SCIENTIFIC CENTENARIES IN 1946

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THE international character of science which has been so often referred to by eminent men and so frequently stressed in the pages of *Nature* is well illustrated by the centenaries of distinguished investigators in physical science which occur in 1946. Disregarding for the moment the tercentenary of the great German scholar, philosopher, diplomatist and mathematician Leibniz, the year recalls first a succession of astronomers of many nationalities from the days when men's views were coloured by the mysteries of astrology and the dogmas of religion, and when there were neither scientific journals nor societies, much less international gatherings.

Foremost in the list of men to attract attention is Tycho Brahe, famous for all time for his laborious observations, which were used by Kepler in the unfolding of the laws of planetary motion. Noble by birth, independent in character, vehement in manner and cast in heroic mould, Tycho was of Danish nationality though born in Knudstrup near Lund in Sweden. His birthday was December 14, 1546. He was well educated and was intended for the law; but as with so many others, a solar eclipse—that of August 21, 1560—determined all his future actions. At Copenhagen, Leipzig, Wittenberg, Rostock, Basle, Augsburg and Cassel he followed his bent, making a reputation which led in 1576, when he was thirty, to his being put in possession of the little island of Hven, situated in The Sound and not far from the romantic castle of Elsinore. Here he built his famous 'City of the Heavens', the Pulkovo of the day. With ample means provided by his patron, King Frederick II of Denmark, he worked there steadily for twenty years, determining the places of the moon, the planets and the stars as accurately as he could with his simple sextants and quadrants. Then less happy times befel him, and in 1597 he left Denmark never to return, and died an exile at Prague on October 24, 1601, at the age of fifty-four, leaving Kepler his mass of observations and his new planetary tables.

The foundation of Tycho's 'Uraniborg' was laid on August 30, 1576. Just a hundred years later, on October 29, 1676, the Rev. John Flamsteed, appointed by Charles II "our astronomical observator", began his observations at the Royal Observatory, Greenwich. In 1676 Flamsteed, like Tycho in 1576, was thirty years of age, having been born on August 19, 1646, at Denby, seven miles from Derby. At Greenwich there was none of the magnificence of Uraniborg. Built partly with materials from Tilbury Fort and the Tower of London, and costing not much more than £500, the Observatory, it is true, was designed by Wren; but when Flamsteed took up his residence there, it was bare of instruments, which the first Astronomer Royal had to provide out of his meagre salary of £100 a year. Lack of means and ill-health dogged Flamsteed's footsteps all his life, and these probably had something to do with the unfortunate quarrels which arose between him and Newton. But in spite of all disabilities, he pursued his course unswervingly, carrying out his instructions "forthwith to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens and the places of the fixed stars so as to find out the so much desired longitude of places for the perfecting of the art of navigation". Though none of his instruments have been preserved, the Observatory has a mural arc similar to that made by Flamsteed and Abraham Sharp at a cost to the former of £120. One of the outcomes of the dissensions which arose between Flamsteed and the Royal Society was the appointment in December 1710 of the Board of Visitors. Among their duties was that of reporting on the state of the instruments; seeing that these belonged to the Astronomer Royal it is easy to understand his chagrin.

The financial position of Flamsteed had been improved somewhat in 1688 by a bequest from his father, and four years earlier by his appointment to the living of Burstow, about three miles south-west of Horley, Surrey. A long straggling parish, Burstow has no central village, and the pleasant little church is surrounded by land which in Flamsteed's time must often have been flooded. His journeys between the rectory and the Observatory were, it is presumed, made on horseback; but of the performance of his parochial duties little appears to be known. At his death on December 31, 1719, he was buried in the chancel of the church, and later on his wife was laid beside him. They both left money to provide annually coats for two worthy men and gowns and petticoats for two worthy widows. For 168 years no memorial marked the Astronomer Royal's burial place, until in 1887 the late J. J. Tustin, of Burstow Hall, gave the stained glass window in the east of the chancel and a tablet to remind visitors where Flamsteed rests.

The next astronomer in the list is Giuseppe Piazzi, the Italian Theatine monk who was born at Ponte in the Valteline, north Italy, on July 16, 1746. After he had been a student under many famous masters and a teacher in several cities, he was appointed in 1780 by Ferdinand II, king of the Two Sicilies, to be professor of mathematics at Palermo, where he was able to erect an exceptionally well-equipped observatory containing one of Ramsden's finest instruments. His discovery on the first day of the nineteenth century of the first of the asteroids, Ceres, was the outcome of plans to search the skies for a planet believed to revolve in an orbit between those of Mars and Jupiter. Twenty-four astronomers, mostly German, were to take part in the search, and Piazzi was to be one of the twenty-four; but he made his discovery before receiving his nomination. Like so many others, he published a catalogue of stars, his containing 6,748 stars he had observed at Palermo. He died at Naples on July 22, 1826.

