OBITUARY NOTICES.

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Sir George Biddell Airy. By Professor Copeland.

(Read January 30, 1893.)

George Biddell Airy was born at Alnwick on the 27th of July 1801. He received his earlier education partly at Hereford and elsewhere, but chiefly at Colchester Grammar School. In the autumn of 1819 he was sent to Cambridge, where, at first, he studied at the expense of his maternal uncle, Arthur Biddell of Playford, near Ipswich. He entered Trinity College as a sizar, and although partly supporting himself by teaching, he found time while yet an undergraduate to contribute a paper on glass reflectors silvered at the back to the *Cambridge Philosophical Transactions*, then recently started. In 1823 he graduated as senior wrangler, and was elected a Fellow of his College in the following year. About this time he wrote a number of important papers on the figure of the earth and on other subjects, not the least valuable of these being one on astigmatism of the eyes and the simple modification of the spectacles, by the introduction of the single cylindrical surface necessary for its correction.

At the end of 1826 he was appointed Lucasian Professor, and early in 1828 Plumian Professor of Astronomy and Natural Philosophy, as well as Director of the new observatory. He at once threw himself heart and soul into both functions of his office, giving experimental lectures, and also systematically observing the sun, moon, planets, and stars with the Dollond transit instrument which, with a couple of clocks, formed the whole equipment of the observatory. The completely reduced observations were published year by year in worthy emulation of the example set on the Continent by Bessel and Struve some years previously. No trouble, we are

told, was spared to secure accuracy in the results, the errors of the instrument being determined, and proper numerical corrections applied to the observations. Although fully ten weeks of the summer of 1828 were devoted to visiting the observatories of France and the north of Italy, and although for the first year Airy had no assistant, the volume containing the earlier Cambridge observations appeared in April of the year after they were made. An assistant was then appointed, without whose aid in the routine work of the observatory it would have been physically impossible for Airy to devote due attention to the investigation of the motion of Venus, which now engaged his attention. In 1831 he presented to the Royal Society his celebrated memoir "On an Inequality of Long Period in the Motions of the Earth and Venus," which, as Airy himself said, "contains the first specific improvement in the solar tables made in this country since the establishment of the theory of gravitation." About this time also he deduced the mass of Jupiter from elongations of the fourth satellite observed with a small equatorial telescope. These important investigations failed, however, to divert Airy altogether from the study of the Undulatory Theory of Light, which he materially helped to develop. Perhaps the most generally known of his discoveries in this field is that of the exquisitely beautiful phenomenon caused by the passage of polarised light through two thick plates of quartz cut from right and left-handed crystals, which will ever bear the name of Airy's Spirals.

For the first meeting of the British Association at York in 1831, Airy wrote a "Report on the Progress of Astronomy during the Present Century." It is in fact a masterly history of the science from the beginning of this century to the date of the meeting, and, as such, can never lose its value. Towards the close of 1832 the mural circle, 8 feet in diameter, was erected, and at the same time an additional assistant was appointed in the person of James Glaisher, afterwards so well known in the scientific world. About 1833 the Duke of Northumberland presented to the Cambridge Observatory a refracting telescope with an object-glass of the then unrivalled aperture of nearly 12 inches. The mounting for this instrument was designed by Professor Airy, who adopted the English arrangement of a long polar-axis, which when built in the solid

style characteristic of all the apparatus constructed by him affords perfect facility for observation near the celestial equator, but is inconvenient to a degree when the telescope is directed to the immediate neighbourhood of the pole of the heavens.

In 1835 Pond, the sixth Astronomer-Royal, resigned, and Airy, the distinguished young Cambridge professor, was naturally appointed to the vacant post by Lord Auckland, then head of the Admiralty. Airy forthwith reorganised the national observatory, introducing the methods and arrangements that had proved so successful at Cambridge. From that time forth the annual volumes of Greenwich observations, in their familiar drab bindings, appeared with unfailing regularity. The field of work, too, was soon extended. For some years the study of terrestrial magnetism had been making rapid strides, mainly under the auspices of the *Magnetische Verein*, of which Gauss and Weber were the leading spirits. Desirous that this country should take a fitting share in investigations so closely bearing on its varied maritime interests, Airy in 1840 established the magnetical and meteorological services at Greenwich. The memorable Antarctic voyage of Captain (afterwards Sir) James Clark Ross at that time doubtless influenced the authorities in sanctioning this extension of the work carried on at Greenwich. The laborious eye observations in this department were replaced by photographic records as early as 1848. The interdependence of solar and magnetic phenomena, which at first escaped Airy, was established from the Greenwich observations many years afterwards by the indefatigable researches of Mr Ellis.

Not content with publishing and discussing his own work, Airy undertook the gigantic task of reducing all the lunar and planetary observations made by Bradley, Bliss, Maskelyne, and Pond from 1750 to 1830. Bradley's matchless observations of the sun and fixed stars for the first twelve years of that period had already been utilised by Bessel in his *Fundamenta Astronomiæ*. For the planetary reductions, Airy in 1847 received the gold medal of the Royal Astronomical Society for the second time, and in the following year the lunar reductions gained him the equivalent testimonial of the same society.

