George Biddell Airy | Encyclopedia.com

(*b*. Alnwick, Northumberland, England, 27 July 1801; *d*. Greenwich, England, 2 January 1892)

astronomy.

George Airy was the eldest of four children of William Airy, a farmer who through self-education acquired posts in the Excise, and of Ann Biddell, daughter of a well-to-do farmer. At the age of ten he took first place at Byatt Walker's school at Colchester but, as he himself records, because he had very little animal vitality, he was not a favorite with his schoolmates. In the school he thoroughly learned arithmetic, double-entry bookkeeping, and the use of the slide rule. An introverted but not shy child, Airy was, even for the time and especially for his circumstances, a young snob. Nevertheless, he overcame some of the dislike of his schoolmates by his great skill and inventiveness in the construction of peashooters and other such devices.

At the age of twelve Airy came to know his uncle Arthur Biddell, a well-educated and highly respected farmer near Ipswich. He recognized in his uncle an opportunity to escape what he considered unpromising surroundings, and secretly requested that he be removed from his family. Arthur Biddell almost literally kidnapped him, without any word to his parents, but because of financial difficulties caused by William Airy's loss of his Excise post, the escape was not blocked. From 1814 to 1819 Airy spent nearly half of his time with his uncle. In later life he put great value on this connection, especially becaue of the resulting acquaintances, including Thomas Clarkson, the abolitionist, who could help his career. It was through Clarkson and Charles Musgrave, fellow of Trinity College, Cambridge, that he was entered as sizar of Trinity College in October 1819.

Airy entered Cambridge with the determination to get on, and he was certainly equipped to do so. Although his own assessment of his abilities was immodestly high, it was nevertheless matched, albeit sometimes reluctantly, by his tutors and college friends. He graduated as a Senior Wrangler in 1823 after far outdistancing all the men of his year, although beginning in his second term he had the burden of supporting himself by taking pupils. He was elected a fellow of Trinity College in 1824.

Three incidents from this period illustrate the care and foresight with which Airy planned his life. The first concerns the habit he adopted, as an undergraduate, of always keeping by him a quire of largesized scribbling paper, sewn together, upon which everything was entered; translations into Latin and out of Greek, several lines of which he attempted every day, no matter how pressing other business might be; mathematical problems; and nearly every thought he had, complete with date. The sheets, even after the more important items were transferred to exercise books or diaries, were kept, together with nearly every communication received and a copy of those sent throughout his life, and are still extant. He seems not to have destroyed a document of any kind whatever: stubs of old checkbooks, notes for tradesmen, circulars, bills, and correspondence of all sorts were carefully preserved in chronological order from the time that he went to Cambridge. This material provides possibly the best existing documentation of a truly Victorian scientist.

The second illustrative incident involves Airy's courtship of his future wife, Ricarda Smith, the eldest daughter of the Rev. Richard Smith, private chaplain to the duke of Devonshire. He met Miss Smith white he was on a walking tour in Derbyshire, and within two days of first seeing her he made an offer of marriage. Neither his means nor his prospects at the time permitted an immediate marriage, and the Rev. Smith would not permit an engagement. Undaunted, Airy renewed his suit from time to time, and six years after his first proposal they were married.

A similar singleness of purpose is shown in Airy's approach to a prospective position at the Royal Greenwich Observatory. In 1824 an attempt was made to improve the educational level of assistants at the Royal Observatory by hiring one or two Cambridge graduates. Airy was proposed as one of these assistants and traveled to Greenwich to investigate the possibility. However, in his own words, "when I found that succession to the post of Astronomer Royal was not considered as distinctly a consequence of it, I took it cooly [*sic*] and returned to Cambridge the next night."

Airy applied for and won the Lucasian professorship in 1826. In doing this, he exchanged an assistant tutorship worth £150 per annum, and the prospect o succeeding to a tutorship, for the £99 per annum of the professorship, supplemented by a somewhat uncertain £100 per annum as *ex officio* member of the Board of Longitude. Other considerations were that "my prospects in the law or other profession might have been good if I could have waited but marriage would have been out of the question and I much preferred a moderate income in no long time. I had now in some measure taken science as my line (though not irrevocably) and I thought it best to work it well for a time at least and wait for accidents."