Freidrich Wilhelm Bessel died on March 17 a century ago, his life overlapping the eighty years of Piazzi's by forty-two years. His birthplace was Minden, the scene of the famous battle of 1759. One in the family of nine of a minor Civil Servant, Bessel was apprenticed to a business firm in the port of Bremen and looked forward to becoming a supercargo of a sailing ship. The study of mathematics, navigation and astronomy, however, led to his acquaintance with the benevolent Bremen physician and astronomer, Olbers, and from that time ships became of secondary importance. When he was twenty-two, he became assistant to Schrötter, 'the Herschel of Germany', and four years later he was made professor of astronomy in Königsberg and also director of the new observatory which, it was said, "will ever remain a monument to his glory no less than to the munificence of the Sovereign [Friedrich Wilhelm III of Prussia] who, amid the alarms of war and the desolation of his country, still mindful of science, ordained its institution".

Charles II, Frederick of Denmark, Ferdinand of the Sicilies and Friedrich Wilhelm of Prussia are but four of scores of rulers and princes who in the past gave their royal support to the erection of observatories; to-day their places have been taken largely by wealthy commoners, millionaires such as James Lick and Charles Tyson Yerkes of the United States. American colonists had their telescopes and sent their observations to the Royal Society in its earliest days. But the first real observatory on the western side of the Atlantic was that erected by David Rittenhouse, F.R.S., at Norriton, twenty miles from Philadelphia, in 1768. It was, however, much later that astronomical studies made rapid headway in the New World. The Harvard Observatory was founded in 1840 with W. C. Bond as director, and the Washington Naval Observatory, where Maury worked, in 1842. Since then American observatories have sprung up rivalling Tycho's Uraniborg, and astronomy has a great following. In his book "Astronomers of To-day" (1905), Macpherson, out of his thirty-two biographical notices, devoted no fewer than nine to Americans. This will partly explain why in the list of centenaries during 1946 are found the names of Edward Singleton Holden (1846–1914), the first director of the Lick Observatory; of Seth Carlo Chandler (1846–1913), the editor of the *Astronomical Journal*; of Lewis Boss (1846–1912), of the Dudley Observatory, Albany, New York; and of Edward Charles Pickering (1846–1919), director of the Harvard College Observatory. All four were associates of the Royal Astronomical Society and three of them gold medallists of the Society. Another associate of the Society and also a foreign member of the Royal Society, born in 1846, was the distinguished Swedish astronomer Johan Oscar Backlund (1846–1916), who in 1895 succeeded Bredikhine as director of the great Russian observatory—now destroyed—at Pulkovo, a few miles south of St. Petersburg. He had become a naturalized Russian some years before.

The year of the birth of Flamsteed was also the year of the birth of Gottfried Wilhelm Leibniz, "le savant le plus universel des temps modernes". Endowed with extraordinary powers of mind, "He may be said," wrote Prof. A. C. Fraser, of Edinburgh, "to have founded in the course of his life the European commonwealth of letters, and to have restored in part that community of intelligence in Christendom, of which the universities were the organ, until the Reformation dissolved their organic unity." His invention of the calculus and the bitter controversy which raged for a long period were reviewed in "A Short Account of the History of Mathematics" (1901) by W. W. Rouse Ball, who said that Leibniz's "title to fame rests on a sure basis, for by his advocacy of the differential calculus his name is inseparably connected with one of the chief instruments of analysis, just as that of Descartes—another philosopher—is with analytical geometry". Germany was greatly indebted to Leibniz for his foundation in 1682 with Otto Mencke of the scientific journal *Acta Eruditorum*, and for the inauguration in 1700 of the Berlin Academy of Sciences. Born in Leipzig on June 21 (O.S.), 1646, he lived at Nuremberg, Mainz, Paris, and other places, his headquarters from 1676 being Hanover, where he was keeper of the ducal library. "On the accession in 1714," says Ball, "of his master George I, to the throne of England, Leibniz was thrown aside as a useless tool; he was forbidden to come to England; and the last two years were spent in neglect and dishonour." He died at Hanover on November 14, 1716.

