THURSDAY, OCTOBER 31, 1878

SCIENTIFIC WORTHIES

XIII.—SIR GEORGE BIDDELL AIRY

SIR GEORGE BIDDELL AIRY was born at Alnwick, Northumberland, on July 27, 1801. He was first educated at private schools in Hereford and Colchester, and passed at the age of eighteen to Cambridge, where he entered at Trinity College as sizar. Here he developed his love for mathematics and graduated as senior wrangler in the year 1823.

In the following year, being elected a Fellow of Trinity College, he was closely engaged with the introduction of a new class of studies into the University, and published his "Mathematical Tracts on the Lunar and Planetary Theories," the "Figure of the Earth," &c., and the "Undulatory Theory of Optics," a work of considerable merit, which showed at once both the ingenious mathematician and the accomplished philosopher. In the year 1825 he wrote for the Cambridge *Transactions* papers "On the Forms of the Teeth of Wheels," and "On Escapements."

In the following year he was elected Lucasian Professor of Mathematics, and applied himself with the utmost ardour to the promotion of the knowledge of experimental philosophy in the University, and a great many of his papers, published at that time and afterwards in the *Transactions* of the Cambridge Philosophical Society, bear on those subjects, and principally on the most remarkable of them, Undulatory Optics, a field of research quite new at that time. The requirements of universities were never afterwards lost sight of. He gave, for instance, in the year 1868, a course of lectures in the University of Cambridge on the subject of Magnetism, with the view of introducing that important department of physical science into the studies of the University. His books—"Theory of Errors of Observations," "On Magnetism," and various memoirs in the *Transactions* of learned societies were written principally for this purpose.

In the year 1828 he was elected Plumian Professor of Astronomy, and was charged with the directorship of the Astronomical Observatory, where he had to superintend the erection of several instruments, principally the mounting of the great Northumberland equatorial, which was constructed almost entirely under his own direction. In the same year he was elected a Fellow of the Royal Astronomical Society; and now commences an activity which is almost unsurpassed in the annals of astronomy.

Prof. Airy, after the example first given by Maskelyne, and followed by Bessel and Struve, introduced into the observatory a most efficient system for reducing the observations, and printed them annually. The greatest regularity in the routine of consecutive years was aimed at and attained, in great measure, from adherence to the rule of forming the plan of observations for each year in the greatest detail practicable before the close of the preceding year.

These practical occupations did not divert his mind from theoretical studies. In the year 1831 a most important paper was published in the Cambridge *Transactions*, "On the Inequality of Long Period in the Motions of the Earth and Venus." In the following year he wrote for the British Association a very interesting "Report on the Recent Progress of Astronomy," a little work which may be read still with great profit by every student of astronomy. Various lacunæ of our science discovered on that occasion were filled up by Prof. Airy in the next year by his papers "On the Mass of Jupiter."

When Mr. Pond, the fifth Astronomer-Royal, resigned in the year 1835, Prof. Airy was appointed his successor, by Lord Auckland, first Lord of the Admiralty, and at the same time he was elected President of the Royal Astronomical Society. During the forty-three years that have elapsed since his appointment as Astronomer-Royal, Sir George has always been most keenly intent in promoting astronomy and science in general in every way.

He has equipped the Royal Observatory at Greenwich with a series of new instruments of very exact construction, all made after his own designs, many of them invented by himself. The first of the new instruments was erected in the year 1847. It was constructed in as few separate parts as possible, and no important parts were connected by small screws, in order that the instrument might possess the greatest amount of firmness. The end to be attained by its use was to make observations out of the meridian as accurate as observations in the meridian, and its main object of observation was the moon. It must be recollected that the moon can very seldom be observed with the meridian instruments before her first quarter and after the last. The altazimuth was designed to obtain observations of her as often as she was visible in the sky and, I am sure, every astronomer will agree that the erection of this instrument was a most important innovation. Its great services were fully acknowledged many years later, when the greatest errors in Burkhardt's Tables of the Moon were shown to exist in parts of her orbit never accessible to meridian observations. The number of days on which the moon is observed by this instrument is nearly double that of the observations in the meridian.

At the end of the year 1850 the new meridian circle was erected, the object-glass of which, made by Mr. Simms, has 8 inches clear aperture and 11 feet 6 inches focal length. With this instrument there was also introduced a great change in the observing routine at Greenwich, the transits and the zenith distances of the stars being now taken by one astronomer at the same time. Nearly simultaneously the American method of observing transits was adopted.

The Troughton zenith-sector, found by Mr. Airy at the Observatory, had given much trouble, and various alterations had not improved the results obtained by it. It was therefore dismantled in the year 1848, and the "reflex-zenith-tube" erected, an instrument admirably calculated for observing the small changes in the zenith distances of γ Draconis, the Greenwich zenith-star.