The Plumian professorship, which involved the care of the Cambridge Observatory, became vacant in 1828, and Airy "made known that I was a candidate and nobody thought it worthwhile to oppose me… . I told everybody that the salary (about £300)

was not sufficient and drafted a manifesto to the University for an increase… . the University had never before been taken by storm in such a manner and there was some commotion about it. I believe very few people would have taken the same step… . I had no doubt of success." He was appointed Plumian professor and director of the observatory on 6 February 1828, with a salary of £500 per annum. Although he accepted the post of astronomer royal in 1835, when he moved from Cambridge to Greenwich, Airy's considerable influence on British astronomy stretches without break from his appointment at Cambridge in 1828 to his retirement as astronomer royal in 1881. He was knighted in 1872, after thrice refusing on the basis that he could not afford the fees.

The ruling feature of Airy's character was undoubtedly order, and from the time he went up to Cambridge until the end of his life his system of order was strictly maintained. He wrote his autobiography up to date as soon as he had taken his degree, and made his first will as soon as he had any money to leave. His accounts were personally kept by double entry, and he regarded their keeping as one of his greatest joys. The effect of this sense of order on British observational astronomy is the only reason that Airy is included in this volume, for he was an organizer rather than a scientist. To realize his importance, it is necessary to understand the astronomy of the nineteenth century and the role played by such institutions as the Royal Greenwich Observatory.

The rise of astronomy in the seventeenth and eighteenth centuries took the form of careful observations of stellar positions made to provide a framework within which planetary motions could be measured. The first astronomer royal, John Flamsteed, provided the earliest observations of this kind that are still useful today. Although the emphasis in modern astronomy has shifted beyond the planets to the stars and external galaxies, these early observations provide us with a three-hundred-year base line for measuring the motions of the stars themselves, and knowledge of these motions is vital to the understanding of the origin and evolution of the stars. Observations of this kind are not only necessary in large numbers but they must be extremely exacting if the results are he be of general use. They are therefore best made in a routine way by those more interested in the technological problems of their procurement than in their scientific use. The Royal Greenwich Observatory, following Flamsteed's early lead, became the primary producer of such observations, mainly because the Admiralty was interested in the more immediate need of them for navigational purposes. Partly because the utilitarian purpose was stressed, scientific supervision of the observations eventually decreased and was refocused only in the nineteenth century, when it became obvious that their lack of accuracy was adversely affecting their use in navigation. The situation was ripe for Airy with his scientific training and his sense of order. The reforms he introduced were copied by other countries that, because they were expanding their navies to protect their expanding merchant fleets, needed the navigational aids.

The secret of Airy's long and successful official career was that he was a good servant who thoroughly understood his position. He never set himself in opposition to his masters, the Admiralty. He recognized the task for which he was appointed and transformed the Royal Greenwich Observatory into a highly efficient institution. The cost, however, was high. No independent thought could be tolerated, and as a result no scientists were trained there. The often slipshod methods that lead to scientific discovery were carried on outside, by John Herschel, John Adams, and many others. Airy himself would not understand this criticism. He wrote, in 1832,"… in those parts of astronomy which depend principally on the assistance of Governments, requiring only method and judgement, with very little science in the persons employed, we have done much; while in those which depend exclusively on individual effort we have done little… . our principal progress has been made in the lowest branches of astronomy while to the higher branches of science we have not added anything," He needed only to add that he had done *his* job.

In any article on Airy mention must be made of the controversy accompanying the discovery of the planet Neptune. It is ironical that the kind of order Airy restored to the observational work at Greenwich should coincide with the greatest need for the results since Newton had put Flamsteed's observations to such good use in the *Principia*—and then be unfairly blamed in nearly every subsequent article on the discovery of Neptune for withholding these observations. In fact, Airy supplied all the major participants in this discovery with the observational data they requested, and the only basis for the subsequent attacks upon him was that he was not at home when John Adams, then a young Cambridge mathematician, called unannounced to present one of his early predictions that such a planet as Neptune had to exist in order to account for the motions of the other planets. Airy's great efficiency in the observatory was noted by other government services and he rapidly became the prototype of the modern government scientist. This kept him from the observatory a large amount of time.