A name famous in the annals of science in Scotland is that of Colin Maclaurin, F.R.S., who died at York on June 14, 1746, his death being due to exposure in the trenches at Edinburgh during the 1745 Rebellion. Born at Kilmordan in February 1698, he was made professor of mathematics in Marischal College, Aberdeen, at the age of nineteen, and six years later succeeded the second James Gregory in the mathematical chair at Edinburgh. His treatise on fluxions appeared in 1742, and his "Account of Sir Isaac Newton's Philosophical Discoveries" posthumously in 1748. Maclaurin served his country and friends in many ways.

Among the men of science born in 1746 were George Atwood, F.R.S. (d. 1807), of Trinity College, Cambridge, writer, lecturer and experimenter, whose paper to the Royal Society on "Determining the Positions assumed by Homogeneal Bodies which Float Freely and at Rest" gained him the Copley Medal for 1796; Jacques-Alexandre-Cæsar Charles (d. 1823), who made aeronautical history by the introduction of the use of hydrogen in balloons and was professor of physics at the Conservatoire des Arts et Métiers; Giovanni Battista Venturi (d. 1822), professor and engineer at Modena, whose name is perpetuated by the 'venturi meter' invented in 1888 by Clemens Herschel of Holyoke, Mass.; and Gaspard Monge, Comte de Péluse, creator of descriptive geometry, a founder of the National Institute and the École Polytechnique in Paris. One of the most prominent men of science in the Napoleonic era, Napoleon's fall meant disaster to Monge, and his dismissal from the Institute was a blow from which he never recovered.

So much for 1746; what of 1846? That year there was fighting in India, riots and famine in Ireland, trouble in Mexico, and revolution in Poland and Switzerland. But none of these events excited the interest or disturbed the peace of the world of science as did the discovery of the planet Neptune. The predictions of Adams and Leverrier, the oversight of Challis and Airy and the success of Galle were discussed everywhere. Before Galle saw the planet, Sir John Herschel had declared in his picturesque way that "We see it as Columbus saw America from the coast of Spain. Its movements have been felt trembling along the far-reaching line of our analysis with a certainty hardly inferior to that of ocular demonstration." The observation of the planet on September 23, as Miss Clerke said, dissipated "the last lingering doubts as to the universal validity of the Newtonian Law!". But again controversy arose, again national bias, incomplete knowledge and hasty conclusions showed that even men of science are not without their human weaknesses. Yet nothing could dim the glory of an achievement which was the subject of many eulogies: as a young professor, Lord Kelvin used to devote three pages of manuscript in his inaugural lectures to the discovery of Neptune, until Tait told him the subject had been "ridden to death".

Reverting to the main theme of this article, the centenaries of men and not of events, 1846 saw the passing of the German astronomers and physicists Johann Friedrich Benzenberg and Christian Ludwig Ideler, the latter a foreign associate of the Paris Academy of Sciences, and of Dr. Ernst Alban, the pioneer in Germany of the use of high-pressure steam in engines. The death of the English chemist James

Marsh, for long the assistant at Woolwich to Faraday, who from 1829 to 1851 was professor of chemistry at the Royal Military Academy, saw the close all too early of an ill-requited career, while the death at Chorlton-upon-Medlock of the manufacturer John Owens made available according to his will more than £90,000 for the foundation of an educational institution in Manchester. The well-known Owens College was opened in 1851, and from it sprang the University of Manchester.

Finally come the men of science and engineers from many lands who were born a century ago, and who in some cases were associated with those still living. Ira Remsen, the American chemist, who died in 1927, was of Dutch descent. He worked in laboratories in Germany, being a fellow student with Sir William Ramsay at Tübingen, and in 1876 became the first professor of chemistry at the newly founded Johns Hopkins University, of which he ultimately became the president. In 1898 he was made a foreign member of the Chemical Society. While Remsen taught at Baltimore, Sir William Hartley, F.R.S., held the chair of chemistry in the Royal College of Science, Dublin. Known especially for his work in spectroscopy, he was a founder and the first president of the (Royal) Institute of Chemistry. He died in 1913, having been knighted two years before. Men of science in Poland have often worked under discouraging conditions, and this was the case with Karol Stanislav Olszewski (1846–1915), one of the leading investigators of low-temperature phenomena and the liquefaction of gases. He had lost his father in the insurrection of the peasants in 1846, but was able to qualify as a chemist under Bunsen at Heidelberg. He was then given the chair of chemistry at Cracow, where all his work was done. In more peaceful Denmark, Poul la Cour (1846–1908) devoted himself to meteorology, and for a time was director of the government wind-power station at Askov, in Jutland. He was an inventor of scientific apparatus and edited Tycho Brahe's diary of 1582–96. Meteorology also claimed the attention of the Rev. John Mackenzie Bacon (1846–1904), of Trinity College, Cambridge. He went on eclipse expeditions, studied acoustics, took to kite-flying and ballooning and was a lecturer of distinction.