When all these new instruments were well in working order, Mr. Airy directed the attention of the Board of Visitors, in the year 1855, to the fact that the extra-meridional apparatus was by no means fit for the present wants of astronomy. A large object-glass (12 French inches in diameter) was, in consequence, procured by the Astronomer-Royal from Mr. Merz, and was mounted

in the manner which was formerly adopted by Mr. Airy in the mounting of the equatorials at Cambridge and Liverpool. With the inauguration of the new equatorial in the year 1859 the change from the old state of the Observatory was complete. There was not then a single person or instrument in the Observatory that had been there in Mr. Pond's time.

A fifth new instrument was planned by Mr. Airy in the year 1869, and erected in the following year in the Royal Observatory, in order to decide the most delicate question of the dependence of the measurable amount of sidereal aberration upon the thickness of the glass or other transparent material in the telescope. The tube of a telescope (the lenses of which were ground to proper curves) was filled with water, and the telescope mounted as zenith-sector. Several years' observations of γ Draconis did not reveal a perceptible difference in the constant of aberration found in this manner from the value generally adopted.

Of the instruments invented by Sir George Airy I may mention also the double-image micrometer, a very useful apparatus, if thoroughly investigated; the eye-piece for correcting the atmospheric dispersion; the orbit-sweeper, a most ingenious contrivance to detect comets approaching perihelion passage, the time of which cannot be exactly fixed.

The observations were made, under his own responsibility, during nearly half a century, without interruption, reduced with great care, regularly printed, and—a very essential thing—very liberally distributed. They form a vast collection of the most important fundamenta of astronomy. Every year Sir George publishes a report on the work done in the Royal Observatory; these reports form a series which will be of the greatest use for the writer of the history of astronomy and science in general in the nineteenth century.

Since the year 1833 the incessant activity of Sir George Airy had been directed to an undertaking, proposed to astronomers by Bessel, in the preface of his "Tabulæ Regiomontanæ," viz., the reduction of the Greenwich lunar and planetary observations since 1750. This most arduous task was completed in the year 1848; and we may say that our present tables of the motions of the moon and the planets rest, for the greatest part, on those bulky volumes, containing these reductions.

But not only was this immense magazine of dormant facts opened by Sir George to science: he reduced also the observations of Groombridge, of Catton, and of Fallows, the first Astronomer-Royal of the Cape of Good Hope. The importance of these reductions is not limited by the usefulness of the observations themselves to the astronomer by the appearance of the "Star-Catalogue," containing Mr. Groombridge's most valuable observations. Mr. Johnson, for instance, was induced to undertake those beautiful observations of circumpolar stars, forming afterwards the Radcliffe catalogue of stars. Prof. Hansen, of Gotha, was very materially supported by the Astronomer-Royal in finishing his great work on the moon and calculating tables of her motion.

The pressure of daily work and the responsibility of keeping up the Greenwich series of solar and lunar observations absolutely uninterrupted, did not prevent the Astronomer-Royal from taking up other scientific questions of the day. In the year 1842 he made a voyage to Turin, in order to observe the total solar eclipse; the same object induced him to visit Gothenburg, in Sweden, in 1851, and to organise, in the year 1860, the famous *Himalaya* expedition to Spain.

His great interest in every branch of his favourite science is evinced by the recent introduction at Greenwich of heliographic and spectroscopic services.

In the year 1847 Sir George went to Russia for the purpose of inspecting the new Russian Central observatory. It is highly gratifying to read with what absence of prejudice the great astronomer expresses himself in regard to this observatory, the personal establishment of which and the construction of instruments is so very different from those at Greenwich.

Magnetical and meteorological observations were not made at Greenwich before the time of the present Astronomer-Royal. Sir George Airy proposed to the Government to make them at Greenwich, and since 1838 the new Magnetical and Meteorological Observatory has been in activity. He introduced for this department also the self-registering instruments constructed by Mr. Brooke.

In later years the Astronomer-Royal has been oppressed with the difficulty of making the meteorological observations practically available. With a store of records, extensive, accurate, and rich, beyond any other which exists, he does not see a probability of physical connections or physical laws sufficiently strong to induce him to enter confidently on an expensive comparison, and he expresses strongly his opinion, that the want of meteorology at the present time is principally in suggestive theory.

Only very briefly can I mention his very useful experiments on iron-built ships, for the purpose of discovering a correction for the deviation of the compass, which resulted in a system of mechanical corrections, universally adopted; his researches on the density of the earth by observations in the Harton Colliery; his extensive aid to Government in recovering the lost standard for measures; in fixing the breadth of railways; in introducing a new system for the sale of gas, &c. All these transactions have proved Sir George Airy "the thorough man of business." Indeed, the promptness of his correspondence and his kindness in answering every scientific inquiry in the most minute manner, is most remarkable and seldom to be met with in so profound a philosopher.

In recent years the Government intrusted to his care the equipment and instruction of the British Expedition for the Transit of Venus, a subject which had engaged the attention of the Astronomer-Royal during thirty years, and had induced him to write a number of most important papers on the matter. In the year 1848 he gave a series of lectures on this difficult subject at Ipswich. The whole responsibility for reducing the observations made during the transit rests likewise with him. Much of his time has, during the last few years, also been spent in promoting the lunar theory by a method of his own.

