Sir George Biddell Airy (1801 – 1892)

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Sir George Biddell Airy PRS KCB was an English mathematician and astronomer, Astronomer Royal from 1835 to 1881. His many achievements include work on planetary orbits, measuring the mean density of the Earth, a method of solution of two-dimensional problems in solid mechanics and, in his role as Astronomer Royal, establishing Greenwich as the location of the prime meridian. His reputation has been tarnished by allegations that, through his inaction, Britain lost the opportunity of priority in the discovery of Neptune.

Biography:

Airy was born at Alnwick, one of a long line of Airys who traced their descent back to a family of the same name residing at Kentmere, in Westmorland, in the 14th century. The branch to which he belonged, having suffered in the English Civil War, moved to Lincolnshire and became farmers. Airy was educated first at elementary schools in Hereford, and afterwards at Colchester Royal Grammar School. An introverted child, Airy gained popularity with his schoolmates through his great skill in the construction of peashooters.

From the age of 13, Airy stayed frequently with his uncle, Arthur Biddell at Playford, Suffolk. Biddell introduced Airy to his friend Thomas Clarkson, the slave trade abolitionist who lived at Playford Hall. Clarkson had an MA in mathematics from Cambridge, and examined Airy in classics and then subsequently arranged for him to be examined by a Fellow from Trinity College, Cambridge on his knowledge of mathematics. As a result he entered Trinity in 1819, as a sizar, meaning that he paid a reduced fee but essentially worked as a servant to make good the fee reduction. Here he had a brilliant career, and seems to have been almost immediately recognised as the leading man of his year. In 1822 he was elected scholar of Trinity, and in the following year he graduated as senior wrangler and obtained first Smith's prize. On 1 October 1824 he was elected fellow of Trinity, and in December 1826 was appointed Lucasian professor of mathematics in succession to Thomas Turton. This chair he held for little more than a year, being elected in February 1828 Plumian professor of astronomy and director of the new Cambridge Observatory. In 1836 he was elected a Fellow of the Royal Society and in 1840, a foreign member of the Royal Swedish Academy of Sciences.

Research:

Some idea of his activity as a writer on mathematical and physical subjects during these early years may be gathered from the fact that previous to this appointment he had contributed no less than three important memoirs to the Philosophical Transactions of the Royal Society, and eight to the Cambridge Philosophical Society. At the Cambridge observatory Airy soon showed his power of organisation. The only telescope in the establishment when he took charge was the transit instrument, and to this he vigorously devoted himself. By the adoption of a regular system of work, and a careful plan of reduction, he was able to keep his observations up to date, and published them annually with a punctuality which astonished his contemporaries. Before long a mural circle was installed, and regular observations were instituted with it in 1833. In the same year the Duke of Northumberland presented the Cambridge observatory with a fine object-glass of 12-inch aperture, which was mounted according to Airy's designs and under his superintendence, although construction was not completed until after he moved to Greenwich in 1835.

Airy's writings during this time are divided between mathematical physics and astronomy. The former are for the most part concerned with questions relating to the theory of light arising out of his professorial lectures, among which may be specially mentioned his paper On the Diffraction of an Object-Glass with Circular Aperture, and his enunciation of the complete theory of the rainbow. In 1831 the Copley Medal of the Royal Society was awarded to him for these researches. Of his astronomical writings during this period the most important are his investigation of the mass of Jupiter, his report to the British Association on the progress of astronomy during the 19th century, and his work On an Inequality of Long Period in the Motions of the Earth and Venus.

One of the sections of his able and instructive report was devoted to "A Comparison of the Progress of Astronomy in England with that in other Countries," very much to the disadvantage of England. This reproach was subsequently to a great extent removed by his own labours.

Engineering mechanics

1. Stress function method:

In 1862, Airy presented a new technique to determine the strain and stress field within a beam. This technique, sometimes called the Airy stress function method, can be used to find solutions to many two-dimensional problems in solid mechanics (see Wikiversity). For example, it was used by H. M. Westergaard to determine the

stress and strain field around a crack tip and thereby this method contributed to the development of fracture mechanics.

2. Tay Bridge Disaster:
Airy was consulted about wind speeds and pressures likely to be encountered on the proposed Forth suspension bridge being designed by Thomas Bouch for the North British Railway in the late 1870s. He thought that pressures no greater than about 10 pounds per square foot could be expected, a comment Bouch took to mean also applied to the first Tay railway bridge then being built. Much greater pressures however, can be expected in severe storms. Airy was called to give evidence before the Official Inquiry into the Tay Bridge disaster, and was criticised for his advice. However, little was known about the problems of wind resistance of large structures, and a Royal Commission on Wind Pressure was asked to conduct research into the problem.

Private life:

In July 1824, Airy met Richarda Smith (1804–1875), "a great beauty", on a walking tour of Derbyshire. He later wrote, "Our eyes met ... and my fate was sealed ... I felt irresistibly that we must be united," and Airy proposed two days later. Richarda's father, the Revd Richard Smith, felt that Airy lacked the financial resources to marry his daughter. Only in 1830, with Airy established in his Cambridge position, was permission for the marriage granted.

The Airys had nine children, the eldest three dying in childhood. The eldest survivor, Wilfrid Airy, was the designer and engineer for "Colonel" George Tomline's Orwell Park observatory. Wilfrid's daughter was the artist Anna Airy.

Airy retired in 1881, living with his two married daughters at Croom's Hill near Greenwich. In 1891, he suffered a fall and an internal injury. He survived the consequential surgery only a few days. His wealth at death was £27,713. Airy and his wife and three pre-deceased children are buried at St. Mary's Church in Playford, Suffolk. A cottage owned by Airy still stands, adjacent to the church and now in private hands.

Legacy and honours:
1. He was elected president of the Royal Astronomical Society four times.
2. Foreign Honorary Member of the American Academy of Arts and Sciences (1832)
3. The Martian crater Airy is named for him. Within that crater lies another smaller crater called Airy-0 whose location defines the prime meridian of that planet, as does the location of Airy's 1850 telescope for Earth.
4. Winner of the Lalande Prize for astronomy from the French Academy of Sciences, 1834
5. There is also a lunar crater Airy named in his honour.
6. Airy wave theory is the linear theory for the propagation of gravity waves on the surface of a fluid.