Biographical Encyclopedia of Astronomers

Whewell, William

Born Lancaster, Lancashire, England, 24 May 1794

Died Cambridge, England, 6 March 1866

William Whewell was a philosopher of science and a central figure in early Victorian science and mathematics whose astronomical work focused upon tides. Born the eldest son of a carpenter, he attended the grammar school at Heversham, Westmorland, and then entered Trinity College, Cambridge, graduating as second wrangler. He became a fellow of the college in 1817, taking his M.A. degree in 1819 and his D.D. degree in 1844

By the first quarter of the 19th century, French mathematicians, applying analytical methods to Newtonian physics, had established a supremacy over British mathematicians. In 1819, the year Whewell helped form the Cambridge Philosophical Society, he published his first textbook, *An Elementary Treatise on Mechanics*, the first English text on applied mathematics that consistently used continental symbols and became the standard for undergraduates at Cambridge. With his second textbook, *A Treatise on Dynamics* (1823), Whewell became a leading advocate for French analytical methods in Britain. He went on to hold professorships first in mineralogy (1828), then moral philosophy (1838); ultimately, he accepted the mastership of Trinity College, Cambridge (1841), an appointment he held until his death

At Cambridge, Whewell developed one of the foremost mathematical curricula in history. A zealous and prolific researcher, he published significant works in experimental physics, crystallography, mineralogy, physical astronomy, science education, architecture, poetry, and religion, along with a bewildering number of more popular reviews, lectures, and sermons. He was the inventor of the self-registering anemometer and the originator of many new scientific terms, including "ion," "cathode," "Eocene," "Miocene," "physicist," and "scientist." Whewell is best known for his multivolume *History of the Inductive Sciences* (1837) and his equally impressive *Philosophy of the Inductive Sciences* (1840), both unrivaled in their day. These works helped to define what "science" was in the early Victorian era, an important period in the professionalization of the sciences

Whewell's work in history and philosophy, and his own researches in physical astronomy, were intimately linked; in the mid-1830s, Whewell composed his *History*, outlined his *Philosophy*, and published his most extensive tidal researches. Physical astronomy, the "queen of sciences" according to Whewell, had reached a state of maturity that no other science could emulate. He referred to it as the only complete science, and it was central to both his *History* and his *Philosophy*. Whewell laid out a complete philosophy of scientific methodology. His *History* focused on the gradual ascension of scientific knowledge from facts to phenomenological laws, and finally to causal laws. Each science began with a "prelude" in which a mass of unconnected facts predominated. The scientist's act of "colligation" brought about an "inductive epoch" where a useful theory was formed through the scientist's creative role. A "sequel" followed in

which the successful theory was refined and applied. Whewell's historical analysis of physical science provided the basis for his philosophy of science.

Deeply influenced by Immanuel Kant, Whewell, like Kant, emphasized the creative role of the mind and the need for bold unifying conjectures that far surpassed the empirical evidence. Because a "boldness and license to guess" was a necessary aspect of all progress in science, Whewell also believed the scientist must be equally prepared for testing each hypothesis. Though a correct theory should be able to account for all of the observed facts and predict new ones, the true test of a scientific hypothesis came when it explained "cases of a kind different from those which were contemplated in [its] formation." According to Whewell, cases in which "inductions from classes of facts altogether different have thus jumped together," a peculiar feature he termed "consilience of induction," belonged only to the best-established theories in the history of science.

Whewell's own research in physical astronomy was in what he termed "tidology." Between 1833 and 1850, he wrote 14 major papers on the study of the tides, along with numerous shorter essays. By following the analogy of physical astronomy, his model science, and Johannes Kepler, his model scientist, Whewell sought to have masses of observations made around the globe to determine the phenomenological laws of the tides. He pursued two major lines of research: The first advanced the earlier work of John William Lubbock and entailed an analysis of long-term observations to determine the tidal constants at the major ports in Great Britain, including the establishment of each port and the effects of the parallax and declination of the sun and moon. His second line of research was unique and entailed an analysis of short-term but simultaneous observations along the entire coast of Great Britain, and eventually Europe and America. In July 1835, Whewell organized a "great tide experiment" where the tides were measured every 15 minutes for a fortnight at over 650 tidal stations in nine countries, including Great Britain, France, and the United States. He used these simultaneous measurements to draw a map of "co-tidal lines" to determine the motion of the tides across the ocean.

Whewell's work on the tides was modestly successful. He combined his method of analyzing long-term observations with simultaneous short-term measurements in a unique fashion to determine the course of the tide around the British coast. He determined the empirical laws for the parallax and declination of the Moon and Sun, and quite correctly noted the importance of the diurnal inequality—his prize analysis—for any future theory. Along with John Herschel, Whewell pioneered the graphical representation of data and its use in theoretical investigations He used his unique "graphical method of curves" throughout his tidal studies and, in turn, used his tidal research as an explanation of the process of data reduction and analysis in his *Philosophy*. Thus, though Herschel had laid out the graphical method in 1833, it was Whewell who explained it for the first time in combination with other methods of data analysis, such as the method of residues, and popularized its use through the pages of his *Philosophy*. He received the Royal Society's Royal Medal for his efforts in 1838.

Whewell held many titles, including Fellow of the Royal Society of London and the Royal Astronomical Society, and honorary membership in numerous foreign societies.

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