Sir George Airy has, of course, deservedly received the recognition of his country and the scientific world in general. He is medallist of the French Institute,

of the Royal Society (twice), of the Royal Astronomical Society (twice), and of the Institute of Civil Engineers. Most scientific societies are proud to have his name on their list of members; he is one of the eight Associés Étrangers de l'Académie des Sciences à Paris.

A. WINNECKE

FOREIGN ORDERS

IN several articles and letters in vol. viii. of NATURE the question of the conferment of foreign orders on British subjects, so far as it concerns men of science, was pretty thoroughly discussed, as well as the proposal made in Parliament, in 1873, to establish an order of intellectual merit. The subject has again come up in connection with the distribution of awards at the close of the Paris Exhibition, and there has been much disappointment and even bitterness of feeling expressed at the refusal of our Government to allow British subjects to accept the coveted Cross of the Legion of Honour. It is well known that many of our men of science, as well as others, possess foreign orders in abundance, and that our Government takes no notice unless consulted, when, on the ground of some antiquated regulations, it thinks it its duty to refuse permission to accept such orders. If not illegal, it is at any rate weak and childish on the part of Government to take such a course, worthy of the days of "good" Queen Bess, who wished her dogs to wear no collars but her own. In the case of the Exhibition awards it has been shown that this decision on the part of our Government falls with peculiar hardship on British exhibitors. It will very naturally be inferred by the general public that as a body they occupy an inferior position to foreign exhibitors, who are allowed to accept the great French honour, which is conspicuous by its absence from the awards in the British department. It is especially hard, we think, upon those who have served on the British jury. From some parsimonious caprice on the part of Government no allowance was made to those who served as jurors at the Paris Exhibition, and the eminent men of science who gave up their time and knowledge for the benefit of the country and the world not only go entirely unrewarded, but must have been seriously out of pocket. One case we know of—and we believe it is not the only one—where a well-known chemist, besides incurring serious expense, worked so hard as to materially affect his health, and all not even for bare thanks.

So far as we ourselves are concerned, we are not anxious to see men of science eager to obtain, or easy to be satisfied, with such honours as those which, if they are simple enough to ask, they are told they must not accept. Our own Government is niggardly enough in its recognition of the services done by the scientific worker to his country; and how can it be otherwise with a Cabinet that has scarcely a member, we believe, who knows the difference between a telescope and a telephone. Fortunately for his self-respect, the purely scientific worker, however eminent he may be as such, is rarely, if ever, embarrassed by the offer of honours from our own Government. These are reserved for the militant and civil services, where, as a rule, they are least requisite, seeing that those who obtain them are generally pretty well paid for their zeal. As for what is called the "honour" of knighthood, it has now become so common, so easily obtainable, that the mere offer of it must make one suspect that after all he must be regarded by its dispensers as a very tenth-rate man. We know of a humble grocer in a small country town in the north in which a statue erected to the late Prince Consort was unveiled by the Queen, when the decent man happened to be provost; of course he was dubbed "Sir," and his life was ever after rendered miserable by the waggish little urchins of the town, who would gravely pass their cans across the counter for "A bawbee worth o' treacle, Sir Dawvid." And C.B. is rapidly becoming little better, so that virtually in this country there is no imperial honour attainable by the purely scientific worker, however eminent, which his self-respect would permit him to accept entirely without question.

As to the creation of an order of merit for men of high eminence in science, literature, or art, we have already expressed our opinion. In the present state of things it is better to let the existing chaos alone. Who is there among those who would now have the dispensation of such an honour who is capable of selecting those really most worthy of it? Had we a Minister of Science, with a council of scientific specialists to guide him, then there would be some chance that such an honour would reach those who really deserved it; but at present it is hopeless. Indeed the devotee of scientific research would much prefer that Government, if it desires to do science honour, would do so by giving her substantial aid to pursue her work, than that it should load her servants with all the honours at her Majesty's disposal.

Still with the parsimony both of money and "honours" at home, it is peculiarly hard that scientific men can accept the distinctions which foreign governments are ready enough to award only as if they were contraband goods. Literature and art are abundantly rewarded in both ways, but, like virtue, science, on which the substantial welfare of the world depends, is its own reward; but this, unfortunately, is not marketable. We trust that the present outcry will lead to a modification of the unreasonable regulation as to foreign orders.

THE "ENCYCLOPÆDIA BRITANNICA"

The Encyclopædia Britannica. Ninth Edition. Vols. vii. and viii. (*Deacon* to *Fakir*). (Edinburgh: A. and C. Black, 1877-78.)

IN the article ENCYCLOPÆDIA, which finds a place in the second of the volumes now before us Mr. Lyons defines an encyclopædia as a book treating of all the various kinds of knowledge. The definition applies well enough to the older encyclopædias, composed when it was still thought practicable to set forth in a single work all that was worth knowing in science and art. To define the province of a modern encyclopædia is a more difficult task, which will probably be avoided by every one who is not compelled either to plan and edit a work of the kind, or to review an editor's plan. Smaller cyclopædias, on the type of the "Conversations Lexicon," naturally limit