member for Argyllshire from 1669 to 1674. As principal creditor he obtained in October 1672, from George, 6th earl of Caithness, a conveyance of his dignities, lands and heritable jurisdictions; and after the latter's death he was created on the 28th of June 1677 earl of Caithness and viscount of Breadalbane. In 1678 he married the widowed countess of Caithness, an economical step which saved him the alimentary provision of 12,000 merks a year he had covenanted to pay. In 1680 he invaded Caithness with a band of 700 men and defeated and dispossessed the earl's heir male. The latter, however, was subsequently confirmed in his lands and titles, and Campbell on the 13th of August 1681 obtained a new patent with the precedency of the former one, creating him earl of Breadalbane and Holland, viscount of Tay and Paintland, Lord Glenorchy, Benederaloch, Ormelie and Weick in the peerage of Scotland, with special power to nominate his successor from among the sons of his first wife. In 1685 he was a member of the Scottish privy council. Though nominally a Presbyterian he had assisted the intolerant and despotic government of Lauderdale in 1678 with 1700 men. He is described as having "neither honour nor religion but where they are mixed with interest," as of "fair complexion, of the gravity of the Spaniard, cunning as a Fox, wise as a Serpent and supple as an Eel."[1] He was reputed the best headpiece in Scotland.[2] His influence, owing to his position and abilities, was greater than that of any man in Scotland after Argyll, and it was of high moment to King William to gain him and obtain his services in conciliating the Highlanders. Breadalbane at first carried on communications with Dundee and was implicated in the royalist intrigue called the "Montgomery plot," but after the battle of Killiecrankie in July 1689 he made overtures to the government, subsequently took the oath of allegiance, and was entrusted with a large sum of money by the government to secure the submission of the clans. On the 30th of June 1691 he met the Jacobite chiefs and concluded with them secret articles by which they undertook to refrain from acts of hostility till October, gaining their consent by threats and promises rather than by the distribution of the money entrusted to him, the greater part of which, it was believed, he retained himself. When asked to give an account of the expenditure he replied: "The money is spent, the Highlands are quiet, and this is the only way of accounting between friends."[3]

On the 27th of August a proclamation was issued offering indemnity to all those who should submit and take the oath of allegiance before the 1st of January 1692, and threatening all those who should refuse with a military execution and the penalties of treason. All the chiefs took the oath except MacIan, the chief of the MacDonalds of Glencoe, who postponed his submission till the 31st of December, and was then prevented from taking the oath till the 6th of January 1692 through the absence of a magistrate at Fort William, whither he had repaired for the purpose. This irregularity gave Breadalbane an immediate opportunity of destroying the clan of thieves which had for generations lived by plundering his lands and those of his neighbours. Accordingly, together with Argyll and Sir John Dalrymple (afterwards Lord Stair), Breadalbane organized the atrocious crime known as the "Massacre of Glencoe," when the unfortunate MacDonalds, deceived by assurances of friendship, and at the moment when they were lavishing their hospitality upon their murderers, were butchered in cold blood on the 13th of February 1692. Breadalbane's astuteness, however, prevented the disclosure of any evidence against him in the inquiry afterwards instituted in 1695, beyond the deposition of a person who professed to have been sent on Breadalbane's behalf to obtain a declaration of his innocence from MacIan's sons, who had escaped. The discovery of his former negotiations with the Jacobite chiefs caused his imprisonment in Edinburgh Castle in September, but he was released when it was known that he had been acting with William's knowledge.

Breadalbane did not vote for the Union in 1707, but was chosen a representative peer in the parliament of Great Britain of 1713-1715. His co-operation with the English government in securing the temporary submission of the Highlands was inspired by no real loyalty or allegiance, and he encouraged the attempted French descent in 1708, refusing, however, to commit himself

to paper. On the occasion of the Jacobite rising in 1715 he excused himself on the 19th of September from obeying the summons to appear at Edinburgh on the ground of his age and infirmities; but nevertheless the next day visited Mar's camp at Logierait and afterwards the camp at Perth, his real business being, according to the Master of Sinclair, "to trick others, not to be trickt," and to obtain a share of the French subsidies. He had taken money for the whole 1200 men he had promised and only sent 300. His 300 men were withdrawn after the battle of Sheriffmuir, and his death, which took place on the 19th of March 1717, rendered unnecessary any inquiry into his conduct. He married (1) Mary, daughter of Henry Rich, 1st earl of Holland, by whom he had two sons, Duncan, styled Lord Ormelie, who was passed over in the succession, and John, and earl of Breadalbane; (2) Mary, daughter of Archibald, marquis of Argyll, and widow of George, 6th earl of Caithness, by whom he had one son, Colin. By Mrs Mildred Littler, who has sometimes but probably in error been named as his third wife, he had a daughter, Mary.



John Campbell, 2nd earl of Breadalbane (1662-1752), an eccentric nobleman, who was known as "Old Rag," was succeeded by his only son, John (*c.* 1696-1782). This earl was a diplomatist, being British ambassador to Denmark and to Russia, and a politician, being for a long time a member of the House of Commons and a supporter of Sir Robert Walpole, in addition to holding several official positions. All his sons having predeceased their father, the title passed on his death, on the 26th of January 1782, to a cousin, John (1762-1834), who became 4th earl and was created a British peer as marquess of Breadalbane in 1831. His son John, the 2nd marquess (1796-1862), a prominent leader of the Free Church during the ecclesiastical disputes in Scotland, died without sons in November 1862. The marquessate now became extinct, but the Scottish earldom passed to a cousin John Alexander (1824-1871), whose son and successor, Gavin (b. 1851), was created marquess of Breadalbane in 1885.

1 *Memoirs* of John Macky (Roxburghe Club, 1895), 121.

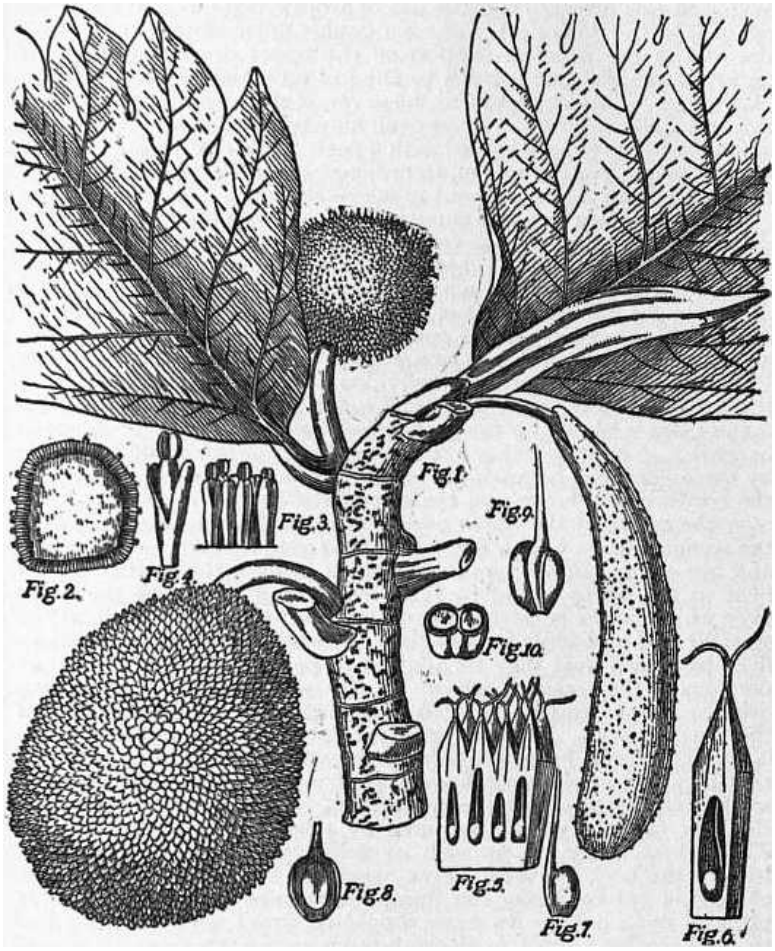
2 *Corr. of Col. N. Hooke* (Roxburghe, Club, 1870), i. 49.

3 Note by Sir W. Scott in Sinclair's *Mem. of Insurrection in Scotland* (Abbotsford Club, 1858), 185.

**BREADALBANE**, a large district of Perthshire, Scotland, bordered N. by Atholl, E. by Strathtay, S. by Strathearn and W. by the districts of Argyll and Lorne, and occupying some 1020 sq. m. Most of the surface is mountainous, Ben Lawers (3984 ft.), Ben More (3843), and Ben Lui (3708), being the principal hills. Loch Tay is the chief lake, and among the rivers are the Orchy, Dochart, Lochay, Lyon, Almond and the Tay (during the early part of its course). Population mostly centres in Aberfeldy, Fortingal, Kenmore and Killin. The soil is not cultivable excepting in some of the glens and straths. Game is plentiful, the lakes and rivers afford good sport, and the deer forests and shootings are valuable. The district has given the titles of earl and marquess to the Campbells of Glenorchy.

**BREAD-FRUIT**. This most important food staple of the tropical islands in the Pacific Ocean is the fruit of *Artocarpus incisa* (nat. ord. Moraceae). The tree attains a moderate height, has very large, acutely lobed, glossy leaves, the male flowers in spikes, and the female flowers in a dense head, which by consolidation of their fleshy carpels and receptacles form the fruit. The fruit is globular in shape, about the size of a melon, with a tuberculated or (in some varieties) nearly smooth surface. Many varieties of the tree are cultivated, the fruits of some ripening numerous seeds, which are eaten as chestnuts; but in the best kinds the seeds are aborted, and it is only these that are highly prized as vegetables. The tree is a native of the South Sea Islands, where its fruit occupies the important position that is held by cereals in temperate latitudes. The fruit, which on distinct varieties ripens at different periods, affording a nearly constant supply throughout the year, is gathered for use just before it ripens, when it is found to be gorged with starchy matter, to which its esculent value is due. It may be cooked and prepared for use in a great variety of ways, the common practice in the South Sea Islands being to bake it entire in hot embers, and scoop out the interior, which when properly cooked should have a soft smooth consistence, fibrous only towards the heart, with a taste which has been compared to that of boiled potatoes and sweet milk. Of this fruit A.R. Wallace, in his *Malay Archipelago*, says: "With meat and gravy it is a vegetable superior to anything I know either in temperate or tropical countries. With sugar, milk, butter or treacle it is a delicious pudding, having a very slight and

delicate but characteristic flavour, which, like that of good bread and potatoes, one never gets tired of.” In the Pacific Islands the fruit is preserved for use by storing in pits, where the fruits ferment and resolve themselves into a mass similar in consistency to new cheese, in which state they emit an offensive odour; but after baking under hot stones they yield a pleasant and nutritious food. Another and more common method of preserving the fruit for use consists in cutting it into thin slices, which are dried in the sun. From such dried slices a flour is prepared which is useful for the preparation of puddings, bread and biscuits, or the slices are baked and eaten without grinding. The tree yields other products of economic value, such as native cloth from the fibrous inner bark of young trees; the wood is used for canoes and articles of furniture; and a kind of glue and caulking material are obtained from the viscid milky juice which exudes from incisions made in the stem.




*Artocarpus incisa*, the Bread-fruit tree.

Fig. 1. Branch reduced about a 6th natural size, with cuneate-ovate pinnatifid leaves, male flowers in a club-shaped deciduous catkin, and female flowers in rounded clusters.
Fig. 2. Transverse section of the male spike with numerous flowers.
Fig. 3. Male flowers.
Fig. 4. Single male flower separated, with a perianth in 2 segments and a single stamen.
Fig. 5. Female flowers.
Fig. 6. Single female flower separated, with ovary, style and bifid stigma.
Fig. 7. Ovary.
Fig. 8. Ovary laid open to show the ovule.
Fig. 9. A variety of the ovary with 2 loculaments.
Fig. 10. Transverse section of a bilocular ovary.

The bread-fruit is found throughout the tropical regions of both hemispheres, and its first introduction into the West Indies is connected with the famous mutiny of the “Bounty,” and the remarkable history of a small company of the mutineers at Pitcairn Island. Attention was directed to the fruit in 1688 by Captain Dampier, and later by Captain Cook, who recommended its transplantation to the West Indian colonies. In 1787 the “Bounty” was fitted out under command of Lieutenant William Bligh (*q.v.*) to proceed to Tahiti to carry plants thence to the West Indian Islands; and it was after the cargo had been secured and the vessel was on her way that the mutiny broke out, and Lieutenant Bligh and some of his crew were turned adrift in a small boat in the open sea. The mutineers returned with the vessel to Tahiti, whence a number of them, with a few native men and women, sailed to the desolate and lone islet of Pitcairn. Lieutenant Bligh ultimately reached England, and was again commissioned to undertake the work of transplanting

the plants, which in the year 1792-1793 he successfully accomplished.

A somewhat similar but inferior fruit is produced by an allied species, the Jack or Jak, *Artocarpus integrifolia*, growing in India, Ceylon and the Eastern Archipelago. The large fruit is from 12 to 18 in. long by 6 to 8 in. in diameter, and is much eaten by the natives in India. This tree is chiefly valuable on account of its timber, which has a grain very similar to mahogany, and although at first light-coloured it gradually assumes much of the appearance of that wood.



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**BREAKING BULK**, a nautical term for the taking out of a portion of the cargo of a ship, or the beginning to unload; and used in a legal sense for taking anything out of a package or parcel, or in any way destroying its entirety. It was thus important in connexion with the subject of bailment, involving as it did the curious distinction that where a bailee received possession of goods in a box or package, and then sold them as a whole, he was guilty only of a breach of trust, but if he “broke bulk” or caused a separation of the goods, and sold a part or all, he was guilty of felony. This distinction was abolished by the Larceny Act 1861, which enacted that whoever, being a bailee of any chattel, money or valuable security, should fraudulently take or convert the same to his own use, or the use of any person other than the owner, although he should not break bulk or otherwise determine the bailment, should be guilty of larceny (s. 3).

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**BREAKWATER.** When a harbour (*q.v.*) is proposed to be established on an exposed coast, whether for naval or commercial purposes, to provide a protected approach to a port or river, or to serve as a refuge for vessels from storms, the necessary shelter, so far as it is not naturally furnished by a bay or projecting headlands, has to be secured by the construction of one or more “breakwaters.” These breakwaters, having to prevent the waves that beat upon the coast from reaching the site which they are designed to protect, must be made sufficiently strong to withstand the shocks of the waves during the worst storms to which they are exposed. It is therefore essential, before constructing a breakwater, to investigate most carefully the force, periods and duration of the winds from the quarters to which the work will be exposed, the distance of any sheltering land from the site in the most stormy direction, the slope of the beach and the depth of the sea in the neighbourhood of the shore, and the protection, if any, afforded by outlying shoals or sandbanks. In a tidal sea, the height required for a breakwater is affected by the amount of tidal range; and the extent of breakwater exposed to breaking waves depends upon the difference in level between low and high water. The existence, also, of any drift of sand or shingle along the shore must be ascertained, and its extent; for the projection of a solid breakwater out from the shore is certain to affect this littoral drift, which, if large in amount, may necessitate important modifications in the design for the harbour.

***Winds.***

Observations of the force and prevalence of the winds from the different quarters at the various periods of the year, and the instruments by which they are recorded, belong to the science of meteorology; but such records are very valuable to the maritime engineer in indicating from which directions, open to the sea, the worst storms, and, consequently, the greatest waves, may be expected, and against which the most efficient shelter has to be provided. Moreover, it is necessary, for constructing or repairing a breakwater, to know the period of the year when the calmest weather may be safely anticipated, and also the stormy season during which no work should be attempted, and in preparation for which unfinished works have to be guarded by protective measures. In the parts of the world subject to periodical winds, such as the monsoons, the direction and force of the winds vary with remarkable regularity according to the seasons; and even such uncertain occurrences as hurricanes and cyclones generally visit the regions in their track at definite periods of the year, according to the locality. Even in western Europe, where the winds are extremely variable, violent gales are much more liable to beat upon the western and northern coasts in the winter months than at any other period of the year; whilst the calmest weather may be expected between May and August.

***Waves.***

The size of waves depends upon the force of the wind, and the distance along which it blows continuously, in approximately the same direction, over a large expanse of ocean. The greatest waves are, accordingly, encountered where the maximum distance in a certain direction from the nearest land, or, as it is termed, the “fetch,” coincides with the line travelled by the strongest gales. The dimensions, indeed, of waves in the

worst storms depend primarily on the extent of the sea in which they are raised; though in certain seas they are occasionally greatly increased by the exceptional velocities attained by hurricanes and typhoons, which, however, are fortunately restricted to fairly well defined and limited regions. Waves have been found to attain a maximum height of about 10 ft. in the Lake of Geneva, 17 ft. in the Mediterranean Sea, 23 ft. in the Bay of Biscay, and 40 ft. in the Atlantic Ocean; whilst waves of 50 to 60 ft. in height have been observed in the Pacific Ocean off the Cape of Good Hope, where the expanse of sea reaches a maximum, and the exposure to gales is complete. The length of large waves bears no definite relation to their height, and is apparently due, in the long waves often observed in exposed situations, to the combination of several shorter waves in their onward course, which is naturally dependent on the extent of the exposure. Thus waves about 560 ft. in length have been met with during severe gales in the Atlantic Ocean; whilst waves from 600 to 1000 ft. long are regarded as of common occurrence in the Pacific Ocean during storms.

The rate of transmission of the undulation also varies with the exposure; for the ordinary velocity of the apparent travel of waves in storms has been found to amount to about 22 m. an hour in the Atlantic Ocean, and to attain about 27 m. an hour off Cape Horn. The large waves, however, observed in mid-ocean do not reach the coast, because their progress is checked, and their height and length reduced, by encountering the shelving sea-bottom, which diminishes the depth of water on approaching the shore; and the actual waves which have to be arrested by breakwaters depend on the exposure of the site, the existence of continuous deep water close up to the shore, and the depth in which the breakwater is situated. On the other hand, the height, and, consequently, the destructive force of waves, is increased on running up a funnel-shaped bay, by the increasing concentration of the waves in the narrowing width, just as the tidal range of a moderate tidal current is much augmented by its passage up the Bay of Fundy, or up the Bristol Channel into the Severn estuary, or by filling the shallow enclosed bay of St Malo. This effect is intensified when the bay faces the direction of the strongest winds. Thus at Wick a mass of masonry weighing 1350 tons, placed at the head of the breakwater projecting half-way across the bay and facing the entrance, was moved by the waves during a violent storm; and a portion of Peterhead breakwater, weighing 3300 tons, was shifted 2 in. in 1898, indicating a wave-stroke of 2 tons per sq. ft. Southwesterly gales, blowing up the Gulf of Genoa, cause large waves to roll into the bay, reaching a height of about 21 ft. in the worst storms.

Where outlying sandbanks stretch in front of a coast, as for instance the Stroombank in front of Ostend and the adjacent shore, and the sandbanks opposite Yarmouth sheltering Yarmouth Roads, large waves cannot approach the land, for they break on the sandbanks outside. Waves, indeed, always break when, on running up a shoaling beach, they reach a depth approximately equal to their height; and the largest waves which can reach a shore protected by intervening sandbanks, are those which are low enough to pass over the banks without breaking.

The force of the wind, as transmitted by degrees to the sea, is manifested as a series of progressing undulations without any material displacement of the body of water, each undulation transmitting its accumulated force to the next in the direction the wind is blowing, till at last, on encountering an obstacle to its onward course, each wave, no longer finding any water to which to communicate its energy, deals a blow against the obstacle proportionate to its size and rate of transmission; or on reaching shoal water near the shore, the undulation is finally transformed into a breaking wave rushing up the sloping beach. till, on its energy being spent, it recoils back to the sea down the beach. A breaking wave concentrates its transmitted force on a portion of the water forming the undulation, which, consequently, strikes a more powerful blow over a limited area against any structure than the more distributed shock of a simple undulation beating against a vertical wall. Moreover, the recoil of broken waves down a sloping beach or rubble mound produces a greater scour than the simple reflection of an undulation from a vertical wall, especially where the depth is sufficient to provide a cushion of water below the undulation, protecting the toe of the wall from the wash of recoil.



*Types of Breakwaters*.—There are three distinct types of breakwaters:—(1) A simple rubble or concrete-block mound; (2) a mound for the bottom portion, surmounted on the top by a solid superstructure of masonry or concrete; and (3) an upright-wall breakwater, built up solid from the sea-bottom to the top. The second type forms a sort of combination of the first and third types; and each type presents several varieties. In a few harbours, two different types have been adopted for different situations at the same place; but generally the choice of type is determined by the materials available at the site for the construction of the breakwater, the nature of the sea-bottom and the depth into which the breakwater has to be carried.

***Rubble mound.***

1. *Rubble and Concrete-Block Mound Breakwaters*.—A rubble mound consists merely of a mass of rubble stone, just as it is obtained from a neighbouring quarry, tipped into the sea along a predetermined line, till the mound emerges out of water. The rubble stone is deposited, either from barges, as adopted for the construction of the detached breakwater sheltering Plymouth Bay, or from wagons, having hinged opening flaps at the bottom for dropping their load, run out from the shore along staging

erected in the proposed line, according to the method employed for the outer breakwater enclosing Portland Harbour, and the north-east breakwater at Colombo Harbour. The mound thus deposited is gradually consolidated under the action of the sea; and a tolerably stable form is by degrees attained by continued deposits of stone. This system of construction is very wasteful of materials, and can only be resorted to where extensive quarries close at hand are able to furnish readily and cheaply very large quantities of stone, especially where, as at Portland and Table Bay, convict labour has been advantageously utilized in quarrying. When the site is very exposed, the large waves in storms, dashing over a rubble-mound breakwater, carry the stones on the top, if unprotected, over on to the harbour slope, and in recoiling down the outer slope, draw down the stones on the face, so that the top and sea slope of the mound need replenishing with a fresh deposit of stones after severe storms.

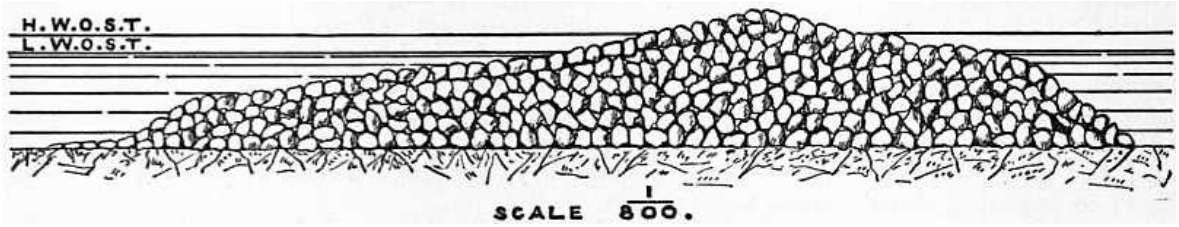



FIG. 1.—Table Bay Breakwater

Under the action of the breaking and recoiling waves, the mound assumes a very flat slope on the sea side, from a few feet above high-water down to several feet below low-wafer level (fig. 1). The flatness of the sea slope depends on the exposure of the site, and the limited size of the stones covering the outer portion of the mound; and its extent increases with the range of tide, as a large tidal rise exposes a greater length of slope to the action of the waves. This flattening of the sea slope greatly increases the amount of stone required for a rubble-mound breakwater, in proportion to the exposure and the range of tide; and the amount is also affected, but in a proportionately minor degree, by the depth in which the breakwater is situated. In order to avoid the injuries to which an ordinary rubble mound is subjected by waves, certain methods have been devised for protecting the top and sea slope of the mound. For instance, the upper portion of Plymouth breakwater has been covered over by granite paving set in cement, to diminish the displacement of the stones by the waves. Frequently, on the continent of Europe, rubble mounds have been formed of materials so sorted that the smallest stones are placed in the centre of the lower part of the mound, and covered over along the slopes and top by layers of larger stones, increasing in size towards the outer part of the mound, so that the largest stones obtainable are deposited on the outside, and especially on the top and sea slope of the mound. This is, no doubt, theoretically the correct method of construction of rubble mounds exposed to the sea; but it involves a considerable amount of trouble and expense.