In 1847 was completed the Greenwich Altazimuth, designed by Professor Airy for the purpose of observing the moon near conjunc-

tion. In one respect the altazimuth marked a new departure in the construction of astronomical instruments. Instead of being built up of many parts bound together by numerous screws, it was made in as few pieces as possible, and the greatest care was taken that the critical parts, such as the micrometer screws, bore immediately against solid portions of the mounting. With this instrument the moon was closely followed through its smaller phases for many years, and if the resulting places have not fulfilled the expectations raised by them, it is chiefly because of the difficulty of obtaining a very exact record from any instrument free to move in two co-ordinates, and partly also from the somewhat insufficient optical power of the telescope employed. The altazimuth was, however, a bold experiment, and cleared the way for a new instrument about to be introduced at Greenwich, viz., the Universal Transit-Circle, which seems destined to accomplish in the most satisfactory manner the task originally proposed by Airy. In 1848 the late Astronomer Royal replaced the old zenith-sector by the reflex zenith-tube, with which γ Draconis, the star which passes almost exactly overhead at Greenwich, is observed from time to time. Greenwich is indeed favoured by the position of this star, so near at once to the zenith, and to the solstitial colure, that for many centuries it will continue to culminate within a few minutes of the zenith, just as it did in the days of Hooke, by whom it was first observed with extreme accuracy.

In 1850 the large and massive transit-circle built, like almost all the Greenwich instruments, by Troughton and Simms, superseded the transit instrument and mural circles till then in use. It is still a magnificent instrument, and one of the most stable of its class. Like the altazimuth it is almost altogether made of cast-iron, but unlike the greater number of transit-circles it cannot be reversed; this disadvantage is, however, very possibly outweighed in a national observatory by the unbroken nature of the records obtained. The chronograph was introduced at Greenwich some four years after the transit-circle.

In 1859 the Greenwich plant was augmented by a large equatorial of $12\frac{3}{4}$ inches aperture. The object-glass was made by Merz, but the mounting, which resembles that of the Northumberland telescope at Cambridge, was designed by Airy. So satisfactory and steady has this mounting proved that it is now being provided with

a telescope of no less than 28 inches aperture made by Sir Howard Grubb. Some years later Airy devised the "Orbit-Sweeper"—a new form of equatorial, with a third axis in the direction of what would be the tube in an ordinary equatorial. When properly set and driven by clockwork the telescope continues to sweep along any given great circle of the heavens. The University Observatory at Strassburg is provided with a beautiful instrument of this kind.

The last considerable extension of the scope of Greenwich Observatory made by the late Astronomer-Royal was the introduction in 1873 of spectroscopy and the regular photography of solar phenomena.

Of Sir George Airy's many labours in fields outside the regular work of the observatory only the briefest mention can here be made. His eminently practical method of correcting the deviation of compasses in iron vessels, the outcome of numerous experiments on board ship, came into general use. The determination of the density of the earth by experiments in Harton Colliery will long be remembered in the North Country.

Of international as well as national importance was the share he took in the restoration of the standard weights and measures lost in the conflagration which destroyed the old Houses of Parliament. He took an active part too in the "battle of the gauges," which decided the width of railways in this country. Indeed, he may be said to have been general adviser on all matters connected with science not only to the government but to the whole country. He observed the total solar eclipse of 1842 in the north of Italy, and that of 1851 in Norway. To him astronomy is mainly indebted for the famous Eclipse Expedition to Spain in 1860, on which occasion the troopship "Himalaya" carried out a large party of observers, who, scattered along the line of total obscuration, shared in reaping perhaps the richest harvest of results ever secured on one of these rare occasions.

The best-known books by Sir George Airy are the *Mathematical Tracts*, *Gravitation*, and *Six Lectures on Astronomy*. For the *Encyclopædia Metropolitana* he wrote a number of articles, notably those on "The Figure of the Earth" and on "Tides and Waves." His contributions to the publications of learned societies were very numerous, no less than 242 papers standing under his name in the

Royal Society's catalogue, besides four papers of which he was joint author.

In addition to the well-earned honours bestowed on him by the Royal Astronomical Society, of which he was repeatedly President, he was elected President of the Royal Society, and received both a Copley and a Royal Medal. He was made a C.B. in 1871, and a K.C.B. in the following year. In 1875 he received the Freedom of the City of London, and also that of the Company of Spectacle Makers, the latter honour in acknowledgment of the signal manner in which he had given a refined development to the Company's craft. Oxford, Cambridge, and Edinburgh conferred on him their honorary degrees. Of the Royal Society he was President from 1871 to 1877, and Fellow for nearly sixty years. At the time of his death he was by many years the senior Honorary Fellow of this Society, having been elected in 1835. Numerous honours came to him from abroad, amongst them the Lalande Medal. He was one of the eight Foreign Associates of the French Academy.

In 1830 he married Richarda, daughter of the Rev. R. Smith of Edensor, by whom he had nine children; of these, three sons and three daughters survived him. Lady Airy died in 1875, almost exactly six years before he resigned the post of Astronomer-Royal, which he did on August 15, 1881, shortly after the completion of his eightieth year. The closing years of his life were spent not far from the great observatory he had directed for more than forty-six years. He died on January 2, 1892, from an internal complication, the result of a fall.