Always of medium stature and not powerfully built, Airy seemed to shrink as he aged, mainly because of an increasing stoop. His constitution, even at eighty-five, was remarkably sound. He took not the least interest in athletic sports or competition, but he was always a very active walker and could endure a great deal of fatigue. His eyesight was peculiar, and he studied it thoroughly all his life, correcting the astigmatism with a cylindrical lens, a method that he invented and is still used. As his powers failed with age, he was tyrannized by his ruling passion for order, and his efforts went into correctly filing his correspondence rather than understanding its contents. He was by nature eminently practical, and his dislike of mere theoretical problems and investigations put him continually in dissent with some of the resident Cambridge mathematicians. This practical bent led him to undertake, in 1872, the preparation of a numerical lunar theory. This work consisted, essentially, of obtaining from observations numerical values of the 320 periodic terms in Delaunay's equations for the moon's motion. His difficulties are summed up in a note of 29 September 1890:

I had made considerable advance (under official difficulties) in calculations on my favourite Numerical Lunar Theory, when I discovered that, under the heavy pressure of unusual matters (two Transits of Venus and some eclipses)I had committed a

grievous error in the first stage of giving numerical value to my Theory. My spirit in the work was broken, and I have never heartily proceeded with it since.

Airy was not a great scientist, but he made great science possible. It is true that he was indirectly responsible for guiding British observational astronomy into a cul-de-sac from which it took many years to retreat, but it was not his fault that the methods he devised to provide a particular service at a particular time were so efficiently contrived and completely implemented that weaker successors continued to apply them, unchanged, to changing conditions.

BIBLIOGRAPHY

Airy's bibliography contains over 500 printed papers and the following books: *Mathematical Tracts on Physical Astronomy, the Figure of the Earth, Precession and Nutation, and the Calculus of Variations* (Cambridge, 1826); 2nd ed. (London, 1831), with the *Undulatory Theory of Optics* added; 4th ed. (London, 1858); *Undulatory Theory of Optics* also published separately (London, 1877); *Gravitation: An Elementary Explanation of the Principal Perturbations in the Solar System* (London, 1834, 1884); *Six Lectures on Astronomy* (London, 1849); *A Treatise in Trigonometry* (London, 1855); *On the Algebraical and Numerical Theory of Errors of Observations and the Combination of Observations* (London, 1861; 3rd ed., 1879); Essays on the invasion of Britain by Julius Caesar, the invasion of Britain by Plautius, and by Claudius Caesar; the early military policy of the Romans in Britain; the Battle of Hastings; and correspondence were published in *Essays* (London, 1865); *An Elementary Treatise on Partial Differential Equations* (London, 1866); *On Sound and Atmospheric Vibrations, With the Mathematical Elements of Music* (London, 1868, 1871); *A Treatise on Magnetism* (London, 1870): *Notes on the Earlier Hebrew Scriptures* (London, 1876): and *Numerical Lunar Theory* (London, 1886).

The complete list of printed papers is given in Wilfred Airy's edition of the *Autobiography of Sir George Airy* (London, 1896). They can be divided into four main categories: optics, both practical and theoretical; practical astronomy, including reports of progress and final publication of results obtained by the observers at Cambridge and Greenwich; government science, concerning the many tasks other than astronomy for which the government claimed his time; and contributions to the many polemics that marked nineteenth-century British science.

The extensive biographical data are housed mainly in the new Royal Greenwich Observatory at Herstmonceux Castle, Sussex. Some of those covering Airy's pre- and post-Greenwich careers are in the hands of the writer, and the remainder are scattered between the archives of the Royal Astronomical Society, the Royal Society, and the Royal Greenwich Observatory. As already noted, Airy apparently never discarded a piece of paper. His son Wilfred (as I have been informed by Airy's granddaughter) had no such inhibitions, and, after including a few extracts in his edition of the *Autobiograophy*, destroyed the voluminous correspondence between Sir George and Lady Airy.

Olin J. Eggen