***Concrete blocks with rubble mound.***

Practically the chief point of importance is to cover the outer slope and the top of the mound with the largest stones that can be procured, and where large stones are not readily obtainable concrete blocks furnish a very convenient substitute. These blocks are generally deposited as the outer covering on the top and sea slope of a rubble mound, as for example at the mound breakwaters in deep water sheltering Algiers harbour, and at the French parts of Cette and Bona on the Mediterranean; whilst they furnish the protection of the top and upper part of the sea slope of the rubble-mound extension of Marseilles breakwater down to 20 ft. below sea-level. At Alexandria, concrete blocks compose the outer half of the mound, sheltering the inner half consisting of small rubble (fig. 2); at Biarritz the mound breakwater is formed mainly of concrete blocks, with rubble stone filling the interstices and on the top; whereas at the outer end of the western breakwater at Port Said, protecting the entrance to the Suez Canal, a bottom layer of rubble is surmounted by concrete blocks. These blocks are generally deposited at random; but at Cette (fig. 3), and at the breakwater in deep water at Civita Vecchia, the concrete blocks covering the rubble have been laid in stepped, horizontal courses. This arrangement necessitates more care and better appliances in construction; but, in compensation, the blocks so placed are less exposed to disturbance and injury by the waves.

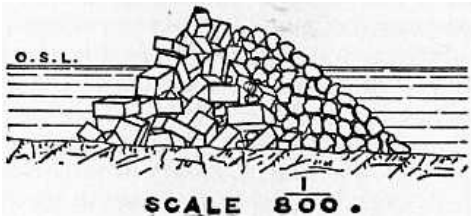



FIG. 2.—Alexandria Breakwater.

Concrete blocks possess the great advantages for breakwaters that they can be made wherever sand and shingle can be procured, and of a size only limited by the appliances which are available for handling them. In fact, in places where stone of any kind is difficult to procure at a reasonable cost, as for instance at Port Said, concrete blocks are indispensable for the construction of breakwaters. Large concrete blocks, moreover, by enabling a comparatively steep slope to be formed with them on the sea side of a mound breakwater, reduce considerably the amount of materials required, especially at exposed sites, and also for breakwaters extended into deep water, such as those of Algiers and Marseilles.

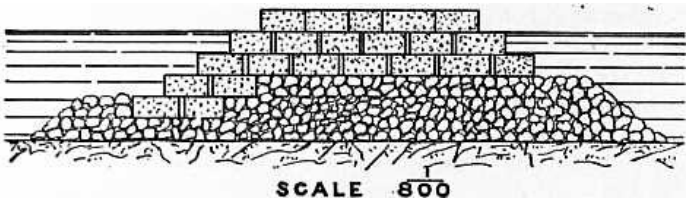



FIG. 3.—Cette Breakwater.

Occasionally, in the absence of suitable rubble stone, a mound breakwater has been formed entirely with concrete blocks; and of this the main portion of the western breakwater at Port Said furnishes a notable example (fig. 4). Sometimes, in exposed situations, the mounds of the composite type of breakwaters have been constructed exclusively with concrete blocks, such, for instance, as in the curved breakwater protecting the outer harbour at Leghorn, and in the central breakwater in deep water sheltering the harbour of St Jean de Luz, and directly facing the Bay of Biscay. These large concrete blocks are deposited by cranes from staging, tipped into the sea from a sloping platform on barges, or floated out between pontoons, or slung out from floating derricks. This last method proved so expeditious for the upper blocks at Alexandria, that, in conjunction with the tipping of the lower blocks from the inclined planes on the decks of barges and the deposit of the rubble from hopper barges, provided also with side flaps for the higher portions, the detached breakwater, nearly 2 m. long, sheltering a very spacious harbour, was constructed in two years (1870-1872). Sometimes, when a mound breakwater has been raised out of water, advantage is taken of a calm period of the year and a low tide to form large blocks of concrete within timber framing on the top of the mound, so as to provide a very efficient protection.

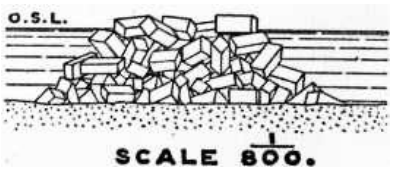



FIG.4.—Port Said Western Breakwater.

***Concrete block mound.***

The large masses composing mound breakwaters give them great stability against the attacks of the sea; and, moreover, the wide base of the mounds enables them to be deposited on a sandy or silty sea-bottom, without any fear of settlement or undermining. A mound breakwater, however, has the disadvantages of requiring a large amount of material, and of occupying a wide space on the bed of the sea, more especially where the mound consists of rubble stone and is in deep water, so that the system, though simple, is costly, and is unsuited for harbours where the available space to be sheltered is limited. Nevertheless, a mound breakwater can be rapidly constructed by the employment of a large number of barges; and by the adoption of large concrete blocks, the quantity of materials and the space occupied by the mound can be considerably reduced. This form of breakwater, with its long outer slope exposed to breaking waves, particularly where the tidal range is considerable, is, indeed, more subject to frequent small injuries than the other types, but they are readily repaired; and a mound is not generally liable to the serious breaches which occasionally are formed in solid superstructures and upright walls in exceptional storms.



2. *Breakwaters formed of a Mound surmounted by a Superstructure.*—The second type of breakwater consists of a mound, composed of rubble or concrete blocks, or generally a combination of the two, carried up from the sea-bottom, on the top of which some form of solid superstructure is erected. This superstructure reduces considerably the amount of materials required (which, on account of the slopes of the mound, increases rapidly with the height) in proportion to the depth at which the superstructure is founded; and the solid capping on the mound serves also to protect the top of the mound from the action of the waves. In the case, however, of a mound breakwater, portions of the highest waves generally pass over the top of the mound, and also to some extent expend their force in passing through the interstices between the blocks; whereas a superstructure presents a solid face to the impact of the waves. A superstructure, accordingly, must be very strongly built in proportion to the exposure, and also to the size of the waves liable to reach it, which depends upon the height and flatness of the slope of the mound just in front of it on the sea side. Special care, moreover, has to be taken to prevent the superstructure from being undermined; for the waves in storms, dashing up against this nearly vertical, solid obstacle, tend in their recoil down the face to scour out the materials of the mound at the outer toe of the superstructure, and thereby undermine it, especially where the superstructure is founded on the mound near low-water level, and there is, therefore, no adequate cushion of water above the mound to diminish the effect of the recoil on the foundation.

The mound constituting the lower portion of the composite type of breakwater has been formed in the same varied way as simple mound breakwaters, namely, of rubble, sorted rubble, rubble protected by concrete blocks, and wholly of concrete blocks. The only differences introduced in the mound in this case are, that it is not carried up so high, that the top portion covered by the superstructure needs no further protection, and that special protection has to be provided on the slope of the mound adjacent to the outer toe of the superstructure.

The forms of the superstructures exhibit considerable variations, ranging from a few concrete

blocks laid in courses on the top of the mound, or a paving furnishing a quay protected by a narrow parapet wall on the sea side, up to a large, solid structure, only differing from an upright-wall breakwater in being founded upon a mound, instead of on the sea-bottom.

***Superstructures.*** Notwithstanding, however, this great variety in design, these breakwaters may be divided into two distinct classes, namely, breakwaters having their superstructures founded at or near low-water level, and breakwaters with superstructures founded some depth below low water. The object in the first case is to lay the foundations of the superstructure on the mound at the lowest level consistent with building a solid structure with blocks set in mortar, out of water, in the ordinary manner; and, in the second case, to stop the raising of the mound at such a depth under water as to secure it from displacement by the waves. In fact, the solidity and facility of construction of the superstructure were the primary considerations in the older form of breakwater; whereas the stability of the mound and the avoidance of the undermining of the superstructure have been regarded as the most important provisions in the more modern form.

***Superstructures at low-water level.*** Well-known examples of breakwaters formed of a rubble mound surmounted by a superstructure founded at or near low water or sea-level, are furnished by Cherbourg and Holyhead breakwaters, the inner breakwater at Portland, and the breakwaters at Marseilles, Genoa, Civita Vecchia, Naples, Trieste and other Mediterranean ports. The very exposed breakwater at Alderney was commenced on this principle about the middle of the 19th century; and the outer breakwaters at Leghorn and St Jean de Luz have superstructures founded at low water on concrete-block mounds.

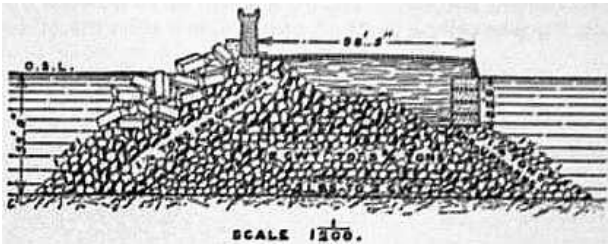



Fig. 5.—Marseilles Breakwater, central portion.

The long, detached breakwater sheltering the series of basins formed by wide projecting jetties along the sea coast at Marseilles (see Dock), is a typical instance of a breakwater where a quay has been formed on the top of a sorted rubble mound, sheltered on the sea side by a high wall, or narrow superstructure, founded at sea-level, and protected on the sea slope of the mound from undermining by large concrete blocks deposited at random (fig. 5). In this case the quay has been rendered accessible for vessels on the harbour side by a quay wall, formed of concrete blocks deposited one above the other, providing a vertical face to a depth of about 22¾ ft. below sea-level; and a similar arrangement has been adopted at Trieste, and in a less effective manner at Civita Vecchia and Naples. At Marseilles, however, when the breakwater reached great depths, the quay was abandoned on account of the increased exposure, and the extension made of a simple rubble mound, protected on the sea side, from the top down to 20 ft. below sea-level, by large concrete blocks deposited at random.

The superstructures at Holyhead and Portland, being built on the old weak system of a sea wall and a harbour wall, with rubble filling between, are protected on the sea side by raising the rubble against them from low water up to high water of spring tides; whereas the superstructure of Cherbourg breakwater, being built solid and less exposed, is only protected on the sea side by large rubble and some concrete blocks, forming an apron raised slightly above low water. These three breakwaters are provided with a quay sheltered by a raised wall or promenade on the sea side; but as the mound on the harbour side is raised up to, or a little above low water, the quay is only accessible for vessels near high water. This, however, is of comparatively little importance, since these quays, though very useful for access to the end of the breakwater in fairly calm weather, are inaccessible in exposed situations with a rough sea; and quays for the accommodation of vessels are better provided well within the sheltered harbour.

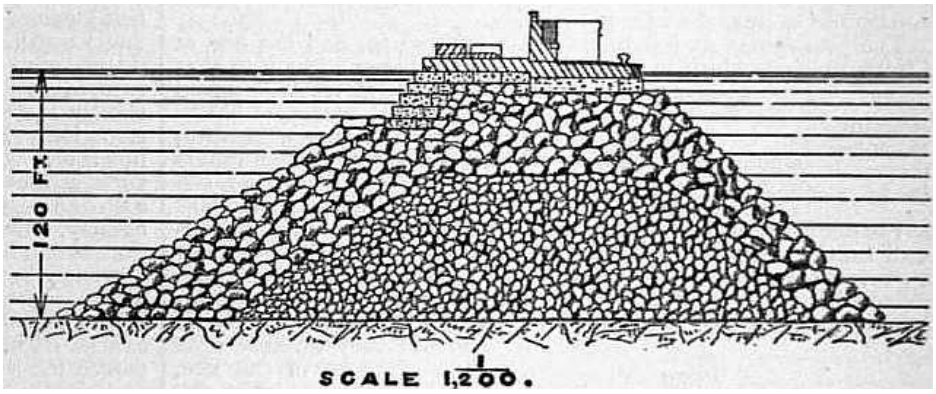



FIG. 6.—San Vincenzo Breakwater, Naples.

The outer portions of the main breakwaters at Genoa and at Naples (fig. 6), extending into depths of about 75 ft. and 110 ft. respectively, have been provided with superstructures, similar in type, but more solid than the superstructure at Marseilles; and the sorted rubble mounds upon which the superstructures rest are protected on the sea slope by stepped courses of concrete blocks from a depth of 26 ft. below sea-level, covered over at the top by a masonry apron forming a prolongation of the superstructure. The outer extension of the main breakwater at Civita Vecchia furnishes an interesting example of a composite form of breakwater, in which the rubble mound has been protected, and greatly reduced in volume and extent in deep water, by stepped courses of concrete blocks carried up from near the bottom of the mound (fig. 7).

The breakwaters in front of Havre, constructed in 1896-1907, for sheltering the altered entrance to the port, were formed of a sorted rubble mound, protected on the sea slope by concrete blocks, and raised a little above low water of spring tides, upon which large blocks of masonry, built on land, were deposited with their upper surfaces about 18 in. above low water of neap tides. As soon as settlement of the mound under the action of the sea appeared to have ceased, these masonry blocks were connected together by filling the spaces between them with masonry; and a solid masonry superstructure was built during low tide on this foundation layer, as shown in fig. 8.



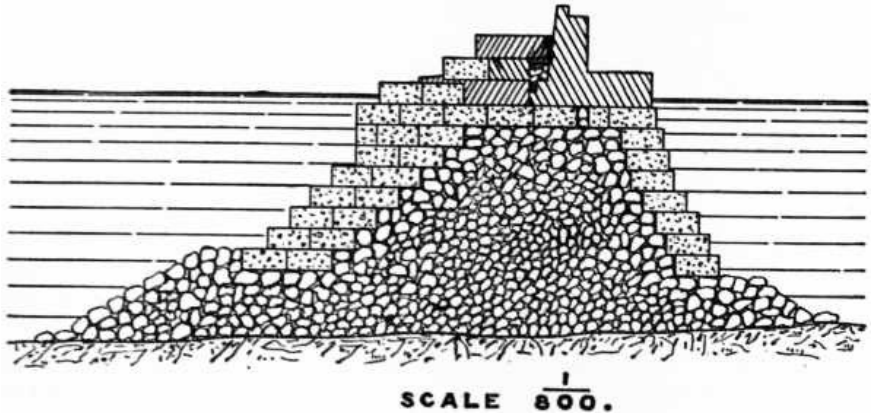



FIG. 7.—Civita Vecchia Outer Breakwater.

The breakwaters constructed for forming harbours on the sea coast of the United States are almost all rubble-mound breakwaters. The two old detached breakwaters sheltering Delaware Harbour near the south-eastern extremity of Delaware Bay, were formed of simple rubble mounds raised about 13 ft. above low water; but in closing the gap between them towards the close of the 19th century, the rubble mound was stopped at low water, and a sort of superstructure, consisting of stepped courses of large rectangular blocks of stone on the sea and harbour sides, with tightly packed rubble between them and capped across the top for a width of 20 ft. with a course of large blocks, was raised to 14 ft. above low water, resembling, on a small scale, the upper part of the Civita Vecchia mound (fig. 7). A similar construction was adopted for the new breakwater formed in 1897-1901 for providing a harbour of refuge at the mouth of Delaware Bay; but in this instance the mound was made considerably wider at the top, and had to be protected along the toe of the superstructure on the sea side by large stones. The same form of superstructure, also, on a narrower base, was resorted to for a breakwater in deeper water at San Pedro in California with satisfactory results. When, however, a breakwater of the Delaware type was in progress for forming a harbour of refuge in Sandy Bay, Massachusetts, in front of Rockport to the north of Boston, the upper 13 ft. of the 600 ft. of completed superstructure were carried away during a severe storm in 1898 leaving only a portion about 5 ft. in height above low water, the average rise of tide there being 8⅗ ft. The design was, accordingly, modified in 1902, by commencing the stepped courses of large stones at 12 ft. below mean low water on each slope, instead of at low water raising this kind of superstructure to 22 ft. above low water in place of 18 ft., and capping the stepped courses at the top by large blocks of stone, 20 ft. long and 5 ft. deep,

laid across the breakwater, which thus presented a marked resemblance to the upper section of the mound at Civita Vecchia.

The breakwater at Sandy Bay just referred to, and the one at Civita Vecchia, which it somewhat resembles, approximate to that class of breakwater which has a superstructure founded below low-water level, so far as stepped courses of blocks can be regarded as forming part of a superstructure; but as the protection afforded by these courses differs only in the arrangement of the blocks from that obtained by blocks deposited at random, it appears expedient to restrict this class to the more solid structures, resembling upright-wall breakwaters, founded on a mound at some depth below low water As the main object of this class of breakwater is to keep the mound below the zone of disturbance by waves in severe storms, it is evident that the depth at which the superstructure is founded should vary directly with the exposure of the site, and inversely with the size of the materials forming the mound.

***Superstructure below low-water level.***

The depth at which waves striking against a superstructure may affect a rubble mound near its toe by the recoil, has been only very gradually realized. Thus, in 1847, the Alderney breakwater, though fully exposed to the Atlantic Ocean, was begun with a superstructure founded at low water of spring tides upon a rubble mound; but within two years the foundations had to be carried down 12 it. below low water, and this was adhered to till close to the head, though the breakwater, completed in 1864, extended 4700 ft. from the shore into a depth of 130 ft. at low tide, the rise of springs being 17 ft. The great recoil of the waves in storms from the promenade wall on the sea side of the superstructure, raised 33 ft. above low water, disturbed the sea slope of the mound along the outer portion, situated in depths of 80 to 130 ft. at low water, out to a distance of 90 ft. from the superstructure and to a depth of 20 ft.; whilst the outer toe of the superstructure was only preserved from being undermined by frequent deposits of stone along the sea face.

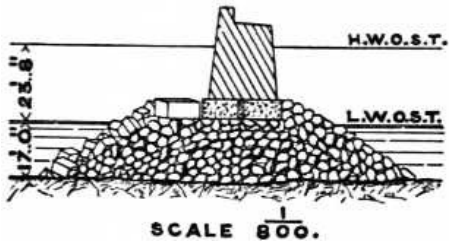


FIG. 8.—Havre Breakwater.

The south-west breakwater at Colombo Harbour, constructed in 1876-1884, facing the seas raised by the south-west monsoon, extends into a depth of 39 ft. at low water, where the rise of tide is only 2 ft. at springs, and was built with a superstructure founded upon a rubble mound at a depth of 20 ft. below low water, but raised only 12 ft. above this level without any parapet, and protected along its sea face by an apron of concrete in bags. In this case, not only was the depth of the sea much less than at Alderney, but the small elevation of the superstructure above low water enabled a portion of the waves in storms to pass over it without materially impairing the shelter inside. These circumstances reduced the shock and recoil of the waves; and the greater depth of the foundations and the protection of the toe of the superstructure greatly diminished the danger of undermining. Consequently, the Colombo breakwater has been preserved from the injuries to which the outer part of the Alderney breakwater succumbed. Nevertheless, in subsequently constructing the north-west detached breakwater, less exposed to the south-west monsoon, but in somewhat deeper water (see COLOMBO), the experience of the action of the sea on the south-west breakwater led to the laying of the foundations of the superstructure on the rubble mound at 30¾ ft. below low water (fig. 9).

The breakwater for sheltering Peterhead Bay, where the rise of springs is 11¼ ft., was begun in 1888, and designed to extend into a depth of 9½ fathoms at low water (see HARBOUR). It was built as an upright wall upon the rocky bottom for 1000 ft. from the shore; but owing to the increase in depth it was decided to construct the outer portion with a rubble base, surmounted by a superstructure originally designed to be founded 30 ft. below low water. As, however, during a storm in October 1898, the recoil of the waves from the breakwater, which is provided with a promenade wall rising about 35 ft. above low water, disturbed rubble to a depth of 36½ ft., the superstructure has been founded 43 ft. below low water on the rubble base; and its outer toe is protected from being undermined by two rows of concrete blocks on the rubble mound.

Formerly, in constructing a large superstructure upon a rubble mound, it was a common practice to build a sea wall and a harbour wall several feet apart, and to fill up the intermediate,. space between them with rubble, so as economically to form a wide structure on the top of the mound, and provide an adequate width for a quay along the top. A sheltering wall was also generally erected on the sea side. This, for instance, was the system of construction adopted for the superstructures, founded at low water, of Holyhead breakwater, Portland inner breakwater, and St Catherine's, Jersey, breakwater. Alderney breakwater, the Tyne breakwaters

***Construction of the superstructure.***

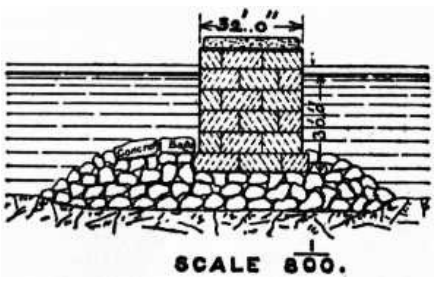


FIG. 9.—Colombo North-West Breakwater.

and Colombo south-west breakwater were also commenced with a precisely similar method of construction. The system, however, possesses a Very serious defect for exposed situations, namely, that if once the sea can force a small opening through the sea wall, the scooping out of the rubble filling, and the overthrow of the thinner harbour wall are rapidly accomplished if the storm continues or recurs before repairs can be effected. Experience soon proved at Alderney and Tynemouth the unsuitability of the system for very exposed situations; and the intermediate rubble filling was replaced by solid hearting down to a certain depth. At Colombo, after the first 1326 ft. of the south-west breakwater had been built with two walls and intermediate rubble for the superstructure, as the exposure proved greater than had been anticipated, and a slight displacement of part of the sea wall, 24 ft. wide, had occurred, the rubble filling was discontinued, and the two walls were united into a solid superstructure 34 ft. in width.

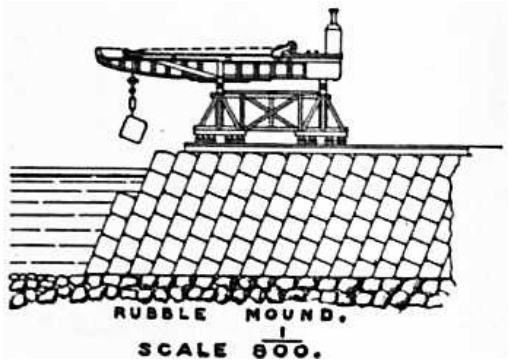


FIG. 10.—Colombo North-West Breakwater with Titan Crane.

A difficulty experienced in constructing a solid superstructure on the top of a rubble mound consists in the settlement of the mound which takes place when the weight of the superstructure comes on it, in spite of the consolidation of the rubble under the action of the sea for one or two years before the erection of the superstructure on it is undertaken. When the superstructure is carried out in long stepped-forward courses, irregular settlement is particularly liable to occur, as the weight is progressively imposed in an uneven manner on the yielding rubble, in proportion to the height of the rubble base and its deficiency in compactness. The open joints between the blocks laid below low water enable the air to penetrate, on the recoil of the waves at low tide, into any internal fissures resulting from settlement; and the following wave, on striking the superstructure, compresses the air inside, which, on its expansion when the wave recedes, forces out any unconnected face stones. The hole thus formed is rapidly enlarged by the sea if the storm continues; and a breach is eventually formed. The sloping-block system was, accordingly devised to provide against the dislocation of superstructures by the inevitable irregular settlement, by forming them of a series of sloping sections, composed of concrete blocks laid at an angle, free to settle independently on the mound, as shown in fig. 10. In the first superstructure thus constructed, in 1869-1874, at the entrance to Karachi harbour, founded 15 ft. below low water on a rubble mound and 24 ft. high, the blocks in each section, consisting of two rows of three superposed blocks laid at an inclination of 76° shorewards, were entirely unconnected; and, consequently, though the superstructure offered as little opposition as practicable to the waves by having its top slightly below high water, the waves in a storm forcing their way into the vertical joint between the two rows, threw some of the top 27-ton blocks of the inner row down on the harbour slope of the mound. This cause of damage was obviated in effecting the repairs, by connecting the top blocks with the next ones by stone dowels. The superstructures of the breakwaters forming Madras harbour, commenced in 1876, were similarly constructed in sloping, independent sections, 4½ ft. thick, composed of two distinct rows of four tiers of blocks founded upon a rubble mound 22 ft. below low water (the rise of tide at springs being 3⅓ ft.), and raised 3½ ft. above high water. The blocks in each row were connected by a tenon, projecting at the top of each block, fitting into a mortise in the block above it. The retention of the vertical joint however, between the two rows led to the overthrow of the greater part of the superstructures of the outer arms at Madras, situated in a depth of 45 ft. and facing the Indian Ocean, during a cyclone of 1881. In the reconstruction of these superstructures, bond was introduced in the successive tiers of each sloping section; and the blocks of the two upper tiers were cramped together. Alter settlement on the mound had ceased, a thick capping of mass concrete was laid all along the top of the superstructure; and, finally, a mound of concrete blocks was deposited at random on the mound in front of the sea face of the superstructure to break the force of the waves and prevent undermining. A similar wave-breaker, with blocks somewhat specially arranged, was deposited in front of the sloping concrete-block superstructure of the breakwater sheltering the Portuguese harbour of Marmagao on the west coast of India, more particularly with the object of preventing the undermining of the superstructure founded only 18 ft. below low water of spring tides, on a layer of rubble spread on the muddy sea-bottom, the settlement in this case being occasioned by the yielding of the soft clay bed. This breakwater having been commenced in 1884, subsequently to the failure at Madras, the superstructure, formed of concrete blocks weighing 28½ to 37½ tons was built in accordance with the design adopted for the reconstructed outer arms at Madras, with the exceptions that the separate sections were given a slope of 70° instead of 76° shorewards to ensure greater stability, that the superstructure was made 30 ft in width instead of 24 ft., that the top tier of blocks in each section was secured to the next tier by two dowels, each formed of a bundle of four rails, penetrating 3½ ft. into each tier, so as to enable the top courses to be more correctly aligned than with tenons and mortises, and that the outer side of the continuous concrete-in-mass capping was raised about 22 ft. above low water (fig. 11). The rise of spring tides at Marmagao is 6 ft.

