

Biographical Encyclopedia of Astronomers

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Ferrel, William

Born Bedford (Fulton) County, Pennsylvania, USA, January 29, 1817

Died Maywood, Kansas, USA, September 18, 1891

William Ferrel was a self-taught American meteorologist and geophysicist best known for his maxima and minima tide-predicting machine, for Ferrel's law, and as the father of geophysical fluid dynamics. He was the son of Benjamin Ferrel, a farmer and sawmill operator; his mother's maiden name was Miller. In 1829, the family relocated from Pennsylvania to a farm in Berkeley County, Virginia (today Martinsburg, West Virginia). William attended public schools and worked on the family farm. His curiosity about the scientific world around him made him a passionate reader of mathematics, surveying, and mathematical physics. With money saved from teaching, he attended Marshall College in Mercersburg, Pennsylvania, beginning in 1839, and later transferred to the new Bethany College

Bethany, Virginia. Following graduation from Bethany in 1844, Ferrel continued teaching, first at Liberty, Missouri (1844-1850), then at Allenville, Kentucky (1850-1854), and finally in Nashville, Tennessee, until 1857, where he opened his own school

Ferrel taught himself mathematics, including algebra, geometry, and trigonometry. He pursued his mathematical studies according to the availability of books rather than by following the traditional route, and he learned land surveying from a professional who lived in the area. Ferrel's early years of educational deprivation, and his later years of intellectual isolation, left his mind open to original methods of thought. His interest in astronomy, which began in the early 1830s, prompted him to ponder mathematical complexities, such as the prediction of eclipses. The essays of George Airy, including his "Figure of the Earth" and "Tides and Waves," influenced Ferrel's study of the oceans and the atmosphere

While in Liberty, Ferrel found a copy of Isaac Newton's *Principia* for sale, which he studied in detail. Newton's explanation of tides particularly intrigued him, and following extensive study, Ferrel correctly concluded that the motion of the tides influenced the speed at which the Earth rotated. Ferrel also studied Nathaniel Bowditch's translation of the classic work *Mécanique céleste* by Pierre de Laplace. He was further influenced by physicist Jean Foucault's studies of the Earth's rotation using his pendulum and gyroscope, and by Matthew Maury's publication *Physical Geography of the Sea* (1855).

Ferrel published his first paper in 1853 in Benjamin Gould's *Astronomical Journal*, in which he correctly argued the accuracy of the equations Laplace used in his work on tides. This was followed in 1856 by the publication of his "Essay on the Winds and Currents of the Ocean" in the *Nashville Journal of Medicine and Surgery*. Ferrel's work on this topic culminated in 1858 with his conclusion, later dubbed Ferrel's law,

that if a body is moving in any direction, there is a force arising from the Earth's rotation, which always deflects it to the right in the northern hemisphere, and to the left in the southern.

This was an independent statement of what is now called the Coriolis effect. He later showed how this law could explain storms, wind patterns, and ocean currents

Ferrel's advancements in science earned him a position in the US Navy's Nautical Almanac Office in Cambridge, Massachusetts. This appointment placed him in proximity to libraries and in an intellectually stimulating environment among mathematicians and astronomers, such as Benjamin Peirce, Gould, Asaph Hall, and Simon Newcomb. When Peirce became superintendent of the United States Coast Survey in 1867, Ferrel followed him to Washington

In 1876, around the same time that William Thomson (Lord Kelvin) developed a tide-predicting machine, Ferrel independently built a tide machine of a somewhat different, more compact and refined design, which predicted minimum and maximum tides. Ferrel's tide-predicting machine was put into service in 1883 and was unrivaled for the next 25 years. The chief of the Tidal Division of the Coast and Geodetic Survey stated that Ferrel's tide machine performed the work of 40 (human) computers.

Ferrel's continuing interest in astronomy led him to use tidal data to calculate the mass of the Moon. The publication from 1877 to 1882 of his three-volume *Meteorological Researches* led to Ferrel's employment from 1882 to 1886 as a meteorologist with the United States Army Signal Service, which was responsible for the nation's weather service prior to the creation of the Weather Bureau in 1891. American meteorologist Cleveland Abbe credited Ferrel's 1859/1860 memoir in the *Mathematical Monthly* on the mechanics of the atmosphere as being "... to meteorology what the *Principia* was to astronomy..."

Ferrel retired to Kansas in 1887 to live with his family and died there. He never married.

Patricia S. Whitesell

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