Various branches of engineering are recalled by the names of Durston, Watts, Westinghouse, Canet and Brandt. Engineer Vice-Admiral Sir John Durston (1846–1916) and Sir Philip Watts, F.R.S. (1846–1926) were both trained in the Royal Dockyards and the Royal School of Naval Architecture and Marine Engineering at South Kensington, Durston rising to the position of engineer-in-chief of the Fleet, while Watts from 1902 until 1912 was the director of naval construction and as such the designer of the famous battleship *Dreadnought*. George Westinghouse (1846–1914), who had German, Dutch and British blood in his veins, was one of the great figures in American engineering. When given the Grashof Medal by German engineers, the citation referred to him as "the pioneer of the automatic brake, the successful protagonist of alternating current, the meritorious designer of high-speed engines". Westinghouse was an industrialist on the grand scale. Jean-Baptiste-Gustave-Adolphe Canet (1846–1908) was as well known in the artillery world as was Westinghouse in the railway world. When he died he was president of the Junior Institution of Engineers, which founded the Gustave Canet Memorial Lecture in his honour. A different sphere of engineering is recalled by the career of Albert Brandt (1846–99). Born in Hamburg, he was a student in Zurich in the days of Zeuner, Culmann and Clausius. In 1875 he assisted in the construction of the St. Gothard Railway, and three years later entered into partnership with his countryman Karl Brandau (1849–1917). To Brandt and Brandau, together with the Swiss engineer Dr. Eduard Locher-Freuler (1840–1910), belongs the credit for the construction of the great Simplon Tunnel referred to by Prof. (now Sir) C. E. Inglis in a broadcast on October 25, 1942, as "the greatest epic in civil engineering history" and "the most courageous victory ever won by engineers in their never-ending conflicts with the forces of Nature".

WILLIAM CURTIS

WILLIAM CURTIS, founder of the *Botanical Magazine* and author of "Flora Londinensis", was born two hundred years ago, on January 11, 1746, in Alton, Hampshire. The bicentenary of his birth is being celebrated, fittingly enough, at his birth-place, by an exhibition of manuscripts and other 'Curtisiana' to be opened on January 11 at the Alton Assembly Rooms, adjoining the Curtis Museum, of which Mr. W. Hugh Curtis, author of "William Curtis" (1941), is a joint honorary curator.

William Curtis was the son of a tanner of good Quaker family, and after leaving school was apprenticed to his grandfather, a surgeon-apothecary practising in Alton. William's early love of wild life was stimulated at this time by the ostler at the Crown Inn, one Thomas Legg, in whose company he searched the country round for plants and insects. His grandfather, however, disapproved of this deviation from the narrow path of an apothecary's curriculum, and William was packed off to the less tempting surroundings of London. Here he pursued his studies and in a short time inherited a business of his own in Gracechurch Street. But natural history was his first and true love and in 1771 he sold his practice and acquired an acre of land in Restoration Spring Garden, Bermondsey, for the culture of British plants. Various other projects, including the "Flora Londinensis", were already seething in his head, and he was now fairly launched on a botanical and entomological career. British botany at this time was badly in need of recruits. The Linnean system had recently been introduced into the country and workers were wanted to re-examine the British flora with a vigour and concentration that had been lacking since the death of Ray in 1704.

Curtis, in 1771, was already closely in touch with many of the leading British botanists, but in 1772 he acquired official status among them by his appointment as *Praefectus Horti* at the Society of Apothecaries' Chelsea Garden—a post he held until 1777.

Curtis's earliest two publications were entomological ("Instructions for Collecting and Preserving Insects", 1771, and a translation of Linnæus's "Fundamenta Entomologiae", 1772); but during his time at Chelsea, plans for his great work, "Flora Londinensis", were maturing, and the first number was issued in May 1775. Publication in parts continued until 1798, though not without the delays and complaints from subscribers that seem inseparable from such a method, and which Curtis's rather unbusinesslike disposition did nothing to mitigate. The two volumes in which the work is usually seen to-day