***sloping block system.***

At Colombo the superstructures of both the south-west and north-west breakwaters were built on the sloping-block system in sections 5½ ft. thick, and built at an angle of 68° shorewards (fig. 10); and the blocks, from 16½ to 31 tons in weight, were laid in bonded courses across each section, with four tiers of blocks in the south-west breakwater founded 20 ft. below low water on the rubble mound, and six tiers of blocks in the north-west breakwater, founded 30¾ ft below low water. Five oblong grooves, moreover, were formed in moulding the blocks, in the adjacent faces of each sloping section, extending from top to bottom of the sections. These, when settlement on the mound had ceased, were filled with concrete in bags which not only connected the tiers of blocks in each section together, but also joined the several sections to one another, and effectually closed the transverse joints between the successive sections, which were further connected together by a continuous capping of concrete-in-mass along the whole length of the breakwater.

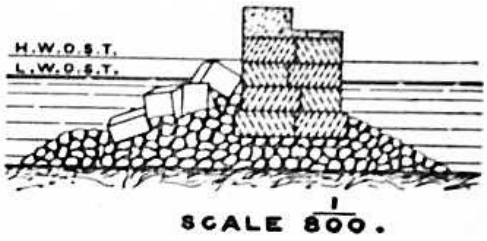


Fig. 11.—Marmagao Breakwater.

These sloping blocks are laid by powerful overhanging, block-setting cranes, called Titans (see Cranes), which travel along the completed portion of the breakwater, and lay the blocks in advance on the mound levelled by divers, as shown in fig. 10. The earlier Titans, employed for the sloping-block superstructures at Karachi and Madras, were constructed to travel only backwards and forwards on the completed work, with sufficient sideways movement of the little trolley travelling along the overhanging arm, from which the block is suspended at the proper angle, to lay the blocks for each side of the superstructure. In later forms, however, such for instance as the Titan laying the 14-ton blocks at Peterhead breakwater in horizontal courses, the overhanging arm is supported centrally on a ring of rollers, placed on the top of the truck on which the Titan travels, so that it can revolve and deposit blocks at the side of the superstructure for protecting the mound, as well as in advance of the finished work. These Titans possess the important advantage over the timber staging formerly employed for such breakwaters, that, in exposed situations, they can be moved back into shelter on the approach of a storm, or for the winter or stormy months, instead of, as in the case of staging, remaining out exposed to the danger of being carried away during stormy weather, or necessitating loss of time in erection at the beginning of the working season.

Though composite breakwaters are still occasionally constructed with a superstructure founded on a rubble mound at, or above, low-water level, these breakwaters are now almost always constructed with the superstructure founded at some depth below low water, even at harbours on the continent of Europe, where formerly broad quays founded at sea-level, protected by a parapet wall and outer concrete blocks, were the regular form of superstructure adopted. The breakwater for the extension of the harbour at Naples provides an interesting example of this change of design. A solid superstructure, formed of large concrete blocks capped with masonry, about 50 ft. wide at the base, is laid on a high rubble mound at a depth of 31 ft. below mean sea-level, and provides a quay on the top, 24½ ft. wide, protected on the sea side by a promenade wall, 10 ft. high and 12½ ft. wide at the top, raised 19⅔ ft. above sea-level (fig. 12). In view of the increased depth at which superstructures are now founded upon rubble mounds, causing the breakwaters to approximate more and more to the upright-wall type, it might seem at first sight that the rubble base might be dispensed with, and the superstructure founded directly on the bed of the sea. Two circumstances, however, still render the composite form of breakwater indispensable in certain cases: (1) the great depth into which breakwaters have sometimes to extend, reaching about 56 ft. below low water at Peterhead, and 102 ft. below mean sea-level at Naples; and (2) the necessity, where the sea-bottom is soft or liable: to be eroded by scour, of interposing a wide base between the upright superstructure and the bed of the sea.

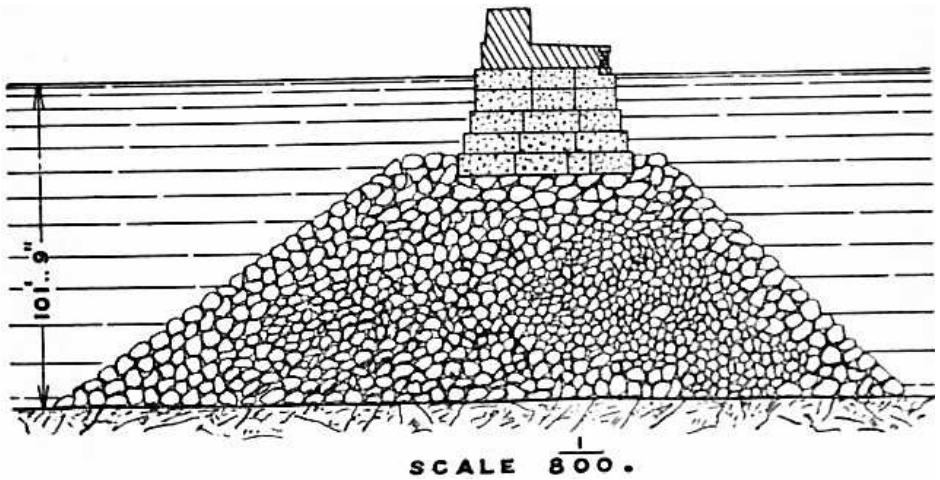


Fig. 12.—Naples Harbor Extension Breakwater.

The injuries to which composite breakwaters appear to have been specially subject must be attributed to the greater exposure and depth of the sites in which they have been frequently constructed, as compared with rubble mounds or upright walls. The latter types, indeed, are not well suited for erection in deep water, in the first case, on account of the very large quantity of materials required for a high mound with flat slopes, and in the second, owing to the increased pressure of air under which divers have to work in laying blocks for an upright wall in deep water. The ample depth in which superstructures are founded, the due protection afforded to their outer toe, the adoption of the sloping-block system for their construction, and the dispensing in most cases with a high sheltering wall on the sea side of the superstructure, render modern superstructures as stable as upright-wall breakwaters of similar height. Nevertheless, superstructures require to be given a greater thickness than similar upright walls, because the greater depth of water in which such composite breakwaters are built causes them to be exposed to larger waves under similar conditions.



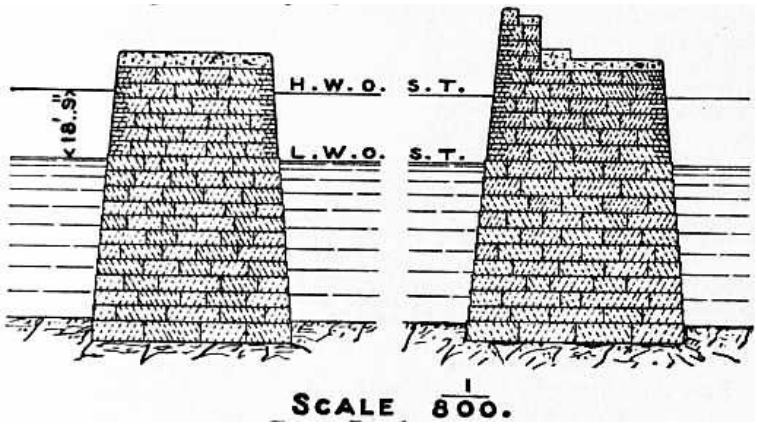
The superstructures of composite breakwaters erected by the United States for harbours on the shores of Lake Superior were formerly in some cases composed of timber cribs floated into position and sunk by filling them with rubble stone. On account of the cheapness of timber several years ago in those regions, this simple mode of construction was also economical, even though the rapid decay of the timber in the portions of the cribs where it was alternately wet and dry involved its renewal about every fifteen years on the average. Owing, however, to the fact that the price of timber has increased considerably, whilst that of Portland cement has been reduced, durable concrete superstructures are beginning to be substituted for the rapidly decaying cribwork structures.

With the exception perhaps of the Alderney breakwater, which, owing to its exceptional exposure and the unparalleled depth into which it extended, had its superstructure so often breached by the sea that, owing to the cost of maintenance, the inner portion only has been kept in repair, the composite breakwater of Bilbao harbour has probably proved the most difficult to construct on account of its great exposure. The original design consisted of a wide rubble mound up to about 16½ ft. below low water, a mound of large concrete blocks up to low water of equinoctial spring tides, and a solid masonry superstructure well protected at its outer toe by a projection of masonry, and raised several feet above high water, forming a quay sheltered by a promenade wall. The rise of equinoctial spring tides at the mouth of the river Nervion is 14¾ ft. In carrying out the work, however, the superstructure built in the summer months was for the most part destroyed by the following winter storms; and, accordingly, the superstructure was eventually constructed on a widened rubble base, so as to be sheltered to some extent by the outlying concrete-block mound already deposited, a system subsequently adopted in rebuilding the damaged portion of the North Pier at Tynemouth under shelter of the ruins of the previous work. The modified superstructure of the Bilbao breakwater was founded on the extended rubble mound at a depth of 16¼ ft. below low water, and formed of iron caissons partially filled with concrete and floated out, sunk in position, and filled up with concrete blocks and concrete. It thus consists of a continuous row of concrete blocks, each of them being 42⅔ ft. in width across the breakwater, 23 ft. in length along the line of the breakwater, 23 ft. high, and weighing 1400 tons. These caisson blocks, raised 6¾ ft. above low water, form the base of the superstructure, upon which the upper part was built of concrete blocks on each face with mass concrete filling between them, forming a continuous quay, 24 ft. wide, raised 8 ft. above high tide, and slightly sheltered by a curved parapet block only 5 ft. high. The outer toe of the caisson blocks is protected from being undermined by two tiers of large concrete blocks laid flat on the rubble mound. This superstructure has successfully resisted the attacks of the Atlantic waves rolling into the bay. At this breakwater and at Tynemouth advantage has been taken of the protection unintentionally provided by previous failures, by which the waves are broken before reaching the superstructure and pier respectively; but instead of introducing a wave-breaker of concrete blocks, for a protection to the superstructure, as arranged at Marmagao (fig. 11) and the outer arms at Madras, it would appear preferable to increase the width of the solid superstructure, if necessary, as carried out at Naples (fig. 12). and to dispense with a parapet and keep the superstructure low, as being unsuitable for a quay in exposed situations, according to the plan adopted at Colombo (fig. 9).

3. *Upright-Wall Breakwaters.*—The third type of breakwater consists of a solid structure founded directly on the sea-bottom, in the form of an upright wall, with only a moderate batter on each face. This form of breakwater is strictly limited to sites where the bed of the sea consists of rock, chalk, boulders, or other hard bottom not subject to erosion by scour, and where the depth does not exceed about 40 to 50 ft. If a solid breakwater were erected on a soft yielding bottom, it would be exposed to dislocation from irregular settlement; and such a structure, by obstructing or diverting the existing currents, tends to create a scour along its base; whilst the waves in recoiling from its sea face are very liable to produce erosion of the sea-bottom along its outer toe. Moreover, when the foundations for an upright-wall breakwater have to be levelled by divers, and the blocks laid under water by their help, the extension of such a breakwater into a considerable depth is undesirable on account of the increased pressure imposed upon diving operations.

The Admiralty pier at Dover was begun about the middle of the 19th century, and furnishes an early and notable example of an upright-wall breakwater resting upon a hard chalk bottom; and it

was subsequently extended to a depth of about 42 ft. at low tide, in connexion with the works for forming a closed naval harbour at Dover. This breakwater, the Prince of Wales pier of the commercial harbour, and the eastern breakwater and detached south breakwater for the naval harbour, were all founded on a levelled bottom, carried down to the hard chalk underlying the surface layer, by means of men in diving-bells. The extension of the Admiralty pier and the other breakwaters of Dover harbour consist of bonded courses of concrete blocks, from 26 to 40 tons in weight, as shown in figs. 13 and 14, the outer blocks above low water being formed on their exposed side with a facing of granite rubble. The blocks, composed of six parts of sand and stones to one part of Portland cement, moulded in frames, and left to set thoroughly in the block-yard before being used, are all joggled together, and above low-water level are bedded in cement and the joints filled with cement grout. The blocks were laid by Goliath travelling cranes running on temporary staging supported at intervals of 50¼ ft. by clusters of iron piles carried down into the chalk bottom. On each line of staging there were four Goliaths, preceded by a stage-erecting machine. The front Goliath was used for working a grab for excavating the surface layer of chalk, which was finally levelled by divers, the second for carrying the diving-bell, the third for laying the blocks below low water, and the fourth for setting the blocks above low water. This succession of Goliaths enabled more rapid progress to be made than with a single Titan at the end of a breakwater; but it involved a considerable increase in the cost of the plant, owing to the temporary staging required. The foundations were carried down from 4 to 6 ft. into the chalk bottom, the deepest being 53 ft. below low water of spring tides, and the average 47 ft. With a rise of tide at springs of 18¾ ft., the average depth is thus approximately 66 ft. at high tide, necessitating a pressure of 29 lb on the square inch, which is the limit at which men can work without inconvenience in the diving-bells. The breakwaters are raised about 11 ft. above high water of springs. The detached southern breakwater was finished off at this level; but the extended western breakwater, or Admiralty pier, is provided with a promenade parapet on its exposed side, rising 13 ft. above the quay; and the eastern breakwater also has a parapet on its exposed eastern side, raised, however, only 9 ft. above its quay. The breakwaters are protected from scour along their outer toe by an apron of concrete blocks, extending 25 ft. out from their sea face.




Dover Breakwater.

FIG. 13.
South Breakwater.

FIG. 14.
Admiralty Pier Extension.

***Concrete-bag foundations.***

The levelling of the foundations for laying the courses of an upright-wall breakwater is costly and tedious, even in chalk; and the expense and delay are considerably enhanced where the bottom is hard rock. Accordingly, in constructing two breakwaters at the entrance to Aberdeen harbour on a bottom of granite in 1870-1877, concrete bags were laid on the sea-bed; and these bags, by adapting themselves to the rocky irregularities, obviated levelling the bottom. They formed the foundation for the concrete blocks in the south breakwater; and by the deposit of successive layers of 50-ton concrete bags till they rose above low water, they constituted the whole of the submerged portion of the north breakwater. The 50-ton bags were deposited from hopper barges towed out to the site; and the portions of both breakwaters above low water were carried up with mass concrete. Subsequently, the breakwater at Newhaven was constructed on a foundation of chalk, with lop-ton concrete bags up to low water, and mass concrete above. Still later, the two breakwaters sheltering the approach to the river Wear (see HARBOUR) and the Sunderland docks were built with a foundation mound of concrete in bags, 56 to 116 tons in weight, on the uneven sea-bottom, raised slightly above low water of spring tides, on which a solid upright wall was erected, formed of concrete blocks on each side faced with granite, filled in the centre and capped on the top with mass concrete. The most exposed northern Roker breakwater, raised about 11 ft. above high water of springs where the rise is 14 ft. 5 in., is devoid of a parapet; but a subway formed near the top in each breakwater gives access to the light on the pierhead in stormy weather (fig. 15). These concrete bags are made by lining the hopper of the barge with jute canvas, which receives the concrete and is sewn up to form a bag whilst the barge is being towed to the site. The concrete is thus deposited unset, and readily accommodates itself to the irregularities of the

bottom or of the mound of bags; and sufficient liquid grout oozes out of the canvas when the bag is compressed, to unite the bags into a solid mass, so that with the mass concrete on the top, the breakwater forms a monolith. This system has been extended to the portion of the superstructure of the eastern, little-exposed breakwater of Bilbao harbour below low water, where the rubble mound is of moderate height; but this application of the system appears less satisfactory, as settlement of the superstructure on the mound would produce cracks in the set concrete in the bags.

***Foundations with large blocks.***

Foundation blocks of 2500 to 3000 tons have been deposited for raising the walls on each side of the wide portion of the Zeebrugge breakwater (fig. 16) from the sea-bottom to above low water, and also 4400-ton blocks along the narrow outer portion (see HARBOUR), by building iron caissons, open at the top, in the dry bed of the Bruges ship-canal, lining them with concrete, and after the canal was filled with water, floating them out one by one in calm weather, sinking them in position by admitting water, and then filling them with concrete under water from closed skips which open at the bottom directly they begin to be raised. The firm sea-bed is levelled by small rubble for receiving the large blocks, whose outer toe is protected from undermining by a layer of big blocks of stone extending out for a width of 50 ft.; and then the breakwater walls are raised above high water by 55-ton concrete blocks, set in cement at low tide; and the upper portions are completed by concrete-in-mass within framing.

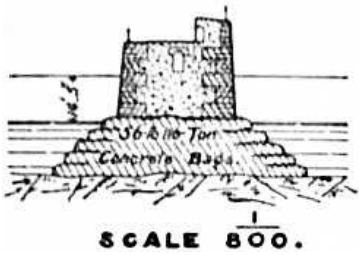



FIG. 15.—Sunderland Southern Breakwater.

***Concrete monoliths.***

Sometimes funds are not available for a large plant; and in such cases small upright-wall breakwaters may be constructed in a moderate depth of water on a hard bottom of rock, chalk or boulders, by erecting timber framing in suitable lengths, lining it inside with jute cloth, and then depositing concrete below low water in closed hopper skips lowered to the bottom before releasing the concrete, which must be effected with great care to avoid allowing the concrete to fall through the water. The portion of the breakwater above low water is then raised by tide-work with mass concrete within frames, in which large blocks of stone may be bedded, provided they do not touch one another and are kept away from the face, which should be formed with concrete containing a larger proportion of cement. As long continuous lengths of concrete crack across under variations in temperature, it is advisable to form fine straight divisions across the upper part of a concrete breakwater in construction, as substitutes for irregular cracks.

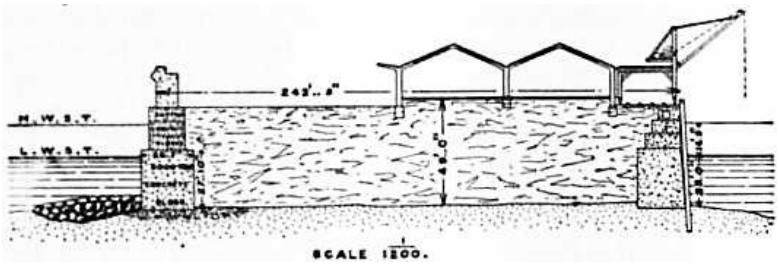



FIG. 16.—Zeebrugge Harbour Breakwater with Quay.

Upright-wall breakwaters should not be formed with two narrow walls and intermediate filling, as the safety of such a breakwater depends entirely on the sea-wall being maintained intact. A warning of the danger of this system of construction, combined with a high parapet, was furnished by the south breakwater of Newcastle harbour in Dundrum Bay, Ireland, which was breached by a storm in 1868, and eventually almost wholly destroyed; whilst its ruins for many years filled up the harbour which it had been erected to protect. In designing its reconstruction in 1897, it was found possible to provide a solid upright wall of suitable strength with the materials scattered over the harbour, together with an extension needed for providing proper protection at the entrance. This work was completed in 1906.

Upright-wall breakwaters and superstructures are generally made of the same thickness throughout, irrespective of the differences in depth and exposure which are often met with in different parts of the same breakwater. This may be accounted for by the general custom of regarding the top of an upright wall or superstructure as a quay, which should naturally be given a uniform width; and this view has also led to the very general practice of sheltering the top of these structures with a parapet. Generally the width is proportioned to the most exposed part, so that the only result is an excess of expenditure in the inner portion to secure uniformity. When, however, as at Madras, the width of the structure is reduced to a minimum, the action of the sea demonstrates that the strength of the structure must be proportioned to the depth and exposure. In small fishery piers, where great economy is essential to obtain the maximum shelter at limited expense, it appears expedient to make the width of the breakwater proportionate to the depth. This was done in Babbacombe Bay; and in reconstructing the southern breakwater at Newcastle,

Ireland, advantage was taken of a change in direction of the outer half to introduce an addition to the width, so as to make the strength of the breakwater proportionate to the increase in depth and exposure. In large structures, however, uniformity of design may be desirable for each straight length of breakwater; though where two or more breakwaters or outer arms enclose a harbour, the design should obviously be modified to suit the depth and exposure. At Colombo harbour, the superstructure of the less exposed north-west breakwater has been made slightly narrower than that of the south-west breakwater; and a simple rubble mound shelters the harbour from the moderate north-east monsoon. In special cases, where a breakwater has to serve as a quay, like the Admiralty pier at Dover, a high parapet wall is essential; but in most cases, where a parapet merely enables the breakwater to be more readily accessible in moderate weather, it would be advisable to keep it very low, or to dispense with it altogether, as at the southern Dover breakwater, the northern breakwater at Sunderland, and the Colombo western breakwaters. This course is particularly expedient in very exposed sites, as a high parapet intensifies the shock of the waves against a breakwater and their erosive recoil. Moreover, when a light has to be attended to at the end of a breakwater, sheltered access can be provided by a subway, as at Sunderland.

Structures in the sea almost always require works of maintenance; and when a severe storm has caused any injury, it is most important to carry out the repairs at the earliest available moment, as the waves rapidly enlarge any holes that they may have formed in weak places.

(L. F. V.-H.)

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**BRÉAL, MICHEL JULES ALFRED** (1832- ), French philologist, was born on the 26th of March 1832, at Landau in Rhenish Bavaria, of French parents. After studying at Weissenburg, Metz and Paris, he entered the École Normale in 1852. In 1857 he went to Berlin, where he studied Sanskrit under Bopp and Weber. On his return to France he obtained an appointment in the department of oriental MSS. at the Bibliothèque Impériale. In 1864 he became professor of comparative grammar at the Collège de France, in 1875 member of the Académie des Inscriptions et Belles-lettres, in 1879 *inspecteur-général* of public instruction for higher schools until the abolition of the office in 1888. In 1890 he was made commander of the Legion of Honour. Among his works, which deal mainly with mythological and philological subjects, may be mentioned: *L'Étude des origines de la religion Zoroastrienne* (1862), for which a prize was awarded him by the Académie des Inscriptions; *Hercule et Cacus* (1863), in which he disputes the principles of the symbolic school in the interpretation of myths; *Le Mythe d'Oedipe* (1864); *Les Tables Eugubines* (1875); *Mélanges de mythologie et de linguistique* (2nd. ed., 1882); *Leçons de mots* (1882,1886), *Dictionnaire étymologique latin* (1885) and *Grammaire latine* (1890). His *Essai de Sémantique* (1897), on the signification of words, has been translated into English by Mrs H. Cust with preface by J.P. Postgate. His translation of Bopp's *Comparative Grammar* (1866-1874), with introductions, is highly valued. He has also written pamphlets on education in France, the teaching of ancient languages, and the reform of French orthography. In 1906 he published *Pour mieux connaître Homère*.

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**BREAM** (*Abramis*), a fish of the Cyprinid family, characterized by a deep, strongly compressed body, with short dorsal and long anal fins, the latter with more than sixteen branched rays, and the small inferior mouth. There are two species in the British Isles, the common bream, *A. brama*, reaching a length of 2 ft. and a weight of 12 lb, and the white bream or bream flat, *A. blicca*, a smaller and, in most places, rarer species. Both occur in slow-running rivers, canals, ponds and reservoirs. Bream are usually despised for the table in England, but fish from large lakes, if well prepared, are by no means deserving of ostracism. In the days of medieval abbeys, when the provident Cistercian monks attached great importance to pond culture, they gave the first place to the tench and bream, the carp still being unknown in the greater part of Europe. At the present day, the poorer Jews in large English cities make a great consumption of bream—and other Cyprinids, most of them being imported alive from Holland and sold in the Jewish fish markets. In America the name bream is commonly given to the golden shiner minnow (*Abramis chrysoleucus*), to the pumpkin-seed sunfish (*Eupomotis gibbosus*), and to some kinds of porgy (*Sparidae*).



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**BREAST** (a word common to Teutonic languages, of the Ger. *Brust*, possibly connected with an O. Sax. *brustian*, to bud), the term properly confined to the external projecting parts of the thorax in females, which contain the mammary glands (for anatomy, and diseases, see MAMMARY GLAND); more generally it is used of the external part of the thorax in animals, including man, lying between the neck and the abdomen.

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**BREAUTÉ, FALKES DE** (d. 1226), one of the foreign mercenaries of King John of England, from whom he received in marriage the heiress of the earldom of Devon. On the outbreak of the Barons' War (1215) the king gave him the sheriffdoms of six midland shires and the custody of many castles. He fulfilled his military duties with as much skill as cruelty. The royalists owed to his daring the decisive victory of Lincoln (1217). But after the death of William Marshal, earl of Pembroke, Falkes joined the feudal opposition in conspiring against Hubert de Burgh. Deprived in 1223 of most of his honours, he was drawn into a rebellion by the imprudence of his brother, who captured a royal justice and threw him into prison (1224). Falkes was allowed to go into exile after his submission, and endeavoured to obtain a pardon through the mediation of Pope Honorius III. But this was refused, and Falkes died at St Cyriac in 1226.

See Shirley, *Royal Letters*, vol. i.; the *Patent* and *Close Rolls*; Pauli, *Geschichte von England*, vol. i. pp. 540-545.

(H. W. C. D.)

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**BRECCIA,** in petrology, the name given to rocks consisting of angular fragments embedded in a matrix. They may be composed of volcanic rocks, limestones, siliceous charts, sandstones, in fact of any kind of material, and the matrix, which usually corresponds to some extent to the fragments it encloses, may be siliceous, calcareous, argillaceous, &c. The distinctive character of the group is the sharp-edged and unworn shapes of the fragments; in conglomerates the pebbles are rounded and water-worn, having been transported by waves and currents from some distance. There are many ways in which breccias may originate. Some are formed by ordinary processes of atmospheric erosion; frost, rain and gravity break up exposed surfaces of rock and detach pieces of all sizes; in this way screes are formed at the bases of cliffs, and barren mountain-tops are covered with broken debris. If such accumulations gather and are changed into hard rock by pressure and other indurating agencies they make typical breccias. Conglomerates often pass into rocks of this type, the difference being merely that the fragments are of purely local origin, and are unworn because they have not been transported. In caves breccias of limestone are produced by the collapse of part of the roof, covering the floor with broken masses. Coral reefs often contain extensive areas of limestone breccia, formed of detached pieces of rock which have been dislodged from the surface and have been carried down the steep external slopes of the reef. Volcanic breccias are very common near active or extinct craters, as sudden outbursts of steam bear fragments from the older rocks and scatter them over the ground.

Another group of breccias is due to crushing; these are produced in fissures, faults and veins, below the surface, and maybe described as "crush-breccias" and "friction-breccias." Very important and well-known examples of this class occur as veinstones, which may be metalliferous or not. A fissure is formed, probably by slight crustal movements, and is subsequently filled with material deposited from solution (quartz, calcite, barytes, &c.). Very often displacement of the walls again takes place, and the infilling or "veinstone" is torn apart and brecciated. It may then be cemented together by a further introduction of mineral matter, which may be the same as that first deposited or quite different. In important veins this process is often repeated several times: detached pieces of the country rock are mingled with the shattered veinstone, and generally experience alteration by the percolating mineral solutions. Other crush-breccias occurring on a much larger scale are due to the folding of strata which have unequal plasticities. If, for example, shales and sandstones are bent into a series of arches, the sandstones being harder and more resistant will tend to crack, while the shales, which are soft and flow under great pressures, are injected into the crevices and separate the broken pieces from one another. Continued movement will give the brecciated fragments of sandstone a rounded form by rubbing them against one another, and, in this way, a crush-conglomerate is produced. Great masses of limestone in the Alps, Scottish Highlands, and all regions of intense folding are thus converted into breccias. Cherts frequently also show this structure; igneous rocks less commonly do so; but it is perhaps

most common where there have been thin bedded alternations of rocks of different character, such as limestone and dolerite, limestone and quartzite, shale or phyllite and sandstone. Fault-breccias closely resemble vein-breccias, except that usually their fragments consist principally of the rocks which adjoin the fault and not of mineral deposits introduced in solution; but many veins occupy faults, and hence no hard and fast line can be drawn between these types of breccia.

A third group of breccias is due to movement in a partly consolidated igneous rock, and may be called “fluxion-breccias.” Lava streams, especially when they consist of rhyolite, dacite and some kinds of andesite, may rapidly solidify, and then become exceedingly brittle. If any part of the mass is still liquid, it may break up the solid crust by pressure from within and the angular fragments are enveloped by the fluid lava. When the whole comes to rest and cools, it forms a typical “volcanic-fluxion-breccia.” The same phenomena are sometimes exemplified in intrusive sills and sheets. The fissures which are occupied by igneous dikes may be the seat of repeated injections following one another at longer or shorter intervals; and the latter may shatter the earlier dike rocks, catching up the fragments. Among the older formations, especially when decomposition has gone on extensively, these fluxion and injection-breccias are often very hard to distinguish from the commoner volcanic-breccias and ash-beds, which have been produced by weathering, or by the explosive power of superheated steam.

(J. S. F.)

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**BRECHIN,** a royal, municipal and police burgh of Forfarshire, Scotland. Pop. (1901) 8941. It lies on the left bank of the South Esk, 7¾ m. west of Montrose, and has a station on the loop line of the Caledonian railway from Forfar to Bridge of Dun. Brechin is a prosperous town, of great antiquity, having been the site of a Culdee abbey. The Danes are said to have burned the town in 1012. David I. erected it into a bishopric in 1150, and it is still a see of the Episcopal Church of Scotland. In 1452 the earl of Huntly crushed the insurrection led by the earl of Crawford at the battle of Brechin Muir, and in 1645 the town and castle were harried by the marquis of Montrose. James VI. gave a grant for founding a hospital in the burgh, which yet supplies the council with funds for charity. No trace remains of the old walls and gates of the town, but the river is crossed by a two-arched stone bridge of very early date. The cathedral church of the Holy Trinity belongs to the 13th century. It is in the Pointed style, but suffered maltreatment in 1806 at the hands of restorers, whose work, however, disappeared during the restoration completed in 1902. The western gable with its flamboyant window and Gothic door and the massive square tower are all that is left of the original edifice. The modern stained glass in the chancel is reckoned amongst the finest in Scotland. Immediately adjoining the cathedral to the south-west stands the Round Tower, built about 1000. It is 86¾ ft. high, has at the base a circumference of 50 ft. and a diameter of 16 ft., and is capped with a hexagonal spire of 18 ft., which was added in the 15th century. This type of structure is somewhat common in Ireland, but the only Scottish examples are those at Brechin, Abernethy in Perthshire, and Egilshay in the Orkneys. Brechin Castle played a prominent part in the Scottish War of Independence. In 1303 it withstood for twenty days a siege in force by the English under Edward I., surrendering only when its governor, Sir Thomas Maule, had been slain. From the Maule family it descended to the Dalhousies. Its library contains many important MSS., among them Burns’s correspondence with George Thomson, and several cartularies including those of St Andrews and Brechin. In the Vennel (alley or small street) some ruins remain of the *maison dieu*, or *hospitium*, founded in 1256 by William of Brechin. Besides these historical buildings the principal public structures include Smith’s school, the municipal buildings, the free library, the episcopal library (founded by Bishop Forbes, who, as well as Bishop Abernethy-Drummond, presented a large number of volumes). The principal industries include manufactures of linen and sailcloth, bleaching, rope-making, brewing, distilling, paper-making, in addition to nurseries and freestone quarries. Brechin—which is controlled by a provost, bailies and council—unites with Arbroath, Forfar, Inverbervie and Montrose to return one member to parliament.



Edzell (pronounced Edyell, and, locally, Aigle) lies about 6 m. north of Brechin, with which it is connected by rail. It is situated on the North Esk and near the West Water, which falls into the Esk 2 m. south-west. Edzell is on the threshold of romantic Highland scenery. The picturesque ruins of Edzell Castle lie a mile to the west of the town. Once the seat of the Lindsays the estate now belongs to the earl of Dalhousie. The church of the parish of Farnell, 3½ m. south-east of Brechin, was erected in 1806 after the model, so it is stated, of the famous Holy House (Casa Santa) of Loreto in Italy. It was here that the old sculptured stone giving a version of the Fall was found. Between Farnell and Brechin lies Kinnaird Castle, the seat of the earl of Southesk.

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**BRECKINRIDGE, JOHN CABELL** (1821-1875), American soldier and political leader, was born near Lexington, Kentucky, on the 21st of January 1821. He was a member of a family prominent in the public life of Kentucky and the nation. His grandfather, John Breckinridge (1760-1806), who revised Jefferson's draft of the "Kentucky Resolutions" of 1798, was a United States senator from Kentucky in 1801-1805 and attorney-general in President Jefferson's cabinet in 1805-1806. His uncles, John Breckinridge (1797-1841), professor of pastoral theology in the Princeton Theological Seminary in 1836-1838 and for many years after secretary of the Presbyterian Board of Foreign Missions, and Robert Jefferson Breckinridge (1800-1871), for several years superintendent of public instruction in Kentucky, an important factor in the organization of the public school system of the state, a professor from 1853 to 1871 in the Danville Presbyterian Theological Seminary at Danville, Kentucky, and the temporary chairman of the national Republican convention of 1864, were both prominent clergymen of the Presbyterian Church. His cousin, William Campbell Preston Breckinridge (1837-1904), was a Democratic representative in Congress from 1885 to 1893. Another cousin, Joseph Cabell Breckinridge (1842- ), served on the Union side in the Civil War, was a major-general of volunteers during the Spanish-American War (1898), became a major-general in the regular United States army in 1903, and was inspector-general of the United States army from 1899 until his retirement from active service in 1904.

John Cabell Breckinridge graduated in 1838 at Centre College, Danville, Kentucky, continued his studies at Princeton, and then studied law at Transylvania University, Lexington, Kentucky. He practised law in Frankfort, Kentucky, in 1840-1841 and in Burlington, Iowa, from 1841 to 1843, and then returned to Kentucky and followed his profession at Lexington. In 1847 he went to Mexico as major in a volunteer regiment, but arrived too late for service in the field. In 1849 he was elected a Democratic member of the Kentucky legislature, and in 1851-1855 he served in the national House of Representatives. President Pierce offered him the position of minister to Spain, but he declined it. In 1856 he was chosen vice-president of the United States on the Buchanan ticket, and although a strong pro-slavery and states rights man, he presided over the Senate with conspicuous fairness and impartiality during the trying years before the Civil War. In 1860 he was nominated for the presidency by the pro-slavery seceders from the Democratic national convention, and received a total of 72 electoral votes, including those of every Southern state except Virginia, Kentucky, Tennessee and Missouri. As vice-president and presiding officer of the Senate, it was his duty to make the official announcement of the election of his opponent, Lincoln. He succeeded John J. Crittenden as United States senator from Kentucky in March 1861, but having subsequently entered the Confederate service he was expelled from the Senate in December 1861. As brigadier-general he commanded the Confederate reserve at Shiloh, and in August 1862 he became major-general. On the 5th of this month he was repulsed in his attack on Baton Rouge, but he won distinction at Stone River (December 31, 1862-January 2, 1863), where his division lost nearly a third of its number. He took part in the battle of Chickamauga, defeated General Franz Sigel at Newmarket, Virginia, on the 15th of May 1864, and then, joined Lee and took part in the battles of Cold Harbor on the 1st and on the 3rd of June. In the autumn he operated in the Shenandoah Valley, and with Early was defeated by Sheridan at Winchester on the 19th of September. Being transferred to the department of South-west Virginia, he fought a number of minor engagements in eastern Tennessee, and in January 1865 became secretary of war for the Confederate States. At the close of the war he escaped to Cuba, and from there went to Europe. In 1868 he returned to the United States and resumed the practice of law at Lexington, Kentucky, where he died on the 17th of May 1875.

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**BRECON,** or Brecknock, a market town and municipal borough, the capital of Breconshire, Wales, 183 m. from London by rail, picturesquely situated nearly in the centre of the county, at the confluence of the Honddu with the Usk. Half a mile higher up the Tarell also falls into the Usk from the south. The ecclesiastical parish of Brecon consists of the two civil parishes of St John the Evangelist and St Mary, both on the left bank of the Usk, while St David's in Llanfaes is on the other side of the river, and was wholly outside the town walls. Pop. (1901) 5875. There is only one line of railway, over which several companies, however, have running powers, so that the town may be reached by the Brecon & Merthyr railway from Merthyr, Cardiff and Newport, by the Cambrian from Builth Wells, or by the Midland from Hereford and Swansea respectively. The Great Western railway has also a service of road motors between Abergavenny and Brecon. A canal running past Abergavenny connects Brecon with Merthyr.

The Priory church of St John, a massive cruciform building, originally Norman with Early English and Decorated additions, is the finest parish church in Wales, and even taking into account the cathedrals it is according to E.A. Freeman "indisputably the third church not in a state of ruin in the principality," its choir furnishing "one of the choicest examples of the Early

English style." Previous to the dissolution, a rood-screen bearing a gigantic rood, the object of many pilgrimages, stood to the west of the tower. The church was restored under Sir Gilbert Scott between 1861 and 1875. St Mary's, in the centre of the town, and St David's, beyond the Usk, are now mainly modern, though the former has some of the Norman arches of the original church. There is also a Roman Catholic church (St Michael's) opened in 1851, and chapels belonging to the Baptists, Calvinistic and Wesleyan Methodists, and to the Congregationalists. In Llanfaes there was formerly a Dominican priory, but in 1542 Henry VIII. granted it with all its possessions to a collegiate church, which was transferred thither from Abergwili, and was given the name of Christ College. Many of the bishops of St David's during the 17th century occasionally resided here, and several are also buried here. A small part of the revenues went to the maintenance of a grammar-school, but in 1841 the collegiate body was dissolved, and its revenues, then amounting to about £8000 a year, were transferred to the ecclesiastical commissioners. In 1853 Henry VIII.'s charter was repealed, and under a chancery scheme adopted two years later, £1200 a year was appropriated for the school. New school buildings  were erected at a cost of about £10,000 in 1862, and these were enlarged at a cost of about £5000 in 1880. The chancel of the old Dominican chapel, dating from the 13th century, was restored in 1864, and is now the school chapel. There is also a Congregationalist theological college, built in 1869 at a cost of £12,000, and now affiliated with the university of Wales. The other chief buildings of the town are the shire hall built in 1842 in the Doric style from designs by T.H. Wyatt; the Guildhall; the barracks, which are the headquarters of two battalions of the South Wales Borderers; the county infirmary founded in 1832; and the prison (in Llanfaes) for the counties of Brecon and Radnor. There is a bronze statue of the duke of Wellington (erected in 1854) by John Evan Thomas, a native of the town. The town commands a magnificent view of the Brecknock Beacons, and is noted for its promenades on the banks of the Usk, and in the priory groves. Brecon is favourably known as a fishing centre, and there is also boating on the Usk and the canal. There are several houses of interest, notably the Priory and Dr Awbrey's residence (now called Buckingham House), both built about the middle of the 16th century, but the finest specimen is Newton (about a mile out, near Llanfaes) built in 1582 by Sir John Games (a descendant of Sir David Gam), but now a farmhouse. The "Shoulder of Mutton" Inn, now known as the "Siddons Wine Vaults," was the birthplace in 1755 of Mrs Siddons.

The name Brecknock is an anglicized form of Brycheiniog, the Welsh name of the territory of Brychan (whence the alternative form of Brecon), a Goidelic chieftain, who gained possession of the Usk valley in the 5th century. The Welsh name of the town, on the other hand, has always been Aber-Honddu (the estuary of the Honddu). There is no evidence of any settlement on the site of the present town prior to about 1092, when Bernard Newmarch, after defeating Bleddin ab Maenarch, built here a castle which he made his residence and the chief stronghold of his new lordship. For this purpose he utilized what remained of the materials of the Roman fort, 3 m. to the west, at Y Gaer, which some identify as Bannium. He subsequently founded, near the castle, the Benedictine priory of St John, which he endowed and constituted a cell of Battle Abbey. In time a town grew up outside the castle, and its inhabitants received a series of charters from the de Bohuns, into which family the castle and lordship passed, the earliest recorded charter being granted by Humphrey, 3rd earl of Hereford. Under the patronage of his great-grandson, the last earl of Hereford (who lived in great splendour at the castle), the town became one of the chief centres of trade in South Wales, and a sixteen days' fair, which he granted, still survives as a hiring fair held in November. Further charters were granted by Henry IV. (who married Hereford's co-heiress), by Henry V., who gave the town two more fairs, and by the Stafford family, to which the castle and lordship were allotted on the partition of the Bohun estates in 1421. Henry Stafford, 2nd duke of Buckingham, resided a good deal at the castle, and Morton, bishop of Ely, whose custody as a prisoner was entrusted to him, plotted with him there for the dethronement of Richard III., for which Stafford was executed in 1483. His son, Edward, the 3rd duke, who was born in the castle in 1478, had the estates restored to him, but, in 1521, suffered a like fate with his father, and the lordship and castle then vested in the crown. Both were acquired in the next century by the ancestors of Viscount Tredegar, to whom they now belong. By a statute of 1535 Brecon was made the county town of the new shire of Brecknock, and was granted the right of electing one burgess to represent it in parliament, a right which it retained till it was merged in the county representation in 1885. A chancery and exchequer for the counties of Brecknock and Radnor were also established at Brecon Castle, and from 1542 till 1830 the great sessions, and since then the assizes, and at all times the quarter sessions for the county, have been held at Brecon. The borough had also a separate court of quarter sessions till 1835. The town was incorporated by a charter granted by Philip and Mary in 1556 and confirmed by Elizabeth in the nineteenth year of her reign. A charter granted by James II. was never acted upon. The borough was placed under the Municipal Corporations Act 1835, and until then the town of Llywel, which is 10 m. off, formed a ward of the borough. There were formerly five trade gilds in the town, the chief industries being cloth and leather manufactures. There are five ancient fairs for stock, and formerly each of them was preceded by a leather fair. The fairs held in May and November were also for hiring, much of the hiring being now done at the Guildhall, and not in the streets as used to be the case.

During the Civil War the greater part of the castle and of the town walls (which with their four gates were until then well preserved) were demolished by the inhabitants in order to prevent the town being either garrisoned or besieged. Charles I., however, stayed a night at the priory house shortly after the battle of Naseby. The chief ruins of the castle are now enclosed in the grounds of the Castle Hotel, the principal object being Ely tower, where Bishop Morton was imprisoned.

Besides those already mentioned the persons of note born in the town include Henry Stafford, duke of Buckingham; Dr Hugh Price, founder of Jesus College, Oxford; Dr Thomas Coke, the first Wesleyan missionary bishop in America; and Theophilus Jones, the historian of the county. Henry Vaughan, the Silurist, at one time practised here as a doctor of medicine.

(D. Ll. T.)

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**BRECONSHIRE,** or Brecknockshire, an inland county in South Wales, and the fourth largest in all Wales, bounded N.W. by Cardigan, N. and N.E. by Radnor, E. and S.E. by Monmouth, S. by Glamorgan and W. by Carmarthen. The general aspect of the county is mountainous, and the scenery is marked by beauty and grandeur. The climate is moist but temperate and healthy, and the soil of the valleys, often consisting of rich alluvial deposits, is very fertile. The loftiest mountains in South Wales, extending from Herefordshire and Monmouthshire (where their eastern spurs form the Hatteral Hills) in a south-easterly direction into Carmarthenshire, completely encircle the county on the east and south except for the break formed by the Vale of Usk at Crickhowell. Their highest summit north of the Usk, on the eastern side, where they are known as the Black Mountains, or sometimes the Black Forest Mountains, is Pen y Gader (2624 ft.) between Talgarth and Llanthony, and on the south-west the twin peaks of the Mynydd Du ("Black Mountain") or the so-called Carmarthenshire Vans or Beacons, only the higher of which, Fan Brycheiniog (2632 ft.), is, however, in Breconshire; while the centre of the crescent is occupied by the masses of the Brecknockshire Beacons or Vans (often called the Beacons simply), the highest point of which, Pen y Fan, formerly also known as Cadair Arthur, or Arthur's Chair, attains an altitude of 2910 ft. In the north, a range of barren hills, which goes by the general designation of Mynydd Eppynt (a name more properly limited to its central portion), stretches right across the county in a north-easterly direction, beginning with Mynydd Bwlch-y-Groes on the boundary to the east of Llandovery, and terminating near Builth. In the dreary country still farther north there is a series of rounded hills covered with peat and mosses, the chief feature being Drygarn Fawr (2115 ft.) on the confines of Cardiganshire.

Of the valleys, the most distinguished for beauty is that of the Usk, stretching from east to west and dividing the county into two nearly equal portions. The Wye is the chief river, and forms the boundary between the county and Radnorshire on the north and north-east, from Rhayader to Hay, a distance of upwards of 20 m.; its tributary, the Elan, till it receives the Claerwen, and then the latter river, continue the boundary between the two counties on the north, while the Towy separates the county from Cardigan on the north-west. The hilly country to the north of the Eppynt is mainly drained by the Irfon, which falls into the Wye near Builth. The Usk rises in the Carmarthenshire Van on the west, and flowing in a direction nearly due east through the centre of the county, collects the water from the range of the Beacons in the south, and from the Eppynt range in the north by means of numerous smaller streams, of which the Tarell and the Honddu (which join it at Brecon) are the most important, and it enters Monmouthshire near Abergavenny. The Taff, the Nêdd (with its tributaries the Hepste and the Mellte) and the Tawe, all rise on the south of the Beacon range and passing through Glamorganshire, flow into the Bristol Channel, the upper reaches of the Nêdd and its tributaries in the Vale of Neath being deservedly famous for its scenery. The mountains of the county constitute one of the best water-producing areas in Wales. Recognizing this, the corporation of Birmingham, under an act of 1892, acquired the watershed of the Elan and Claerwen, and constructed on the Elan three impounding reservoirs whence the water is conducted through an aqueduct to Birmingham (*q.v.*). Swansea obtains its chief supply from a reservoir of one thousand million gallons constructed in 1898-1906 on the Cray, a tributary of the Usk. A large industrial area around Neath is supplied from Ystradfellte. Merthyr Tydfil draws its supply from the lesser Taff, while Cardiff's main supply comes from the Great Taff valley, where, under acts of 1884 and 1894, two reservoirs with a capacity of 668 million gallons have been constructed and a third authorized.



In the east of the county, at the foot of the Black Forest Mountains, is Llyn Safaddan, or Brecknock Mere, now more generally known as Llangorse Lake (from being partly situated in the parish of that name). It is about 3 m. long by 1 m. broad, being the largest lake in South Wales. Upon an artificial island in the lake traces of lake-dwellings were discovered in 1869, together with the bones of red deer, wild boar and *Bos longifrons*.

*Geology.*—The oldest rocks in Brecknockshire are the Llandeilo shales and intrusive diabases of

pre-Llandovery age which near Builth extend across the Wye from Radnorshire; another patch with volcanic outflows comes up at Llanwrtyd, and at both places they give rise to mineral springs. Next follow the Bala Beds, which, with the succeeding Lower and Upper Llandovery shales, sandstones and conglomerates, form the sparsely populated sheepwalks and valleys which occupy most of the north-western part of the county. These rocks are much folded and the shales are locally cleaved into slates, while the sandstones and conglomerates form scarps and ridges. To the south-east of this region a narrow outcrop of Upper Llandovery, Wenlock and Ludlow sandstones and mudstones follows, uncomformably overlying the Llandeilo and Bala rocks, and dipping conformably under the Old Red Sandstone; they extend from Newbridge-on-Wye and Builth through Llangammarch (where there are mineral springs) towards Llandovery, while a tongue of Ludlow rocks brought up by faulting extends from Erwood on the Wye for 8 m. south-westwards into the Old Red Sandstone. The remainder and greater part of the county is occupied chiefly by the gently inclined Old Red Sandstone; in the dissected plateau of the Black Mountains north of Crickhowell the lower marls and cornstones are laid open, while south of Brecon the conglomeratic upper beds form the escarpment and plateaus of the Beacons. The southern edge of the county is formed by the scarps and moorlands of the Carboniferous Limestone and Millstone Grit (both of which form also the outlier of Pen-ceryg-calch north of Crickhowell), while the lowest beds of the Coal Measures of the South Wales coalfield are reached in the Tawe and Neath valleys (where the beds are much folded) and near Tredegar and Brynmawr. Glacial deposits spread over the lower grounds and striae occur at great heights on the Black Mountains.

*Industries.*—Agriculture is the chief industry, and the Agricultural Society of the county, dating from 1755, is the oldest in Wales. About one-fourth only of the area of the county is under cultivation, and the chief crops grown are wheat and barley, but above all, turnips and oats. The acreage devoted to any other crop is practically infinitesimal, though in the eastern part more attention is paid to fruit-growing than perhaps in any other part of South Wales. The farming is, however, chiefly pastoral, nearly one-third of the county is common or waste land, and its number of sheep (mainly of the Radnor Forest breed) far exceeds that of any other county in Wales. The breeding of cobs and ponies comes next in importance, and thirdly that of cattle, now mostly Herefords, though Speed mentions a native breed, long since extinct, all white with red ears. These, together with pigs, wool, butter, and (in small quantities) cheese, form the staple of a considerable trade with the Midlands and the industrial districts to the south and southwest. The farms are of comparatively small size, the average cultivated area of the holdings in 1894 being 63 acres, and the hired labour averages about two men for each farm. A large share of the work, especially on the highland farms, is done by the occupiers and members of their own families, with the aid, where required, of an indoor servant or two. Few hands are employed in manufactures, but the mining industry is more important, coal being extensively worked—chiefly anthracite in the upper reaches of the Swansea and Neath valleys, and bituminous in the south-eastern corner of the county. There are also limestone and fireclay, firebrick and cement works, chiefly on the northern outcrop of the carboniferous limestone, as at Abernant in the Vale of Neath and at Penwyllt.

The Central Wales section of the London & North-Western railway from Craven Arms to Swansea crosses the north-west corner of the county, and is intersected at Builth Road by a branch of the Cambrian, which, running for the most part on the Radnorshire side of the Wye, follows that river from Rhayader to Three Cocks; the Midland railway from Hereford to Swansea runs through the centre of the county, effecting junctions at Three Cocks with the Cambrian, at Talyllyn with the Brecon & Merthyr railway (which connects the county with the industrial areas of East Glamorgan and West Monmouthshire), and at Capel Colbren with the Neath and Brecon line. The North-Western and Rhymney joint line skirts the south-eastern boundary of the county. Brecon is also connected with Newport by means of the Brecknock and Abergavenny Canal, which was completed in 1801 and is 35 m. in length. The Swansea Canal and that of the Vale of Neath have also their northern terminal within the county, at Ystradgynlais and Abernant respectively. The main roads of the county are probably the best in South Wales.

*Population and Administration.*—The area of the ancient county is 475,224 acres, with a population in 1891 of 57,031 and in 1901 of 59,907. The area of the administrative county is 469,301 acres. The only municipal borough is Brecon, which is the county town, and had in 1901 a population of 5741. The other urban districts are Brynmawr, Builth Wells and Hay, with populations of 6833, of 1805 and of 1680 respectively in 1901. Crickhowell and Talgarth are market towns, while Llanwrtyd Wells is a rapidly developing health resort. The county forms part of the South Wales circuit, and the assizes are held at Brecon. It had one court of quarter sessions, and is divided into ten petty sessional divisions. The borough of Brecon has a separate commission of the peace, but no separate court of quarter sessions. There are 94 civil parishes, while the ecclesiastical parishes or districts wholly or in part within the county number 70, of which 67 are in the diocese of St David’s and the archdeaconry of Brecon, the remaining 3 being in the diocese of Llandaff. The county is not divided for parliamentary purposes, and returns one member to parliament. It contains a small part of the parliamentary borough of Merthyr Tydfil.

In the eastern parts and along the Wye valley, English has become the predominant language, but in the rest of the county, especially north of the Eppynt range, Welsh occupies that position.

In 1901 about 51% of the population above three years could speak both English and Welsh, 38% could speak English only and 11% Welsh only. The majority of the population is Nonconformist in religion, the chief denominations being the Baptists, Calvinistic Methodists and Congregationalists. Besides an endowed grammar-school (Christ College) at Brecon, there are in the county four secondary schools, established under the Welsh Intermediate Education Act 1899, viz. separate schools for boys and girls at Brecon, and dual schools at Builth and Brynmawr. Most of the county institutions are in the town of Brecon, but the joint asylum for the counties of Brecon and Radnor is at Talgarth. It was opened in February 1903. At Trevecca, near the same town, was a theological college for ministerial students attached to the Calvinistic Methodist body, but in October 1906 the institution was removed to Aberystwyth, and the buildings have since been utilized for a preparatory school belonging to the same body.

*History.*—There are no traces or record of Breconshire being inhabited before the Neolithic period, but to that period may be ascribed a number of cairns, menhirs and one cromlech (near Glanusk). In Roman times the eastern half of the county formed part of the territory of the Silures, a pre-Celtic race, whose governing class at that time probably consisted of Brythonic 486
Celts. But an earlier wave of Celtic invasion represented by the Goidels had passed westwards along the valleys of the Usk and Wye, leaving traces in place-names (*e.g. llwch*, lake), and in the Ogham inscribed stones found at Glanusk, Trallwng and Trecastle, and probably surviving into historic times around the Beacon range and farther south even to Gower and Kidwelly. The conquest of the district by the Romans was effected between about A.D. 75 and 80, and they established a frontier fort (which some have called Caer Bannau, identifying it as Bannium) some 3 m. out of the present town of Brecon, with smaller stations on roads leading thereto at Y Gaer near Crickhowell, and at Capel Colbren in the direction of Neath. On the departure of the Romans, the Goidelic hill-tribes, probably with help from Gower and Ireland, seem to have regained possession of the Usk valley under the leadership of a chieftain of their own race, Brychan, who became the ancestor of one of the three chief tribes of hereditary Welsh saints. His territory (named after him Brycheiniog, whence Brecknock) lay wholly east of the Eppynt range, for the lordship of Buallt, corresponding to the modern hundred of Builth, to the west, remained independent, probably till the Norman invasion. Most of the older churches of central Brecknockshire and east Carmarthenshire were founded by or dedicated to members of Brychan's family.

From the middle of the 8th century to the 10th, Brycheiniog proper often bore the brunt of Mercian attacks, and many of the castles on its eastern border had their origin in that period. Subsequently, when Bernard de Newmarch and his Norman followers obtained possession of the country in the last quarter of the 11th century, these were converted into regular fortresses. Bernard himself initiated this policy by building a castle at Talgarth on the Upper Wye, but in 1091 he moved southwards, defeated the regulus of Brycheiniog, Bleddyn ab Maenarch, and his brother-in-law Rhys ap Tewdwr, the prince of south-west Wales, and with materials obtained from the Roman fort of Caer Bannau, built a castle at Brecon, which he made his *caput baroniae*. Brycheiniog was then converted into a lordship marcher and passed to the Fitzwalter, de Breos, the Bohun and the Stafford families in succession, remaining unaffected by the Statute of Rhuddlan (1282), as it formed part of the marches, and not of the principality of Wales.

The Irfon valley, near Builth, was, however, the scene of the last struggle between the English and Llewelyn, who in 1282 fell in a petty skirmish in that district. The old spirit of independence flickered once again when Owen Glendower marched to Brecon in 1403. Upon the attainder of Edward, duke of Buckingham, in 1521, the lordship of Brecon with its dependencies became vested in the crown. In 1536 it was grouped with a whole series of petty lordships marcher and the lordship of Builth to form the county of Brecknock with Brecon as the county town, and the place for holding the county court. The county returns one member to parliament, and has done so since 1536; the borough of Brecon, with the town of Llywel, had also a separate representative from the same date till 1885, when it became merged in the county.

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**BREDA,** a fortified town in the province of North Brabant, Holland, at the confluence of the canalized rivers Merk and Aa, 15 m. by rail E.N.E. of Roozendaal. Pop. (1900) 26,296. It is connected by steam tramway with Antwerp (30 m. S.S.W.), and with Geertruidenberg in the north, and the island of Duiveland on the west. The fortress of Breda, which was once considered impregnable, has been dismantled, but the town is still protected by extensive lines of fortification and lies in the midst of a district which can be readily laid under water. It has a fine quay, town-hall and park. There are several Roman Catholic and Protestant churches. The principal Protestant church is a Gothic building dating from the end of the 13th century, with a fine tower, and a choir of later date (1410). Among the many interesting monuments is the

imposing tomb of the stadtholder Count Engelbert II. of Nassau and his wife. This is the work of Tomasino Vincenz of Bologna, who, though a pupil of Raphael in painting, in sculpture followed Michelangelo, to whom the work is sometimes ascribed. Since 1828 Breda has been the seat of a royal military academy for all arms of the service. It also possesses a Latin school, an arsenal, and a modern prison built on the isolated-cell principle. The prison is in the form of a rotunda, 58 yds. in diameter, and covered by a high dome. In the middle is the office of the administration, and on the top of this a small watch-tower. Round the walls of the rotunda are the cells, 208 in number, and arranged in four tiers with balconies reached by iron staircases. Each cell measures 35 cub. yds., is provided with an electric bell communicating with the warder in the tower, heated by hot-air pipes, and lighted by day through a window on the outer wall of the rotunda, and from sunset till ten o'clock by electric light. The industries of Breda comprise the manufacture of linen and woollen goods, carpets, hats, beer and musical instruments. In the neighbourhood of the town are the villages of Ginneken and Prinsenhage, situated in the midst of pretty pine woods. They form favourite places of excursion, and in the woods at Ginneken is a Kneipp sanatorium.

*History.*—Breda was in the 11th century a direct fief of the Holy Roman Empire, its earliest known lord being Henry I. (1098-1125), in whose family it continued, though, from the latter part of the 13th century, in the female line, until Alix, heiress of Philip (d. 1323), sold it to Brabant. In 1350 the fief was resold to John (Jan) of Polanen (d. 1377), the heiress of whose line, Joanna (d. 1445), married Engelbert of Nassau-Dillenburg (d. 1442). Henceforth it remained in the house of Nassau, passing ultimately to William I. (1533-1584), the first stadtholder of the Netherlands. Breda obtained municipal rights in 1252, but was first surrounded with walls in 1534 by Count Henry of Nassau, who also restored the old castle, originally built by John of Polanen in 1350. From this period until late in the 19th century it remained the most important of the line of fortresses along the Meuse. Breda was captured by surprise by the Spaniards in 1581; but in 1590 it fell again into the hands of Maurice of Nassau, 68 picked men contriving to get into the town concealed under the turf in a peat-boat. The so-called "Spaniard's Hole" still marks the spot where the peat-boat lay. Its surrender in 1625, after a ten months' siege, to the Spaniards under Spinola is the subject of the famous picture by Velasquez in the Museo del Prado in Madrid. In 1637 Breda was recaptured by Frederick Henry of Orange after a four months' siege, and in 1648 it was finally ceded to Holland by the treaty of Westphalia. During the wars of the French Revolution, it was taken by Dumouriez in 1793, evacuated soon after and retaken by Pichegru in 1795, after the whole of Holland had already succumbed to the French. In 1813, a sally being made by the French garrison on an advance-guard of the Russians under Benckendorff, the citizens of Breda again made themselves masters of the town.

Breda was the residence, during his exile, of Charles II., who, by the declaration of Breda (1660), made known the conditions of his acceptance of the crown of England. In 1696 William, prince of Orange and king of England, built the new castle, one of the finest buildings of the period, which now serves as the military academy. Breda also derives some celebrity from the various political congresses of which it has been the scene. In 1575 a conference was held here between the ambassadors of Spain and those of the United Provinces; in 1667 a peace was signed between England, Holland, France and Denmark; and in 1746-1747 the representatives of the same powers met in the town to discuss the terms of another treaty.

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**BREDAEL, JAN FRANS VAN** (1683-1750), Flemish painter, son of Alexander van Bredael (d. 1720), who was also an artist, was born in Antwerp. He imitated the style of Wouverman and Breughel with such dexterity that even connoisseurs are often unable to distinguish his copies of their pictures from the originals. He visited England, where he was so well employed that in a few years he was able to retire to his native country with a competency. The earl of Derwentwater was one of his chief patrons. There were several other van Bredaels, who won honour as artists—notably Pieter (1622-1719), Alexander's father, and Jozef (1688-1739). They were formerly known as "Breda," but this apparently is incorrect, though it occurs as a signature on a picture by Jan Frans in the Amsterdam gallery.



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**BREDERODE, HENRY,** Count of (1531-1568), was born at Brussels in 1531. He was the descendant of an ancient race, which had for some centuries been settled in Holland, and had taken an active part in the affairs of war and peace. Count Henry became a convert to the Reformed faith and placed himself at the side of the prince of Orange and Count Egmont in

resisting the introduction of the Spanish Inquisition and Spanish despotism into the Netherlands. In 1566 he was one of the founders of the confederacy of nobles who bound themselves to maintain the rights and liberties of the country by signing a document known as “the Compromise.” On the 5th of April of that year Brederode accompanied to the palace a body of 250 confederates, of whom he acted as the spokesman, to present to the regent, Margaret of Parma, a petition setting forth their grievances, called “the Request.” It was at a banquet at the Hotel Culemburg on the 8th of April, presided over by Brederode, that the sobriquet of *les Gueux*, or “the Beggars,” was first given to the opponents of Spanish rule. Brederode was banished from the Netherlands by Alva, and died in exile shortly afterwards at the early age of thirty-six.

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**BREDOW, GOTTFRIED GABRIEL** (1773-1814), German historian, was born at Berlin on the 14th of December 1773, and became successively professor at the universities of Helmstadt, Frankfort-on-Oder and Breslau. He died at Breslau on the 5th of September 1814. Bredow’s principal works are *Handbuch der alien Geschichte, Geographic und Chronologie* (Eutin, 1799; English trans., London, 1827); *Chronik des 19. Jahrhunderts* (Altona, 1801); *Entwurf der Weltkunde der Alten* (Altona, 1816); *Weltgeschichte in Tabellen* (Altona, 1801; English trans, by J. Bell, London, 1820); *Grundriss einer Geschichte der merkwürdigsten Welthändel von 1796-1810* (Hamburg, 1810).

Bredow’s posthumous writings were edited by J.G. Kunisch (Breslau, 1823), who added a biography of the author.

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**BREDOW**, a village of Germany, in the kingdom of Prussia, immediately north of Stettin, of which it forms a suburb. Here are the Vulcan iron-works and shipbuilding yards, where the liners “Deutschland” (1900), the “Kaiserin Augusta Victoria” (1906), and the “George Washington” (1908), the largest vessel (722 ft. long, 27,000 tons) in the German mercantile marine, were built; and also sugar, cement and other factories.

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**BREECH** (common in early forms to Teutonic languages), a covering for the lower part of the body and legs. The Latin *braca* or *bracca* is a Celtic word, probably cognate with the Teutonic. The word in its proper meaning is used in the plural, and, strictly, is confined to a garment reaching to the knees only. The meaning of “the hinder part of the body” is later than, and derived from, its first meaning; this sense appears in the “breech” or hinder part of a gun. The word is also found in “breeches buoy,” a sling life-saving apparatus, consisting of a support of canvas breeches. The “Breeches Bible,” a name for the Geneva Bible of 1560, is so called because “breeches” is used for the aprons of fig-leaves made by Adam and Eve. On the stage the phrase a “breeches” part is used when a woman plays in male costume. “Breeching” is a strap passed round the breech of a harnessed horse and joined to the shafts to allow a vehicle to be backed.

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**BREEDS AND BREEDING.** Breeds may be defined as domestic varieties of animals or plants which man has been able to bring into existence and to maintain in existence. The process of breeding includes all the modifying influences which man may bring to bear on a wild stock for the purpose, conscious or unconscious, of establishing and maintaining breeds. Charles Darwin’s *Variation of Animals and Plants under Domestication* (1868) was the starting-point of exact knowledge on this subject; when it appeared, it contained not only the best collection of empirical facts, but the only rational theory of the facts. The first relations between man and domesticated animals and plants were due to unconscious or accidental selection of wild stocks that tolerated the vicinity of man and that were useful or attractive to him. The new conditions must have

produced modifications in these stocks, whether these were caused by a survival in each generation of individuals with the power of response to the new environment, or were due to a conscious selection of individuals capable of such favourable response. The essence of the process, however, came to be a conscious selection in each generation of the best individuals, that is to say, of those individuals that seemed to man to be most adapted to his wants. The possibility of establishing a breed depended, therefore, in the first place on the natural variability of wild animals and plants, then on the variations induced in animals and plants under subjection to the new conditions brought about by man's interference, next on the extent to which these variations, natural or artificial, persisted through the series of generations, and finally on man's intelligence in altering or maintaining the conditions of the environment, and in selective mating. The theory of breeds and breeding depends, in fact, on knowledge of variation, of modification by the environment, and of heredity. Any attempt to give an account of what actually has been done by man in establishing breeds would be little more than an imperfect summary of Darwin's work. The articles Heredity, Mendelism and Variation and Selection show that what may be called the theoretical and experimental knowledge of variation and heredity is far in advance of the practical art of breeding. Even horticulturists, who have been much more successful than those who deal with animals, are still far from being able to predict the result of their selections and crossings. None the less it may be stated definitely that such prediction is already so nearly within the power of the practical breeder that it would be a waste of time to give a summary of the existing rule-of-thumb methods. The art of breeding is so immediately destined to become a science of breeding that existing knowledge and conceptions must be dismissed as of no more than historical interest.

(P. C. M.)

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**BREEZE,** (1) A current of air generally taken as somewhat less than a "wind," which in turn is less than a "gale." The term is particularly applied to the light wind blowing landwards by day, "sea-breeze," and the counter wind, blowing off the land at night, "land-breeze." The word appears in Fr. *brise* (admitted by the Academy in 1762). The Span, *brisa*, Port. *briza*, and Ital. *brezza* are used for a wind blowing from the north or north-east. According to Cotgrave, Rabelais uses *brize* in the sense of *bise*, the name of a dry north or north-east wind prevalent in Switzerland and the bordering parts of France, Italy and Germany. The word is first used in English as applied to the cool sea-breeze blowing usually from the east or north-east in the West Indies and Atlantic sea-coast of Central America. It was then applied to sea-breezes from any quarter, and also to the land-breeze, and so to any light wind or current of air. (2) Fine ashes or cinders, the refuse of coal, coke and charcoal burning. This is probably from the O. Fr. *brese*, modern *braise*, a word connected with *braser*, whence Eng. *brazier*, a pan for burning coals, charcoal, &c.

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**BREGENZ** (anc. *Brigantium*), the capital of the Austrian, province of Vorarlberg, as well as of the administrative district of Bregenz. In 1900 its population was 7595, German-speaking and Roman Catholic. It is situated at the south-east angle of the Lake of Constance, and, besides communications by water with the other towns on the shores of that lake, is connected by: rail with Feldkirch on the Arlberg line (24 m.) and with Munich. The old town is on a hillock, crowned by the ancient castle, while the new town is built on the level ground at the foot of the hill. The fine parish church (dedicated to St Gall) stands on another mound more to the south. In the local museum are collections of various kinds, especially of the Roman antiquities which have been dug up on the site of the old town. The position of the town on the lake has always made it an important port and commercial centre. Nowadays the main trade is in grain, but much is done also in cattle and in the products of the cotton-spinning factories of Vorarlberg.

We hear of counts of Bregenz as early as the 10th century, their heirs in the early 13th century being the counts of Montfort (a castle north of Feldkirch), who gradually acquired most of the surrounding country (including Feldkirch and Bludenz). But little by little the Habsburgers, counts of Tirol since 1363 bought from them most of their domains—first Feldkirch in 1375, next Bludenz and the Montafon valley in 1394, finally the county of Bregenz in two parts, acquired in 1451 and 1523. In 1408 the Appenzellers were defeated before Bregenz, while in 1647, during the Thirty Years' War, the town was sacked by the Swedes under Wrangel.

(W. A. B. C.)

**BREHON LAWS,** the English but incorrect appellation of the ancient laws of Ireland, the proper name for which is *Feineachas*, meaning the laws of the Feine or Feini (fainyeh), who were the free Gaelic farmers. *Dlighthe Feine* is another name for the laws, with the same meaning. Laws of universal application which could be administered only by duly qualified judges were called *Câin* law, while minor laws administered by nobles and magistrates were called *Urradhus* law. Regular courts and judges existed in Ireland from prehistoric times. The Anglo-Irish word "Brehon" is derived from the Gaelic word *Brethem* (= judge).

The extant remains of these laws are manuscript transcripts from earlier copies made on vellum from the 8th to the 13th century, now preserved with other Gaelic manuscripts in Trinity College and the Royal Irish Academy, Dublin, the British Museum, Oxford University, some private collections and several libraries on the continent of Europe. The largest and most important of these documents is the *Senchus Mór* or "Great Old Law Book." No copy of it now existing is complete, and some portions are missing from all. What remains of it occupies the first, second, and a portion of the third of the volumes produced by the Brehon Law Commission, which was appointed in 1852.

In the *Annals of the Four Masters* it is said: "The age of Christ 438, the tenth year of King Laeghaire (Lairy), the *Senchus Mór* and *Feineachas* of Ireland were purified and written." This entry has ample historical corroboration. Of many separate treatises dealing with special branches of the law, the *Book of Aicill*, composed of opinions or placita of King Cormac Mac Art, otherwise Cormac ua Quim, Ard-Rig of Erinn from A.D. 227 until 266, and Cennfaeladh the Learned, who lived in the first part of the 7th century, is the most important.

The text and earlier commentaries are in the *Bearla Feini*—the most archaic form of the Celtic or Gaelic language. From gradual changes in the living tongue through a long expanse of time many words, phrases and idioms in the *Bearla Feini* became obsolete, and are so difficult to translate that the official translations are to some extent confessedly conjectural. In many cases only opening words of the original text remain. Wherever the text is whole, it is curt, elliptical, and yet rhythmical to a degree attainable only through long use. The rigorously authentic character of these laws, relating to, and dealing with, the actual realities of life, and with institutions and a state of society nowhere else revealed to the same extent, the extreme antiquity both of the provisions and of the language, and the meagreness of continental material illustrative of the same things, endow them with exceptional archaic, archaeological and philological interest.

In the earliest times all learned men, whether specially learned in law or not, appear to have acted as judges. Gradually as literature and learning increased, judgments delivered by men without special legal training fell into disfavour. In the 1st century of the Christian era, when Conchobhar or Conor Mac Nessa was king of Ulster, a crisis was reached, the result of which was that no man was allowed to act as Brehon until he had studied the full law course, which occupied twenty years, and had passed a rigorous public examination. The course of study for Brehon and Ollamh, advocate and law-agent respectively, is carefully laid down in the law itself. The Brehonship was not an office of state like that of the modern judge, but a profession in which success depended upon ability and judgment. The Brehon was an arbitrator, umpire, and expounder of the law, rather than a judge in the modern acceptation. It appears, without being expressly stated, that the facts of a case were investigated and ascertained by laymen, probably by the *Aireachtas*—a local assembly or jury—before submission to a Breton for legal decision. A Brehon whose decision was reversed upon appeal was liable to damages, loss of position and of free lands, if any, disgrace, and a consequent loss of his profession. No Brehon had any fixed territorial jurisdiction. A party initiating proceedings could select any Brehon he pleased, if there were more than one in his district. Every king or chief of sufficient territory retained an official Brehon, who was provided with free land for his maintenance. In ordinary cases the Brehon's fee was said to have been one-twelfth of the amount at stake.

Assemblies, national, provincial and local, were a marked characteristic of ancient Irish life. They all, without exception, discharged some legal functions, legislative or administrative, and even in those in which amusement predominated, the *Cáin* law was publicly rehearsed. Most of the assemblies were annual, some triennial, some lasted only a day or two, others a week and occasionally longer. All originated in pagan funeral or commemorative rites, and continued to be held, even in Christian times, in very ancient cemeteries. They were called by different names —*Feis, Aenach, Aireachtas, Dál, &c.*

The Feis of Tara, in Meath, was from its origin seven centuries before Christ down to A.D. 560, mainly national and political, being convened by the Ard-Rig, held at his residence, presided over by him, and consisting of the provincial kings, tanists, flaiths, Brehons, warriors, historians, poets

and other distinguished men from the whole of Ireland. It was due to be held every third year for the purpose of “preserving the laws and rules,” and it might be called specially on any urgent occasion. After the statesmen had consulted, the laws were proclaimed, with any modifications agreed upon. Then the proceedings became festive, queens and great ladies taking part. The Feis of A.D. 560 was the last regular one held at Tara because the monarch ceased to reside there. One national assembly of an exceptional character was held at Tara in A.D. 697, by a decree of which women were emancipated from liability to military service.

The Aenach held annually at Tailltenn, also in Meath, was a general assembly of the people without restriction of rank, clan or country, and became the most celebrated for athletic sports, games and contests. Yet even here the laws were read aloud, and it is not without significance that the last national assembly held at Tailltenn under King Rhoderic O’Connor in 1168 was a political one.

The *Dál-Criche* (= territorial assembly), held at Uisneach in Westmeath, was a gathering for political and quasi-legislative purposes. At one assembly there about a century before Christ, a uniform law of distraint for the whole of Ireland was adopted on the motion of Sen, son of Aigé. This did not prevent the gatherings at Uisneach from being for ages celebrated for gaiety and amusement.

Each provincial kingdom and each tuath had assemblies of its own. Every *flaith* and *flaith-fine* was a member of a local assembly, the clan system conferring the qualification, and there being no other election.

An assembly when convened by the *Bruigh-fer* for the special purpose of electing a tanist or successor to the king was called a *Tocomra*.

Very careful provision is made for the preparation of the sites of great assemblies, and the preservation of peace and order at them is sanctioned by the severest penalties of the law. The operation of every legal process calculated to occasion friction, such as seizure of property, was suspended during the time the assemblies lasted.

The term *Rig* (reeh = *rex*, king) was applied to four classes or grades of rulers, the lower grades being grouped, each group being subject to one of their number, and all being subject to, and owing tribute and allegiance to the Ard-Rig (= supreme king of Erinn). The Ard-Rig had an official residence at Tara and the kingdom of Meath for his special use. The provincial king, Rig Cuicidh, also had an official residence and kingdom of his own, together with allegiance and tribute from each Rig-mor-Tuatha in his province, who in his turn received tribute and allegiance from each Rig-Tuatha under subjection to him. The Rig-Tuatha received tribute and allegiance from the flaiths or nobles in his tuath. The tuath was the political unit, and the ruler of it was the lowest to whom the term “king” was applied. For each payment of tribute a king always made some return. Every king was obliged, on his inauguration, to swear that he would govern justly and according to law, to which he remained always subject. The Ard-Rig was selected by the sub-kings and other leading men who legally constituted the Feis of Tara, the sub-kings by those under them in their respective spheres. No person not of full age, imperfectly educated, stupid, blind, deaf, deformed or otherwise defective in mind or body, or for any reason whatsoever unfit to discharge the duties or unworthy to represent the manhood of the nation, could be king, even though he were the eldest son of the preceding king. “It is a forbidden thing for one with a blemish to be king at Tara.”



*Tuath, Cinel* and *Clann* were synonyms meaning a small tribe or nation descended from a common ancestor. A king and clan being able, subject to certain limitations, to adopt new members or families, or amalgamate with another clan, the theory of common origin was not rigidly adhered to. Kinship with the clan was an essential qualification for holding any office or property. The rules of kinship largely determined status with its correlative rights and obligations, supplied the place of contract and of laws affecting the ownership, disposition and devolution of property, constituting the clan an organic, self-contained entity, a political, social and mutual insurance co-partnership. The solidarity of the clan was its most important and all-pervading characteristic. The entire territory occupied by a clan was the common and absolute property of that clan. Subject to this permanent and fundamental ownership, part of the land was set apart for the maintenance of the king as such. Warriors, statesmen, Brehons, Ollamhs, physicians, poets, and even eminent workers in the more important arts, were, in different degrees, rewarded with free lands for their respective public services. On the death of any person so rewarded, the land in theory reverted to the clan; but if like services continued to be rendered by the son or other successor, and accepted by the clan, the land was not withdrawn. The successors of statesmen, for whom the largest provision was made, became a permanent nobility. Flaith (flah = noble chief) was a term applied to a man of this rank. Rank, with the accompanying privileges, jurisdiction and responsibility, was based upon a qualification of kinship and of property, held by a family for a specified number of generations, together with certain concurrent conditions; and it could be lost by loss of property, crime, cowardice or other disgraceful conduct. The flaiths in every tuath and all ranks of society were organized on the same hierarchical

pattern as royalty. A portion of land called the *Cumhal Senorba* was devoted to the support of widows, orphans and old childless people.

*Fine* (finna), originally meaning family, came in course of time to be applied to a group of kindred families or to a whole clan. From differences between incidental accounts written in different ages, it appears that the social system underwent some change. For the purpose of conveying some idea, one theory may be taken, according to which the *fine* was made up of seventeen clansmen, with their families, viz. the *Geilfine* consisting of the flaith-fine and four others in the same or nearest degree of kinship to the centre, and the *Deirbhfine, Tarfine* and *Innfine*, each consisting of four heads of families, forming widening concentric circles of kinship to which the rights and liabilities of the *fine* extended with certainty, but in diminishing degrees.

In course of time a large and increasing proportion of the good land became, under the titles so far described, limited private property. The area of arable land available for the common use of the clansmen was gradually diminished by these encroachments, but was still always substantial. A share of this was the birthright of every law-abiding member of the Feini who needed it. To satisfy this title and give a start in life to some young men who would otherwise have got none, this land was subject to *Gabhailcine* (= clan-resumption), meaning that the clan resumed the whole area at intervals of a few years for a fresh distribution after some occupants had died, and young men by attaining manhood had become entitled. Hence the Anglo-Irish word *gavelkind*. Anciently this re-distribution extended throughout the clan at the same time. Later it extended only to the land of a *fine*, each *fine* making its own distribution at its own time and in its own way as determined by the seventeen men above specified. In this distribution men might or might not receive again their former portions. In the latter case compensation was made for unexhausted improvements. This land could not be sold, nor even let except for a season in case of domestic necessity. The Feini who used it had no landlord and no rent to pay for this land, and could not be deprived of it except by the clan for a crime. They were subject only to public tributes and the ordinary obligations of free men. Presumably their homesteads were not on this land and were not subject to *Gabhailcine*. Neither were the unfenced and unappropriated common lands—waste, bog, forest and mountain—which all clansmen were free to use promiscuously at will.

There was hardly any selling and little letting of land in ancient times. Flaiths and other persons holding large areas let to clansmen, who then became *Ceiles*, not land, but the privilege of feeding upon land a number of cattle specified by agreement. Flaiths and Bo-aires also let cattle to a *ceile* who had none or not enough, and this was the most prevalent practice. There were two distinct methods of letting and hiring—*saer* (= free) and *daer* (= base), the conditions being fundamentally different. The conditions of *saer*-tenure were largely settled by the law, were comparatively easy, did not require any security to be given, left the *ceile* free within the limits of justice to end the connexion, left him competent in case of dispute to give evidence against that of the flaith, and did not impose any liability on the *fine* of the *ceile*. By continued user of the same land for some years and discharge of the public obligations in respect of it in addition to the *ciss* or payment as tenant, a *ceile* became a sub-owner or permanent tenant and could not be evicted. There is no provision in these laws for evicting any one. For the hire of cattle a usual payment was one beast in seven per annum for seven years; after which the cattle that remained became the property of the hirer. A *saer-ceile* on growing wealthy might become a *bo-aire*. *Daer-tenure*, whether of cattle or of the right to graze cattle upon land, was subject to a *ciss-ninsciss* (= wearisome tribute), for the payment of which security had to be given. A man not in the enjoyment of full civil rights, if able to find security, could become a *daer-ceile*. A free clansman by becoming a *daer-ceile* lowered his own status and that of his *fine*, became incompetent to give evidence against that of a flaith, and could not end the connexion until the end of the term except by a large payment. The members of his *fine* were liable, in the degree of their relationship, to make good out of their own property any default in the payments. Hence this tenure could not be legally entered into by a free clansman without the permission of his fine. *Daer-ceiles* were also exposed to casual burdens, like that of lodging and feeding soldiers when in their district. All payments were made in kind. When the particular kind was not specified by the law or by agreement, the payments were made according to convenience in horses, cattle, sheep, pigs, wool, butter, bacon, corn, vegetables, yarn, dye-plants, leather, cloth, articles of use or ornament, &c. As the clan system relaxed, and the fine lost its legal power of fixing the amounts of public tributes, which were similarly payable to the *flaith*, and neglected its duty of seeing that those tributes were duly applied, the *flaith* became able to increase these tributes with little check, to confuse them with rent, to confuse jurisdiction with ownership, and to exalt himself at the expense of his fellow-clansmen. A *flaith* by arranging that his tenants should make their payments at different periods of the year, secured a constant and copious supply without an inconvenient surplus.

People who did not belong to the clan and were not citizens were in a base condition and incompetent to appear in court in suit or defence except through a freeman. The *Bothach* (= cottier) and the *Sen-clèithe* (= old dependent) were people who, though living for successive generations attached to the families of flaiths, did not belong to the clan and had no rights of citizenship. *Fuidhirs*, or manual labourers without property, were the lowest section of the

population. Some were born in this condition, some clansmen were depressed into it by crime, consequences of war or other misfortune; and strangers of a low class coming into the territory found their level in it. The *fuidhirs* also were divided into *saer* and *daer*; the former being free by industry and thrift to acquire some property, after which five of them could club together to acquire rights corresponding to those of one freeman. The *daer-fuidhirs* were tramps, fugitives, captives, &c.

Fosterage, the custom of sending children to be reared and educated in the families of fellow-clansmen, was so prevalent, especially among the wealthy classes, and the laws governing it are so elaborate and occupied such a large space, that some mention of it here is inevitable. Beyond mention, there is little to be said, owing to the absence of general principles in an infinity of specific details, mostly domestic and apparently trivial. A child in fosterage was reared and educated suitably for the position it was destined to fill in life. There was fosterage for affection, for payment and for a literary education. Fosterage began when the child was a year old and ended when the marriageable age was reached, unless previously terminated by death or crime. Every fostered person was under an obligation to provide, if necessary, for the old age of foster-parents. The affection arising from this relationship was usually greater, and was regarded as more sacred than that of blood relationship.

The solidarity of clan and *fine* in their respective spheres, the provisions of the system, the simple rural life, and the prevalence of barter and payments in kind, left comparatively little occasion for contracts between individuals. Consequently the rules relating to contract are not very numerous. They are, however, sufficiently solemn. No contract affecting land was valid unless made with the consent of the *fine* and in the presence of the *Aire-Forgaill*. Contracts relating to other kinds of property are more numerous. When important or involving a considerable amount, they had to be made in the presence of a *flaith* or magistrate. The *Aire-Coisring* presided over most of the contracts of the common people. The parties to a contract should be free citizens, of full age, sound mind, free to contract or not, and under no legal disability. “The world would be in a state of confusion if express contracts were not binding.” From the repeated correlative dicta that “nothing is due without deserving,” and that a thing done “for God’s sake,” *i.e.* gratis, imposed little obligation, it is clear that the importance of valuable consideration was fully recognized. So also was the importance of time. “To be asleep avails no one”; “Sloth takes away a man’s welfare.” Contracts made by the following persons were invalid: (1) a servant without his master’s authority; (2) a monk without authority from his abbot or manager of temporalities; (3) a son subject to his father without the father’s authority; (4) an infant, lunatic, or “one who had not the full vigilance of reason”; (5) a wife in relation to her husband’s property without his authority. She was free to hold and deal with property of her own and bind it by contract. If a son living with his father entered into a contract with his father’s knowledge, the father was held to have ratified the contract unless he promptly repudiated it. “One is held to adopt what he does not repudiate after knowledge, having the power.” Contract of sale or barter with warranty could be dissolved for fraud, provided action was taken within a limited time after the fraud had become known. Treaties and occasional very important contracts were made “blood-covenants” and inviolable by drawing a drop of blood from the little finger of each of the contracting parties, blending this with water, and both drinking the mixture out of the same cup. The forms of legal evidence were pledges, documents, witnesses and oaths. In cases of special importance the pledges were human beings, “hostage sureties.” These were treated as in their own homes according to the rank to which they belonged, and were discharged on the performance of the contract. If the contract was broken, they became prisoners and might be fettered or made to work as slaves until the obligation was satisfied. Authentic documents were considered good evidence. A witness was in all cases important, and in some essential to the validity of a contract. His status affected the force of the contract as well as the value of his evidence; and the laws appear to imply that by becoming a witness, a man incurred liabilities as a surety. The pre-Christian oath might be by one or more of the elements, powers or phenomena of nature, as the sun, moon, water, night, day, sea, land. The Christian oath might be on a copy of the Gospels, a saint’s crozier, relic or other holy thing.

These laws recognized crime, but in the same calm and deliberate way in which they recognized contract and other things seriously affecting the people. Although we find in the poems of Dubhthach, written in the 5th century and prefixed to the *Senchus Mór*, the sentences, “Let every one die who kills a human being,” and “Every living person that inflicts death shall suffer death,” capital punishment did not prevail in Ireland before or after. The laws uniformly discountenanced revenge, retaliation, the punishment of one crime by another, and permitted capital punishment only in the last resort and in ultimate default of every other form of redress. They contain elaborate provision for dealing with crime, but the standpoint from which it is regarded and treated is essentially different from ours. The state, for all its elaborate structure, did not assume jurisdiction in relation to any crimes except political ones, such as treason or the disturbance of a large assembly. For these it inflicted the severest penalties known to the law—banishment, confiscation of property, death or putting out of eyes. A crime against the person, character or property of an individual or family was regarded as a thing for which reparation

should be made, but the individual or family had to seek the reparation by a personal action. This differed from a civil action only in the terms employed and the elements used in calculating the amount of the reparation. The function of a judge in a criminal as in a civil action was to see that the facts, with modifying circumstances, were fully and truly submitted to him, and then by applying the law to these facts to ascertain and declare the amount of compensation that would make a legal adjustment. For this amount the guilty person, and in his default his kindred, became legally debtor, and the injured person or family became entitled to recover the amount like a civil debt by distraint, if not paid voluntarily. There were no police, sheriffs or public prisons. The decisions of the law were executed by the persons concerned, supported by a highly organized and disciplined public opinion springing from honour and interest and inherent in the solidarity of the clan. There is good reason to believe that the system was as effectual in the prevention and punishment of crime and in the redress of wrongs as any other human contrivance has ever been.

In calculating the amount of compensation the most characteristic and important element was *Einechlan* (= honour-price, honour-value), a value attaching to every free person, varying in amount from one cow to thirty cows according to rank. It was the assessed value of *status* or *caput*. It was frequently of consequence in relation to contracts and other clan affairs; but it emerges most clearly in connexion with crime. By the commission of crime, breach of contract, or other disgraceful or injurious conduct, Einechlan was diminished or destroyed, a *capitis diminutio* occurred, apart from any other punishment. Though existing apart from fine, Einechlan was the first element in almost every fine. *Dire* was the commonest word for fine, whether great or small. *Eric* (= reparation, redemption) was the fine for “separating body from soul”; but the term was used in lighter cases also. In capital cases the word sometimes meant Einechlan, sometimes *coirp-dire* (= body-fine), but most correctly the sum of these two. It may be taken that, subject to modifying circumstances, a person guilty of homicide had to pay (i) *coirp-dire* for the destruction of life, irrespective of rank; (2) the honour-value of the victim; (3) his own honour-value if the deed was unintentional; and (4) double his own honour-value if committed with malice aforethought. The sum of these was in all cases heavy; heaviest when the parties were wealthy. The amount was recoverable as a debt from the criminal to the extent of his property, and in his default from the members of his *fine* in sums determined by the degree of relationship; and it was distributable among the members of the *fine* of a murdered person in the same proportions, like a distribution among the next of kin. The *fine* of a murderer could free themselves from liability by giving up the murderer and his goods, or if he escaped, by giving up any goods he had left, depriving him of clanship, and lodging a pledge against his future misdeeds. In these circumstances the law held the criminal’s life forfeit, and he might be slain or taken as a prisoner or slave. He could escape only by becoming a *daer-fuidhir* in some distant territory. When the effect of a crime did not go beyond an individual, if that individual’s *fine* did not make good their claim while the criminal lived, it lapsed on his death. “The crime dies with the criminal.” If an unknown stranger or person without property caught red-handed in the commission of a crime refused to submit to arrest, it was lawful to maim or slay him according to the magnitude of the attempted crime. “A person who came to inflict a wound on the body may be safely killed when unknown and without a name, and when there is no power to arrest him at the time of committing the trespass.” For crimes against property the usual penalty, as in breach of contract, was generic restitution, the quantity, subject to modifying circumstances, being twice the amount taken or destroyed.



Distress of seizure of property being the universal mode of obtaining satisfaction, whether for crime, breach of contract, non-payment of debt, or any other cause, the law of distress came into operation as the solvent of almost every dispute. Hence it is the most extensive and important branch, if not more than a branch, of these ancient laws. Of several words meaning distress, *athgabail* was the most frequently used. A person having a liquidated claim might either sue a debtor or proceed at his peril to seize without this preliminary. In the latter case the defendant could stop the progress of the seizure by paying the debt, giving a pledge, or demanding a trial; and he then could choose a Brehon. Distress was of two kinds—(1) *athgabal ar fut* (= distress on length, *i.e.* with time, with delays); and (2) *athgabail tulla* (= immediate distress). Which method was pursued depended partly upon the facts of the case and partly upon the respective ranks of the parties. A person entitled to seize property had to do it himself, accompanied, if the amount was large, by a law agent and witnesses. No man was entitled to seize unless he owned, or had a surety who owned, sufficient property for indemnity or adjustment in case the seizure should be found to have been wrongful. The formalities varied in different circumstances and also at different times in the long ages in which these laws prevailed. Some forms may, in the Irish as in other legal systems, have become merely ceremonial and fictitious.

*Tellach* (= seizure of immovable property) was made in three periods or delays of ten days each (= 30 days). The first step was a notice that unless the debt was paid immediately seizure would be made. Ten days later, the plaintiff crossed the fence in upon the land, with a law agent, a witness and a pair of horses yoked or harnessed, and in a loud voice stated the amount of the debt and called upon the defendant to pay it according to law. On receiving no answer, or an

unsatisfactory one, he withdrew. After an interval of ten days more, the creditor entered with his law agent, two witnesses and four horses, went farther in upon the land, repeated his demand, and if refused withdrew. Finally, after a further interval of ten days, he entered once more with his law agent, three witnesses and eight horses, drove up to the debtor's house, repeated his demand, and if not satisfied drove a herd of cattle or a flock of sheep in upon the farm and left men to care for them.

*Athgabail* ordinarily meant the seizure of movable property. The following technical terms will indicate the procedure in distress with time:—*Aurfocre* (= demand of payment, stating the amount in presence of witnesses); *apad* (= delay); *athgabail* (= the actual seizure); *anad* (= delay after seizure, the thing remaining in the debtor's possession); *toxal* (= the taking away of the thing seized); *fasc* (= notice to the debtor of the amount due, the *mainder* or pound in which the thing seized is impounded, and the name of the law agent); *dithim* (= delay during which the thing is in pound); *lobad* (= destruction or forfeiture of the debtor's ownership and substitution of the creditor's ownership). There was no sale, because sale for money was little known. The property in the thing seized, to the amount of the debt and expenses, became legally transferred from the debtor to the creditor, not all at once but in stages fixed by law. A creditor was not at liberty to seize household goods, farming utensils, or any goods the loss of which would prevent the debtor recovering from embarrassment, so long as there was other property which could be seized. A seizure could be made only between sunrise and sunset. "If a man who is sued evades justice, knowing the debt to be due of him, double the debt is payable by him and a fine of five seds." When a large debt was clearly due, and there was no property to seize, the debtor himself could be seized and compelled to work as a prisoner or slave until the debt was paid.

When a defendant was of rank superior to that of the plaintiff, distress had to be preceded by *troscad* (= fasting). This is a legal process unknown elsewhere except in parts of India. The plaintiff having made his demand and waited a certain time without result, went and sat without food before the door of the defendant. To refuse to submit to fasting was considered indelibly disgraceful, and was one of the things which legally degraded a man by reducing or destroying his honour-value. The law said "he who does not give a pledge to fasting is an evader of all; he who disregards all things shall not be paid by God or man." If a plaintiff having duly fasted did not receive within a certain time the satisfaction of his claim, he was entitled to distrain as in the case of an ordinary defendant, and to seize double the amount that would have satisfied him in the first instance. If a person fasting in accordance with law died during or in consequence of the fast, the person fasted upon was held guilty of murder. Fasting could be stopped by paying the debt, giving a pledge, or submitting to the decision of a Brehon. A creditor fasting after a reasonable offer of settlement had been made to him forfeited his claim. "He who fasts notwithstanding the offer of what should be accorded to him, forfeits his legal right according to the decision of the Feini."

AUTHORITIES.—Since Sir Samuel Ferguson wrote his article on "Brehon Laws" in the 9th edition of this *Encyclopaedia*, much research has been done on the subject, and Ferguson's account is no longer accepted by scholars, either as regards the language or the substance of the laws. Pending the work of a second Brehon Law Commission, the Laws are best studied in the six imperfect volumes (*Ancient Laws of Ireland*, 1865-1901) produced by the first Commission (ignoring their long and worthless introductions), together with, Dr. Whitley Stokes's *Criticism* (London, Nutt, 1903) of Atkinson's *Glossary* (Dublin, 1901). The following are important references (kindly supplied by Dr Whitley Stokes) for detailed research:— R. Dareste, *Études d'histoire de droit*, pp. 356-381 (Paris, 1889); Arbois de Jubainville and Paul Collinet, *Études sur le droit celtique* (2 vols., Paris, 1895); Joyce, *Social History of Ancient Ireland*, vol. i. pp. 168-214 (2 vols., London, 1903); *Zeitschrift für celtische Philologie*, iv. 221, the Copenhagen fragments of the Laws (Halle, 1903); important letters in *The Academy*, Nos. 699, 700, 701, 702, 703, 704, 706, 707 (substantially covered by Stokes's *Criticism*); *Revue Celtique*, xxv. 344; *Erin*, i. 209-315 (collation by Kuno Meyer of the Law-tract Crith Gablach); Maine's *Early Hist, of Institutions* (1875) and *Early Law and Custom*, pp. 162, 180 (1883); Hearn's *Aryan Household* (1879), and Maclennan's *Studies in Ancient History*, pp. 453-507 (1876), contain interesting general reference, but the writers were not themselves original students of the laws. L. Ginnell's *Brehon Laws* (1894) may also be consulted. See further the article CELT, sections *Language* and *Literature*.

(L. G.)

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**BREISACH,** or ALTBREISACH, a town of Germany, in the grand duchy of Baden, on the left bank of the Rhine, standing on a basalt rock 250 ft. above the river, 10 m. W. of Freiburg-im-Breisgau, and on the railway connecting that city with Colmar. Pop. (1900) 3537. It has a fine minster, partly Romanesque, partly Gothic, dating from the 10th to the 15th centuries; of its two principal towers one is 13th century Gothic, the other Romanesque. The interior is remarkable for its rich

decorations, especially the wood-carving of the high altar, and for many interesting tombs and pictures. There is little industry, but a considerable trade is done in wines and other agricultural produce. On the opposite bank of the Rhine, here crossed by a railway bridge, lies the little town of Neubreisach and the fort Mortier.

Breisach (*Brisiacum*), formerly an imperial city and until the middle of the 18th century one of the chief fortresses of the Empire, is of great antiquity. A stronghold of the *Sequani* (a Gallic tribe, which occupied the country of the Doubs and Burgundy), it was captured in the time of Julius Caesar by Ariovistus and became known as the *Mons Brisiacus*. Fortified by the emperor Valentian in 369 to defend the Rhine against the Germans, it retained its position throughout the middle ages as one of the chief bulwarks of Germany and was called the “cushion and key (*Kissen und Schlussel*) of the German empire.” Its importance was such that it gave its name to the district Breisgau, in which it is situated. In 939 it was taken by the emperor Otto I., and after remaining in the exclusive possession of the emperors for two centuries, was strengthened and shared for a while between them and the bishops of Basel. In 1254 and 1262 the bishops obtained full control over it; but in 1275 it was made an imperial city by King Rudolph I., and at the beginning of the 14th century his son brought it definitively into the possession of the Habsburg monarchs, leaving the bishops but few privileges. In the Thirty Years’ War Breisach successfully resisted the Swedes, but after a memorable siege and a defence by General von Reisach, one of the most famous in military annals, it was forced to capitulate to Duke Bernhard of Saxe-Weimar on the 18th of December 1638. The endeavours of the emperor Ferdinand III. to retake it were fruitless, and by the peace of Westphalia (1648) Breisach was annexed to France. By the peace of Ryswick (1697) it was restored to Austria, when Louis XIV. built the town and fortress of Neubreisach on the left bank of the Rhine. Again in 1703 it fell into the hands of the French, owing to treachery, but was ceded to Austria by the peace of Rastatt (1714)—Yet again, in the War of the Austrian Succession, it was captured (1744) by the French, who dismantled the fortifications. They refortified it in 1796, and after passing, by the peace of Lunéville (1801), together with the Breisgau to the duke of Modena, Breisach was by the peace of Pressburg (1805) finally incorporated with Baden, when the fortifications were razed. During the Franco-German War (1870) Breisach suffered severely from bombardment directed against it from Neubreisach.

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**BREISGAU,** a district of Germany, in the grand duchy of Baden. It extends along the right bank of the Rhine from Basel to Kehl, and includes the principal peaks of the southern Black Forest and the Freiburg valley. The Breisgau, originally a *pagus* or *gau* of the Frankish empire, was ruled during the middle ages by hereditary counts. Of these the earliest recorded is Birtilo (962-995), ancestor of the counts and dukes of Zähringen. On the death of Berchthold V. of Zähringen in 1218, his coheiresses brought parts of the Breisgau to the counts of Urach and Kyburg, while part went to the margraves of Baden. At the close of the 13th century the Kyburg part of the Breisgau passed to the Habsburgs, who in 1368 acquired also the town and countship of Freiburg, which had been sold by the counts of Urach to the Freiburgers and given in pledge by them to the house of Austria in exchange for a loan of the purchase price, which they were unable to repay. The male Urach line becoming extinct in 1457, an heiress carried what remained of their possessions in the Breisgau to the house of Baden. In the struggle between France and Austria from the 17th century onwards the Breisgau frequently changed masters. In 1801 Austria was forced to cede it to Ercole III., duke of Modena, in compensation for the duchy of which Napoleon had deprived him. His successor Ferdinand took the title of duke of Modena-Breisgau, but on his death in 1805 the Breisgau was divided between Baden and Württemberg. The latter ceded its portion to Baden in 1810.

See Stokvis, *Manuel d’histoire, &c.* (Leiden, 1890-1893).

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**BREISLAK, SCIPIONE** (1748-1826), Italian geologist of German parentage, was born at Rome in 1748. He early distinguished himself as professor of mathematical and mechanical philosophy in the college of Ragusa; but after residing there for several years he returned to his native city, where he became a professor in the Collegio Nazareno, and began to form the fine mineralogical cabinet in that institution. His leisure was dedicated to geological researches in the papal states. His account of the aluminous district of Tolfa and adjacent hills, published in 1786, gained for him the notice of the king of Naples, who invited him to inspect the mines and similar works in

that kingdom, and appointed him professor of mineralogy to the royal artillery. The vast works for the refining of sulphur in the volcanic district of Solfatara were erected under his direction. He afterwards made many journeys through the ancient Campania to illustrate its geology, and published in 1798 his *Topografia fisica della Campania*, which contains the results of much accurate observation. Breislak also published an essay on the physical condition of the seven hills of Rome, which he regarded as the remains of a local volcano,—an opinion shown to be erroneous by the later researches of G.B. Brocchi. The political convulsions of Italy in 1799 brought Breislak to Paris, where he remained until 1802, when, being appointed inspector of the saltpetre and powder manufactories near Milan, he removed to that city. The mineral Breislakite was named after him. He died on the 15th of February 1826. His other publications include:—*Introduzione alla geologia* (1811, French ed. 1819); *Traité sur la structure extérieure du globe*, 3 vols. and atlas (Milan, 1818, 1822); *Descrizione geologica della provincia di Milano* (1822).

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**BREITENFELD,** a village of Germany in the kingdom of Saxony, 5½ m. N.N.W. of Leipzig, noted in military history. The first battle of Breitenfeld was fought on the 17th of September 1631, between the allied Swedish and Saxon armies under Gustavus Adolphus and the imperial forces under Count Tilly. The battlefield is a low ridge running east and west between the villages of Göbschelwitz and Breitenfeld, the position of the Imperialists lying along the crest from Göbschelwitz on the right to a point about 1 m. short of Breitenfeld on the left; opposite this position, and behind a group of villages on the Loberbach stream, lay the Swedish forces, flanked on their left by the Saxon contingent under the elector, who was assisted by Arnim. The villages formed the only obstacle on the gentle slope lying between the Loberbach and Tilly's line; through these villages the Swedes defiled slowly, and formed up on the open ground beyond them. Tilly's army was drawn up in a continuous line, the infantry ranged in heavy battalions in the centre, the cavalry on the wings, and the heavy artillery in a mass in front of the infantry. Gustavus arrayed the Swedes in two lines and a reserve, infantry in the centre, cavalry on the flanks, and the Saxons were drawn up in a similar formation on the left of the Swedish left-wing cavalry. So far as can be gauged the respective numbers were at least 32,000 Imperialists, 22,000 Swedes and 15,000 Saxons. The Swedish infantry was drawn up on an entirely novel system; each brigade of infantry, composed of several battalions, was formed in many small and handy corps of pikemen and musketeers, and parties of musketeers were also detached to support the cavalry. The guns were scattered along the front. The Saxons were ranged, like Tilly's army, in heavy masses of foot and horse preceded by a great battery of guns. At 2 P.M. Pappenheim, commanding Tilly's left wing, led forward the whole of his cavalry in a furious charge. Feeling the fire of the musketeers who were intercalated amongst the Swedish horse, Pappenheim swung round to his left and charged the Swedish right wing in flank. The Swedes of both lines promptly wheeled up, and after a prolonged conflict the Imperial horse were driven completely off the field. The attack of Tilly's right wing under Fürstenberg directed against the Saxons was more successful. The Saxons were at once broken and routed, only a handful under Arnim maintaining the ground. Fürstenberg pursued the fugitives for many miles, and Tilly with the centre of infantry (which, considering the depth of its formations, must have possessed great manoeuvring power) rapidly followed him and formed up opposite the now exposed left of the Swedes. Thereupon the Swedes, in their light and handy formation, changed position rapidly and easily to meet him. Tilly's attack was strenuously opposed, and at this moment the decisive stroke of the battle was delivered by the Swedish right wing, which, having disposed of Pappenheim, swung round and occupied the ground originally held by the Imperial infantry, seized Tilly's guns, and with them enfiladed the enemy's new line. This put an end to the attack of the Imperial foot, and before sunset Tilly was in full retreat, hotly pursued and losing heavily in prisoners. His losses on the field have been estimated at 7000 killed and wounded and almost as many prisoners; the Swedes lost about 2000 and the Saxons over 4000 men.



The village of Breitenfeld also gives its name to another great battle in the Thirty Years' War (November 2, 1642), in which the Swedes under Torstensson defeated the Imperialists under the archduke Leopold and Prince Piccolomini, who were seeking to relieve Leipzig. The Swedish cavalry decided the day on this occasion also.

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**BREMEN,** a free state in the German empire, bearing the title *Freie Hansestadt Bremen*. It falls into three distinct parts: (1) the largest portion, with the city of Bremen, lying on both banks,

but chiefly on the right, of the lower course of the Weser, surrounded by the Prussian province of Hanover and the grand-duchy of Oldenburg, and consisting in the main of lowland country intersected by canals and dykes; (2) the town and district of Vegesack, lying separate from, but immediately north of the main portion, on the right bank of the river; (3) the port of Bremerhaven, 46 m. down the Weser, at its mouth. Of the whole territory, which has an area of 99 sq. m., about one-half is meadow and grazing land, one-quarter under tillage, and the remainder occupied by a little woodland, some unprofitable sandy wastes, the bed of the Weser and the towns. Market gardening, the rearing of cattle, for which the district is widely famed, and fishing, form the chief occupations of the rural population. The climate is mild, but the rainfall (26.9 in. annually on the average) is relatively considerable. The population is shown as follows:—

| | 1900 | 1905 |
|---|---|---|
| Bremen, city | 186,822 | 214,953 |
| Vegesack | 3,943 | 4,130 |
| Bremerhaven | 20,315 | 24,159 |
| Rural districts | 37,327 | 20,431 |
| Total | 248,407 | 263,673 |

Of the inhabitants, who belong to the Lower Saxon (*Nieder-Sachsen*) race and in daily intercourse mostly speak the Low German (*Plattdeutsch*) dialect, about two-thirds are natives of the state and one-third immigrants from other parts of Germany, chiefly from Hanover and Oldenburg. About 93% are Protestants, 6% Roman Catholics, and only ½% Jews. The form of government is that of a republic, under a constitution proclaimed on the 8th of March 1849, revised on the 21st of February 1854, the 17th of November 1875, and the 1st of January 1894. The sovereignty resides jointly in the senate and the Bürgerschaft, or Convent of Burgesses. The senate, which is the executive power, is composed of sixteen life members, elected by the convent, on presentation by the senate. Of these ten at least must be lawyers and three merchants. Two of the number are nominated by their colleagues as burgomasters, who preside in succession for a year at a time and hold office four years, one retiring every two years. The Bürgerschaft consists of 150 (formerly 300) representatives, chosen by the citizens for six years, and forms the legislative body. Fourteen members are elected by such citizens of Bremen (city) as have enjoyed a university education, forty by the merchants, twenty by the manufacturers and artisans, and forty-eight by the other citizens. Of the remaining representatives, twelve are furnished by Bremerhaven and Vegesack and sixteen by the rural districts. As a member of the German empire, the state of Bremen has one voice in the Bundesrat and returns one member to the Imperial diet (Reichstag). Formerly Bremen was a free port, but from the 1st of October 1888 the whole of the state, with the exception of two small free districts in Bremen and Bremerhaven respectively, joined the German customs union. The state has two Amtsgerichte (courts of first instance) at Bremen and Bremerhaven respectively, and a superior court, Landgericht, at Bremen, whence appeals lie to the Oberlandesgericht for the Hanseatic towns in Hamburg. The judges of the Bremen courts are appointed by a committee of members of the senate, the Bürgerschaft and the bench of judges. By the convention with Prussia of the 27th of June 1867, the free state surrendered its right to furnish its own contingent to the army, the recruits being after that time drafted into the Hanseatic infantry regiment, forming a portion of the Prussian IX. army corps.

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**BREMEN,** a city of Germany, capital of the free state of Bremen, and one of the Hanseatic towns. It lies on a sandy plain on both banks of the Weser, 46 m. from the North Sea and 71 m. S.W. from Hamburg by rail, on the mainline to Cologne. Pop. (1905) 214,953. It has also direct railway communication with Berlin via Uelzen, Hanover and Bremerhaven. The city consists of four quarters,—the old town (Altstadt) and its suburban extensions (Vorstadt) being on the right bank of the river, and the new town (Neustadt) with its southern suburb (Südervorstadt) on the left bank. The river is crossed by three bridges, the old, the new (1872-1875) Kaiserbrücke, and the railway bridge, with a gangway for foot passengers. The ramparts of the old town have long been converted into beautiful promenades and gardens, the moats forming a chain of lakes.

The romantic old town, with its winding streets and lanes, flanked by massive gabled houses, dates from the medieval days of Hanseatic prosperity. On the market square stands the fine town hall (Rathaus), dating from the 15th century, with a handsome Renaissance *façade* of a somewhat later date, and before it a stone statue of Roland, the emblem of civic power. Its celebrated underground wine cellar has been immortalized by Wilhelm Hauff in his *Phantasien im Bremer Ratskeller*. The town hall is internally richly embellished and has a gallery of interesting

paintings. In an upper hall a model of an old Hanseatic frigate, with the device *Navigare necesse est, vivere non est necesse*, hangs from the ceiling. Among other ancient buildings, situated chiefly in the old town, are the following:—the cathedral of St Peter (formerly the archiepiscopal and now the Lutheran parish church), erected in the 12th century on the site of Charlemagne's wooden church, and famous for its Bleikeller, or lead vault, in which bodies can be preserved for a long time without suffering decomposition; the church of St Ansgarius, built about 1243, with a spire 400 ft. high; the church of Our Lady, dating from the 12th and 13th centuries; the 12th century Romanesque church of St Stephen; the Schütting, or merchants' hall, originally built in 1619 for the cloth-traders' gild; the Stadthaus (town house), formerly the archiepiscopal palace, and converted to its present uses only in 1819. The most important and imposing among the more modern architectural additions to the city are the handsome Gothic exchange, completed in 1867, the municipal theatre, the municipal library, the post office (1878), the law courts (1891-1895), the wool exchange, the German bank, the municipal museum for natural science, ethnology and commerce, and the fine railway station (1888). The principal memorials embrace, besides the Roland, the Willehad fountain (1883), the monument of the Franco-German War (erected 1875), the centaur fountain (1891), an equestrian statue of the emperor William I. (1893), and a statue of the poet Theodor Körner. A beautiful park, Bürgerpark, has been laid out in the Bürgerweide, or meadows, lying beyond the railway station to the north-east of the city. It is a peculiarity of the domestic accommodation of Bremen that the majority of the houses, unlike the custom in most other German towns, where flats prevail, are occupied by a single family only.

The industries and manufactures of Bremen are of considerable variety and extent, but are more particularly developed in such branches as are closely allied to navigation, such as shipbuilding, founding, engine-building and rope-making. Next in importance come those of tobacco, snuff, cigars, the making of cigar boxes, jute-spinning, distilling, sugar refining and the shelling of rice. Bremen owes its fame almost exclusively to its transmaritime trade, mainly imports. By the completion of the engineering works on the Weser in 1887-1899, whereby, among other improvements, the river was straightened and deepened, to 18 ft., large ocean-going vessels are able to steam right up to the city itself. It has excellent railway connexions with the chief industrial districts of Germany. Like Hamburg, it does predominantly a transit trade; it is especially important as the importer of raw products from America. In two articles, tobacco and rice, Bremen is the greatest market in the world; in cotton and indigo it takes the first place on the continent, and it is a serious rival of Hamburg and Antwerp in the import of wool and petroleum. The value of the total imports (both sea-borne and by river and rail) increased from £22,721,700 in 1883 to about £60,000,000 in 1905; the imports from the United States, from £9,755,000 in 1883 to about £25,000,000 in 1905. The countries from which imports principally come are the United States, England, Germany, Russia, the republics of South America, the Far East and Australia. The exports rose from a total of £26,096,500 in 1883 to £62,000,000 in 1905. The number of vessels which entered the ports of the free state (*i.e.* Bremen city, Bremerhaven and Vegesack) increased from 2869 of 1,258,529 aggregate tonnage in 1883, to 4024 of 2,716,633 tons in 1900. Bremen is the centre for some of the more important of the German shipping companies, especially of the North German Lloyd (founded in 1856), which, on the 1st of January 1905, possessed a fleet of 382 steamers of 693,892 tons, besides lighters and similar craft. Bremen also shares with Hamburg the position of being one of the two chief emigration ports of Germany. There are three docks, all to the north-west of the city—namely, the free harbour (which was opened in 1888), the winter harbour, and the timber and industrial harbour. Internal communication is served by an excellent system of electric tramways, and there is also a local steamboat service with neighbouring villages on the Weser.



*History.*—According to Brandes, quoting Martin Luther in the *Lexicon Philologicum*, the name is derived from *Bram, Bräm, i.e. hem* = the river-bank, or confine of the land on which it was built. In 787 Bremen was chosen by St Willehad, whom Charlemagne had established as bishop in the *pagi* of the lower Weser, as his see. In 848 the destruction of Hamburg by the Normans led to the transference of the archiepiscopal see of Hamburg to Bremen, which became the seat of the archbishops of Hamburg-Bremen. In 965 the emperor Otto I. granted to Archbishop Adaldag "in the place called Bremen" (*in loco Bremun nuncupato*) the right to establish a market, and the full administrative, fiscal and judicial powers of a count, no one but the bishop or his *advocatus* being allowed to exercise authority in the city. This privilege, by which the archbishop was lord of the city and his *Vogt* its judge, was frequently confirmed by subsequent emperors, ending under Frederick I. in 1158. Though, however, there is no direct evidence of the existence of any communal organization during this period, it is clear from the vigorous part taken by the burghers in the struggle of the emperor Frederick with Henry the Lion of Saxony that some such organization very early existed. Yet in the *privilegium* granted to the townspeople by Frederick I. in 1186 the emperor had done no more than guarantee them their personal liberties. The earliest recognition of any civic organization they may have possessed they owed to Archbishop Hartwig II. (1184-1207), who had succeeded in uniting against him his chapter, the nobles and the citizens; and the first mention of the city council occurs in a charter of Archbishop Gerhard II. in 1225, though the *consules* here named doubtless represented a considerably older institution. In the 13th century, however, whatever the civic organization of the townsfolk may have been, it

was still strictly subordinate to the archbishop and his *Vogt*; the council could issue regulations only with the consent of the former, while in the judicial work of the latter, save in small questions of commercial dishonesty, its sole function was advisory. By the middle of the 14th century this situation was exactly reversed; the elected town council was the supreme legislative power in all criminal and civil causes, and in the court of the *advocatus* two *Ratsmänner* sat as assessors. The victory had been won over the archbishop; but a fresh peril had developed in the course of the 13th century in the growth of a patrician class, which, as in so many other cities, threatened to absorb all power into the hands of a close oligarchy. In 1304 the commonalty rose against the patricians and drove them from the city, and in the following year gained a victory over the exiles and their allies, the knights, which was long celebrated by an annual service of thanksgiving. This was the beginning of troubles that lasted intermittently throughout the century. Bremen had been admitted to the Hanseatic league in 1283, but was excluded in 1285, and not readmitted until 1358. Owing to the continued civic unrest it was again excluded in 1427, and only readmitted in 1433 when the old aristocratic constitution was definitively restored. But though in Bremen the efforts of the craftsmen's "arts" to secure a share of power had been held in check and the gilds never gained any importance, the city government did not, as at Cologne and elsewhere, develop into a close patrician oligarchy. Power was in the hands of the wealthy, but the avenues to power were open to those who knew how to acquire the necessary qualification. There was thus no artificial restraint put upon individual enterprise, and the question of the government having been settled, Bremen rapidly developed in wealth and influence.

The Reformation was introduced into Bremen in 1522 by Heinrich von Zütphen. Archbishop Christopher of Brunswick-Wolfenbüttel (1487-1558), a brutal libertine, hated for his lusts and avarice, looked on the reforming movement as a revolt against himself. He succeeded in getting the reformer burned; but found himself involved in a life and death struggle with the city. In 1532 Bremen joined the league of Schmalkalden, and twice endured a siege by the imperial forces. In 1547 it was only saved by Mansfeld's victory at Drakenburg. Archbishop Christopher was succeeded in 1558 by his brother Georg, bishop of Minden (d. 1566), who, though he himself was instrumental in introducing the reformed model into his other diocese of Verden, is reckoned as the last Roman Catholic archbishop of Bremen. His successor, Henry III. (1550-1585), a son of Duke Francis I. of Lauenburg, who had been bishop of Osnabrück and Paderborn, was a Lutheran and married. Protestantism was not, however, definitively proclaimed as the state religion in Bremen until 1618. The last archbishop, Frederick II. (of Denmark), was deposed by the Swedes in 1644. In 1646 Bremen received the privileges of a free imperial city from the emperor Ferdinand III.; but Sweden, whose possession of the archbishopric was recognized two years later, refused to consent to this, and in 1666 attempted vainly to assert her claims over the city by arms—in the so-called Bremen War. When, however, in 1720 the elector of Hanover (George I. of Great Britain) acquired the archbishopric, he recognized Bremen as a free city. In 1803 this was again recognized and the territory of the city was even extended. In 1806 it was taken by the French, was subsequently annexed by Napoleon to his empire, and from 1810 to 1813 was the capital of the department of the Mouths of the Weser. Restored to independence by the congress of Vienna in 1815, it subsequently became a member of the German Confederation, and in 1867 joined the new North German Confederation, with which it was merged in the new German empire.

See Buchenau, *Die freie Hansestadt Bremen* (3rd ed., Bremen, 1900, 5 vols.); *Bremisches Urkundenbuch*, edited by R. Ehmck and W. von Bippen (1863, fol.); W. von Bippen, *Geschichte der Stadt Bremen* (Bremen, 1892-1898); F. Donandt, *Versuch einer Geschichte des bremischen Stadtrechts* (Bremen, 1830, 2 vols.); *Bremisches Jahrbuch* (historical, 19 vols., 1864-1900); and Karl Hegel, *Städte und Gilden*, vol. ii. p. 461 (Leipzig, 1891).

**BREMER, FREDRIKA** (1801-1865), Swedish novelist, was born near Åbo, in Finland, on the 17th of August 1801. Her father, a descendant of an old German family, a wealthy iron master and merchant, left Finland when Fredrika was three years old, and after a year's residence in Stockholm, purchased an estate at Årsta, about 20 m. from the capital. There, with occasional visits to Stockholm and to a neighbouring estate, which belonged for a time to her father, Fredrika passed her time till 1820. The education to which she and her sisters were subjected was unusually strict; Fredrika's health began to give way; and in 1821 the family set out for the south of France. They travelled slowly by way of Germany and Switzerland, and returned by Paris and the Netherlands. It was shortly after this time that Miss Bremer became acquainted with Schiller's works, which made a very deep impression on her. She had begun to write verses from the age of eight, and in 1828 she succeeded in finding a publisher for the first volume of her *Teckningar ur hvardagslifvet* (1828), which at once attracted attention. The second volume

(1831), containing one of her best tales, *Familjen H.*, gave decisive evidence that a real novelist had been found in Sweden. The Swedish Academy awarded her their smaller gold medal, and she increased her reputation by *Presidentens döttrar* (1834), *Grannarne* (1837) and others. Her father had died in 1830, and her life was thereafter regulated in accordance with her own wishes and tastes. She lived for some years in Norway with a friend, after whose death she travelled in the autumn of 1849 to America, and after spending nearly two years there returned through England. The admirable translations (1846, &c.) of her works by Mary Howitt, which had been received with even greater eagerness in America and England than in Sweden, secured for her a warm and kindly reception. Her impressions of America, *Hemmen i nya verlden*, were published in 1853-1854, and at once translated into English. After her return Miss Bremer devoted herself to her scheme for the advancement and emancipation of women. Her views on these questions were expounded in her later novels—*Hertha* (1856) and *Far och dotter* (1858). Miss Bremer organized a society of ladies in Stockholm for the purpose of visiting the prisons, and during the cholera started a society, the object of which was the care of children left orphans by the epidemic. She devoted herself to other philanthropic and social schemes, and gradually abandoned her earlier simple and charming type of story for novels directed to the furtherance of her views. In these she was less successful. In 1856 she again travelled, and spent five years on the continent and in Palestine. Her reminiscences of these countries have all been translated into English. On her return she settled at Årsta, where, with the exception of a visit to Germany, she spent the remaining years of her life. She died on the 31st of December 1865.

See *Life, Letters and Posthumous Works of F. Bremer*, by her sister, Charlotte Bremer, translated by F. Milow, London, 1868. A selection of her works in 6 vols. appeared at Örebro, 1868-1872.

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**BREMERHAVEN,** a seaport town of Germany, in the free state of Bremen, on the right bank and estuary of the Weser, at the confluence of the Geeste, 38 m. N. of the city of Bremen by rail. Pop. (1895) 18,366; (1905) 24,159. It is built on a tract of territory ceded to Bremen by Hanover in 1826, and further increased by treaty with Prussia in 1869. It forms practically a single town with Geestemünde (Prussia), which lies across the Geeste and with which it is connected by a drawbridge. The port was opened in 1830, and besides an excellent harbour, there are three large wet docks, including the Kaiserhafen, enlarged in 1897-1899 at a cost of £900,000. This, together with the north portion of the Neuerhafen, constitutes the free harbour. Here are the workshops and dry docks of the North German Lloyd steamship company. The whole internal harbour system is furnished with powerful hydraulic cranes and lines of railway running alongside the quays. The entrance to the port is free from ice nearly all the year round, is excellently buoyed, and lighted by two lightships and eight lighthouses, among the latter the remarkable Rothesand Leuchtturm, erected 1884-1885. The Hanoverian fort and batteries, which formerly protected the town, have been removed, and their place is supplied by four modern forts, with revolving turtleback turrets, lower down. The town possesses two Protestant and a Roman Catholic church, a technical institute, a natural history museum, a library, a theatre, a monument to the emperor William I. and one to Johann Smidt (1773-1859), the burgomaster of Bremen to whose enterprise the harbour of Bremerhaven is due. Shipbuilding and kindred industries are carried on.

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**BRENDAN,** Brandon, or Brandan (*c.* 484-578), Irish saint and hero of a legendary voyage in the Atlantic, is said to have been born at Tralee in Kerry in A.D. 484. The Irish form of his name is *Brennain*, the Latin *Brendanus*. Medieval historians usually call him Brendan of Clonfert, or Brendan son of Finnloga, to distinguish him from his contemporary, St Brendan of Birr (573). Little is known of the historical Brendan, who died in 578 as abbot of a Benedictine monastery which he had founded twenty years previously at Clonfert in eastern Galway. The story of his voyage across the Atlantic to the “Promised Land of the Saints,” afterwards designated “St Brendan’s Island,” ranks among the most celebrated of the medieval sagas of western Europe. Its traditional date is 565-573. The legend is found, in prose or verse and with many variations, in Latin, French, English, Saxon, Flemish, Irish, Welsh, Breton and Scottish Gaelic. Although it does not occur in the writings of any Arabian geographer, several of its incidents—such as the landing on a whale in mistake for an island—belong also to Arabic folk-literature. Many of Brendan’s fabulous adventures seem to be borrowed from the half-pagan Irish saga of Maelduin or

Maeldune, and others belong also to Scandinavian mythology. The oldest extant version of the legend is the 11th century *Navigatio Brendani.*

St Brendan's island was long accepted as a reality by geographers. In a Venetian map dated 1367, in the anonymous Weimar map of 1424, and in B. Beccario's map of 1435, it is identified with Madeira. Columbus, in his journal for the 9th of August 1492, states that the inhabitants of Hierro, Gomera and Madeira had seen the island in the west; and Martin Behaim, in the globe he made at Nuremberg in the same year, places it west of the Canaries and near the equator. During the 16th century the progress of exploration in these latitudes compelled many cartographers to locate the island elsewhere; and it was marked about 100 m. west of Ireland, or afterwards among the West Indies. But in Spain and Portugal the older belief as to its situation was maintained. In 1526 an expedition under Fernando Alvarez left Grand Canary in search of St Brendan's island, which had again been reported as seen by many trustworthy witnesses. In 1570 an official inquiry was held, and a second expedition undertaken, by Fernando de Villalobos, governor of Palma. Similar voyages of discovery were made by the Canarians in 1604 and 1721; and only in 1759 was the apparition of St Brendan's island explained as an effect of mirage.

Among the numerous books which deal with the legend, the following are important: *Die altfranzösische Prosaübersetzung von Brendans Meerfahrt*, by C. Wahlund (Upsala, 1900); *La "Navigatio Sancti Brendani" in antico Veneziano*, by F. Novati (Bergamo, 1892); *Zur Brendanus-Legende*, &c., by G. Schirmer (Leipzig, 1888); *Les Voyages merveilleux de St. Brendan*, &c., by F. Michel (Paris, 1878); and *Acta Sancti Brendani.... Original Latin Documents connected with the Life of St Brendan*, by P.F. Moran (Dublin, 1872).

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**BRENHAM,** a city and the county-seat of Washington county, Texas, U.S.A., situated in the S.E. part of the state, about 68 m. N.W. of Houston. Pop. (1890) 5209; (1900) 5968, including 2701 negroes and 531 foreign-born; (1910) 4718. Brenham is served by the Gulf, Colorado & Santa Fé (controlled by the Atchison, Topeka & Santa Fé) and the Houston & Texas Central railways. It is the seat of Blinn Memorial College (German Methodist Episcopal), opened as "Mission Institute" in 1883, and renamed in 1889 in honour of the Rev. Christian Blinn, of New York, a liberal benefactor; of Brenham Evangelical Lutheran College, and of a German-American institute (1898). The municipality owns and operates the waterworks. The city is situated in an agricultural and cotton-raising region, and has cotton compresses and gins, cotton mills, cotton-seed oil refineries, foundries and machine shops, and furniture and wagon factories. Brenham was settled about 1844, was incorporated in 1866, and was chartered as a city in 1873.

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**BRENNER PASS,** the lowest (4495 ft.) and one of the most frequented passes across the Alps in all ages, though the name itself rarely occurs in the middle ages, the route over it being said to lie through "the valley of Trent." It may be described as the great gate of Italy, and by it most of the Teutonic tribes made their way to Italy. One reason of its importance is that many side passes in the end join this great thoroughfare. It was crossed no fewer than 66 times by various emperors, between 793 and 1402. A carriage road was constructed over it as far back as 1772, while the railway over it was built in 1864-1867. From Innsbruck to the summit of the pass is a distance by rail of 25 m. The line then descends through the Eisack valley past Brixen (34 m.) to Botzen (24 m.). Thence it follows the valley of the Adige to Trent (35 m.) and on to Verona (56½ m.)—in all 174½ m. by rail from Innsbruck to Verona.



(W. A. B. C.)

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**BRENNUS,** the name, or perhaps the official title, of two chiefs of the Celtic Gauls.

(1) The first Brennus crossed the Apennines in 391 B.C., ravaged Etruria, and annihilated a Roman army of about 40,000 men on the Allia some 12 m. from Clusium (July 16, 390). Rome thus lay at his mercy, but he wasted time, and the Romans were able to occupy and provision the Capitol (though they had not sufficient forces to defend their walls) and to send their women and children to Veii. When on the third day the Gauls took possession, they found the city occupied

only by those aged patricians who had held high office in the state. For a while the Gauls withheld their hands out of awe and reverence, but the ruder passions soon prevailed. The city was sacked and burnt; but the Capitol itself withstood a siege of more than six months, saved from surprise on one occasion only by the wakefulness of the sacred geese and the courage of Marcus Manlius. At last the Gauls consented to accept a ransom of a thousand pounds of gold. As it was being weighed out, the Roman tribune complained of some unfairness. Brennus at once threw his heavy sword into the scale; and when asked the meaning of the act, replied that it meant *Vae victis* ("woe to the conquered"). The Gauls returned home with their plunder, leaving Rome in a condition from which she took long to recover. A later legend, probably an invention, represents M. Furius Camillus as suddenly appearing with an avenging army at the moment when the gold was being weighed, and defeating Brennus and all his host.

See null v. 33-49; Plutarch, *Camillus*, 17, 22, 28; Polybius i. 6, ii. 18; Dion. Halic. xiii. 7.

(2) The second Brennus is said to have been one of the leaders of an inroad made by the Gauls from the east of the Adriatic into Thrace and Macedonia (280), when they defeated and slew Ptolemy Ceraunus, then king of Macedonia. Whether Brennus took part in this first invasion or not is uncertain; but its success led him to urge his countrymen to a second expedition, when he marched with a large army through Macedonia and Thessaly until he reached Thermopylae. To this point the united forces of the northern Greeks—Athenians, Phocians, Boeotians and Aetolians—had fallen back; and here the Greeks a second time held their foreign invaders in check for many days, and a second time had their rear turned, owing to the treachery of some of the natives, by the same path which had been discovered to the Persians two hundred years before. Brennus and his Gauls marched on to Delphi, of whose sacred treasures they had heard much. But the little force which the Delphians and their neighbours had collected—about 4000 men—favoured by the strength of their position, made a successful defence. They rolled down rocks upon their enemies as they crowded into the defile, and showered missiles on them from above. A thunderstorm, with hail and intense cold, increased their confusion, and on Brennus himself being wounded they took to flight, pursued by the Greeks all the way back to Thermopylae. Brennus killed himself, "unable to endure the pain of his wounds," says Justin; more probably determined not to return home defeated.

See Justin xxiv. 6; Diod. Sic. xxii. 11; Pausanias x. 19-23; L. Contzen, *Die Wanderungen der Kelten* (Leipzig, 1861).

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**BRENTANO, KLEMENS** (1778-1842), German poet and novelist, was born at Ehrenbreitstein on the 8th of September 1778. His sister was the well-known Bettina von Arnim (*q.v.*), Goethe's correspondent. He studied at Jena, and afterwards resided at Heidelberg, Vienna and Berlin. In 1818, weary of his somewhat restless and unsettled life, he joined the Roman Catholic Church and withdrew to the monastery of Dülmen where he lived for some years in strict seclusion. The latter part of his life he spent in Regensburg, Frankfort and Munich, actively engaged in Catholic propaganda. He died at Aschaffenburg on the 28th of July 1842. Brentano, whose early writings were published under the pseudonym Maria, belonged to the Heidelberg group of German romantic writers, and his works are marked by excess of fantastic imagery and by abrupt, bizarre modes of expression. His first published writings were *Satiren und poetische Spiele* (1800), and a romance *Godwi* (1801-1802); of his dramas the best are *Ponce de Leon* (1804), *Victoria* (1817) and *Die Gründung Prags* (1815). On the whole his finest work is the collection of *Romanzen vom Rosenkranz* (published posthumously in 1852); his short stories, and more especially the charming *Geschichte vom braven Kasperl und dem schönen Annerl* (1838), which has been translated into English, are still popular. Brentano also assisted Ludwig Achim von Arnim, his brother-in-law, in the collection of folk-songs forming *Des Knaben Wunderhorn* (1806-1808).

Brentano's collected works, edited by his brother Christian, appeared at Frankfort in 9 vols. (1851-1855). Selections have been edited by J.B. Diel (1873), M. Koch (1892), and J. Dohmke (1893). See J.B. Diel and W. Kreiten, *Klemens Brentano* (2 vols., 1877-1878), the introduction to Koch's edition, and R. Steig, *A. von Arnim und K. Brentano* (1894).

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**BRENTANO, LUDWIG JOSEPH** [called Lujo] (1844- ), German economist, a member of the same family as the preceding, was born at Aschaffenburg on the 18th of December 1844. He received some of his academical education in Dublin. In 1868 he made a thorough study of trade-

unionism in England, which resulted in his principal work, *Die Arbeitergilden der Gegenwart* (Leipzig, 1871-1872; Eng. trans, by L.T. Smith). The book was assailed by Bamberger and other economists, but is important not only as an authority on modern associations of workmen, but for having given an impetus to the study of the gilds of the middle ages, and the examination of the great stores of neglected information bearing upon the condition of the people in olden days. Brentano's other works are of a more theoretical character, and chiefly relate to political economy, of which he was professor at Breslau from 1872 to 1882, at Strassburg from 1882 to 1888, at Vienna 1888-1889, at Leipzig 1889-1891, and at Munich since 1891. We may mention *Das Arbeitsverhältnis gemäss dem heutigen Recht* (1877); *Die christlich-soziale Bewegung in England* (1883); *Über das Verhältnis von Arbeitslohn und Arbeitszeit zur Arbeitsleistung* (1893); *Agrarpolitik* (1897).

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**BRENTFORD,** a market town in the Brentford parliamentary division of Middlesex, England, 10½ m. W. of Waterloo terminus, London, by the London & South-Western railway, at the junction of the river Brent with the Thames. Pop. of urban district (1901) 15,171. The Grand Junction Canal joins the Brent, affording ample water-communications to the town, which has considerable industries in brewing, soap-making, saw-milling, market-gardening, &c. The Grand Junction waterworks are situated here. Brentford has been the county-town for elections since 1701.

In 1016 Brentford, or, as it was often called Braynford, was the scene of a great defeat inflicted on the Danes by Edmund Ironside. In 1280 a toll was granted by Edward I., who granted the town a market, for the construction of a bridge across the river, and in the reign of Henry VI. a hospital of the Nine Orders of Angels was founded near its western side. In 1642 a battle was fought here in which the royalists defeated the parliamentary forces. For his services on this occasion the Scotsman Ruthven, earl of Forth, was made earl of Brentford, a title afterwards conferred by William III. on Marshal Schomberg. Brentford was during the 16th and 17th centuries a favourite resort of London citizens; and its inn of the Three Pigeons, which was kept for a time by John Lowin, one of the first actors of Shakespeare's plays, is frequently alluded to by the dramatists of the period. Falstaff is disguised as the "Fat Woman of Brentford" in Shakespeare's *Merry Wives of Windsor*, and numerous other references to the town in literature point, in most cases, to its reputation for excessive dirt. The "two kings of Brentford" mentioned in Cowper's *Task*, and elsewhere, seem to owe their mythical existence to the play, *The Rehearsal*, by George Villiers, second duke of Buckingham, produced in 1671.



South of Brentford, towards Isleworth, is Sion House, a mansion founded by Lord Protector Somerset in 1547, and rebuilt and enlarged by the 10th earl of Northumberland and Sir Hugh Smithson, afterwards duke of Northumberland, the architects being Inigo Jones and Robert Adam. The gardens are very beautiful. The site of Sion or Syon House was previously occupied by a convent of Bridgetine nuns established at Twickenham by Henry V. in 1415 and removed here in 1431.

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**BRENTON, SIR JAHLEEL** (1770-1844), British admiral, was born in Rhode Island, U.S.A., on the 22nd of August 1770. He was the son of Rear-Admiral Jahleel Brenton (1729-1802), who belonged to a loyalist family which suffered the loss of most of its property in the insurrection of the American colonies. He was a lieutenant in the British navy when the war began, and emigrated with his family to the mother country. Three of the sons entered the navy—Jahleel (the eldest), Captain Edward Pelham Brenton (1774-1839), and James Wallace Brenton, who was killed young in 1799 when attacking a Spanish privateer near Barcelona in the boats of the "Petrel," of which he was lieutenant. Jahleel went to sea first with his father in 1781, and on the return of peace was sent to the "maritime school" at Chelsea. He served in the peace before the beginning of the war in 1793, and passed his examination as lieutenant, but seeing no chance of employment went with other English naval officers to serve in the Swedish navy against the Russians. In 1790 he received his commission and returned home. Till 1799 he served as lieutenant, or acting commander, mostly under Earl St Vincent, and was present in the battle from which the admiral received his title. As commander of the "Speedy" brig he won much distinction in actions with Spanish gunboats in the Straits of Gibraltar. In 1800 he reached the rank of post-captain, and had the good fortune to serve as flag-captain to Sir James (afterwards Lord) Saumarez in the action at Algeciras, and in the Straits in 1801. During the peace of Amiens

he married Miss Stewart, a lady belonging to a loyalist family of Nova Scotia. After the renewal of the war he commanded a succession of frigates. In 1803 he had the misfortune to be wrecked on the coast of France, and remained for a time in prison, where his wife joined him. Having been exchanged he was named to another ship. His most brilliant action was fought with a flotilla of Franco-Neapolitan vessels outside of Naples in May 1801. He was severely wounded, and Murat, then king of Naples, praised him effusively. He was made a baronet in 1812 and K.C.B. in 1815. After his recovery from his wound he was unable to bear sea service, but was made commissioner of the dockyard at Port Mahon, and then at the Cape, and was afterwards lieutenant-governor of Greenwich hospital till 1840. He reached flag rank in 1830. In his later years he took an active part in philanthropic work, in association with his brother, Captain E.P. Brenton, who had seen much service but is best remembered by his writings on naval and military history,—*Naval History of Great Britain from the Year 1783 to 1822* (1823), and *The Life and Correspondence of John, Earl of St Vincent* (1838).

*A Memoir of the Life and Services of Vice-Admiral Sir Jahleel Brenton*, based on his own papers, was published in 1846 by the Rev. Henry Raikes, and reissued by the admiral's son, Sir L.C.L. Brenton, in 1855.

(D. H.)

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**BRENTWOOD,** a market town in the mid or Chelmsford parliamentary division of Essex, England; 18 m. E.N.E. of London by the Great Eastern railway (Brentwood and Worley station). Pop. of urban district (1901) 4932. The neighbouring country is pleasantly undulating and well wooded. The church of St Thomas the Martyr, with several chapels, is modern. The old assize house, an Elizabethan structure, remains. A free grammar school was founded in 1557. The county asylum is in the vicinity. There are breweries and brick works. To the south lies the fine upland of Worley Common, with large barracks. Adjoining Brentwood to the north-east is Shenfield, with the church of St Mary the Virgin, Early English and later. Brentwood was formerly an important posting station on the main road to the eastern counties, which follows the line of the railway to Colchester. The name (*Burntwood*) is supposed to record an original settlement made in a clearing of the forest. The district is largely residential.

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**BRENZ, JOHANN** (1499-1570), Lutheran divine, eldest son of Martin Brenz, was born at Weil, Württemberg, on the 24th of June 1499. In 1514 he entered the university of Heidelberg, where Oecolampadius was one of his teachers, and where in 1518 he heard Luther discuss. Ordained priest in 1520, and appointed preacher (1522) at Hall in Swabia, he gave himself to biblical exposition. He ceased to celebrate mass in 1523, and reorganized his church in 1524. Successful in resisting the peasant insurrection (1525), his fortunes were affected by the Schmalkaldic War. From Hall, when taken by the imperial forces, he fled on his birthday in 1548. Protected by Duke Ulrich of Württemberg, he was appointed (January 1553) provost of the collegiate church of Stuttgart. As organizer of the reformation in Württemberg he did much fruitful work. A strong advocate of Lutheran doctrine, and author of the *Syngramma Suevicum* (October 21, 1525), which set forth Luther's doctrine of the Eucharist, he was free from the persecuting tendencies of the age. He is praised and quoted (as Joannes Witlingius) for his judgment against applying the death penalty to anabaptists or other heretics in the *De Haereticis, an sint persequendi* (1554), issued by Sebastian Castellio under the pseudonym of Martinus Bellius. An incomplete edition of his works (largely expository) appeared at Tübingen, 1576-1590. Several of his sermons were reproduced in contemporary English versions. A volume of *Anecdota Brentiana* was edited by Pressel in 1868. He died on the 11th of September 1570, and was buried in his church at Stuttgart; his grave was subsequently violated. He was twice married, and his eldest son, Johann Brenz, was appointed (1562) professor of theology in Tübingen at the early age of twenty-two.

See Hartmann and Jäger, *Johann Brenz* (1840-1842); Bossert, in Hauck's *Realencyklop.* (1897).

(A. Go.*)

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**BRÉQUIGNY, LOUIS GEORGES OUDARD FEUDRIX DE** (1714-1795), French scholar, was born at Gainneville near Havre, on the 22nd of February 1714, and died at Paris on the 3rd of July 1795. His first publications were anonymous: an *Histoire des révolutions de Gènes jusqu'à la paix de 1748* (1750), and a series of *Vies des orateurs grecs* (1752). Elected a member of the Académie des Inscriptions et Belles-lettres in 1759, he contributed an *Histoire de Posthume empereur des Gaules* (vol. xxx., 1760) to the collected works of that illustrious society, and also a *Mémoire sur l'établissement de la religion et de l'empire de Mahomet* (vol. xxxii., 1761-1763). After the close of the Seven Years' War he was sent to search in the archives of England for documents bearing upon the history of France, more particularly upon that of the French provinces which once belonged to England. This mission (1764-1766) was very fruitful in results; Bréquigny brought back from it copies of about 7000 documents, which are now in the Bibliothèque Nationale. A useful selection of these documents was published (unfortunately without adequate critical treatment) by Jean Jacques Champollion-Figeac, under the title *Lettres de rois, reines et autres personnages des cours de France et d'Angleterre, depuis Louis VII. jusqu'à Henri IV., tirées des archives de Londres par Bréquigny* (collection of *Documents inédits relatifs a l'histoire de France*, 2 vols., 1839, 1847). Bréquigny himself drew the material for many important studies from the rich mine which he had thus exploited. These were included in the collection of the Académie des Inscriptions: *Mémoire sur les différends entre la France et l'Angleterre sous le règne de Charles le Bel* (vol. xli.); *Mémoire sur la vie de Marie, reine de France, soeur de Henri VIII., roi d'Angleterre* (vol. xlii.); four *Mémoires pour senir à l'histoire de Calais* (vols. xliii. and l.); and *Mémoire sur les négotiations touchant les projets de mariage d'Elizabeth, reine d'Angleterre, d'abord avec le duc d'Anjou, ensuite avec le due d'Alençon, tons deux frères de Charles IX.* (vol. l.). This last was read to the Academy on the 22nd of January 1793, the morrow of Louis XVI.'s execution. Meanwhile, Bréquigny had taken part in three great and erudite works. For the *Recueil des ordonnances des rois de France* he had prepared volumes x.-xiv., the preface to vol. xi. containing important researches into the French communes. To the *Table chronologique des diplômes, chartes, lettres, et actes imprimés concernant l'histoire de France* he contributed three volumes in collaboration with Mouchet (1769-1783). Charged with the supervision of a large collection of documents bearing on French history, analogous to Rymer's *Foedera*, he published the first volume (*Diplomatat. Chartae*, &c., 1791). The Revolution interrupted him in his collection of *Mémoires concernant l'histoire, les sciences, les lettres, et les arts des Chinois*, begun in 1776 at the instance of the minister Bertin, when fifteen volumes had appeared.



See the note on Bréquigny at the end of vol. i. of the *Mémoires de l'Académie des Inscriptions* (1808); the Introduction to vol. iv. of the *Table chronologique des diplômes* (1836); Champollion-Figeac's preface to the *Lettres des rois et reines*; the *Comité des travaux historiques*, by X. Charmes, vol. i. *passim*; N. Oursel, *Nouvelle biographie normande* (1886); and the *Catalogue des manuscrits des collections Duchesne et Bréquigny* (in the Bibliothèque Nationale), by René Poupardin (1905).

(C. B.*)

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