Biographical Encyclopedia of Astronomers

Moulton, Forest Ray

Born Osceola County, Michigan, USA, April 29, 1872

Died Wilmette, Illinois, USA, December 7, 1952

Forest Moulton is perhaps best remembered for his collaboration with Thomas Chamberlin on what became known as the Chamberlin-Moulton hypothesis

Moulton was born in a log cabin built by his father, Belah Moulton, a Civil War veteran, on the family's 160-acre homestead in Michigan. His mother, Mary (née Smith) Moulton, was impressed by rays of sunlight filtering through the surrounding forest; hence her son's name. Moulton was educated at home by his mother, next in a one-room school, and then at Albion College, from which he received his B.A. degree in 1894. He attended the University of Chicago as a graduate student in 1895, was appointed assistant in astronomy in 1896, received his Ph.D. in astronomy and mathematics in 1899, and then joined the university's faculty.

Moulton rose to full professor in the astronomy department. His field was celestial mechanics, including the three-body problem and its application to the motion of the Moon under the influence of the Earth and Sun His 1902 text, *Introduction to Celestial Mechanics*, later revised in 1914, was widely used. More elementary texts were his *Introduction to Astronomy*, published in 1906, and *Descriptive Astronomy*, in 1912. With his colleagues at Chicago, Moulton developed a survey course, and the accompanying text, *The Nature of the World and Man*, was published in 1926. It was reissued in 1937 and revised in 1939 as *The World and Man as Science Sees Them*. Moulton also wrote *Consider the Heavens*, a popular book, in 1935. Always interested in popularizing astronomy, Moulton acted as an informal advisor to Frederick Charles Leonard (1896–1960) and his Society for Practical Astronomy, which enjoyed some national success in the period from 1910 to 1916. Leonard went on to found the astronomy department at the University of California, Los Angeles, and established himself as an authority in meteorology.

During World War I, Moulton was commissioned a major in the Army and placed in charge of the Ballistics Branch of the Army Ordnance Department at Aberdeen, Maryland. There, he developed new methods for calculating the trajectories of artillery projectiles. In 1926, he published *New Methods in Exterior Ballistics*. Also of a technical nature was Moulton's 1930 textbook, *Differential Equations.*

Moulton was a member of an interdisciplinary research team headed by Chamberlin, the chairman of the Geology Department at the University of Chicago. The team investigated mutual problems in geophysics and astronomy. Beginning in 1903, half of Moulton's salary was covered by Chamberlin's grant from the Carnegie Institution of Washington.

In his studies on the Earth's changing climate in the geological past, Chamberlin had begun to question the plausibility of Pierre de Laplace's nebular hypothesis. Laplace had postulated that

a hot fluid had cooled, condensed, and gradually shrunk to the present size of the Sun; rings of gas shed by the shrinking Sun had condensed into the planets of the Solar System. Chamberlin, however, realized that glaciation and salt deposits indicated a colder and more arid climate in the past, incompatible with the warm and moist conditions postulated by Laplace's theory

More troubling was the fact that a majority of the Solar System's angular momentum resided in the orbits of the Jovian planets, while its mass is heavily concentrated in the Sun—an unlikely occurrence within Laplace's nebular hypothesis. This unsymmetrical distribution of matter and angular momentum suggested to Chamberlin that the Solar System had been formed by the near-collision of a nebulous cloud and the proto-Sun. From his analysis of the dynamic considerations, Moulton concluded that the original solar nebula had perhaps been similar to a spiral nebula. Astronomers have since abandoned the Chamberlin-Moulton hypothesis and have assumed an alternate version of the nebular hypothesis, despite its unsolved dynamical problems

Moulton served as a private consultant to the directors of the Meteor Crater Exploration and Mining Company (1929/1930), organized by Daniel Barringer, and produced the most thorough analysis regarding the probable size, mass, and speed of the incoming projectile. His calculations cast serious doubt on the existence of a still-buried meteoric mass

By the early 20th century, the calculation of orbits as practiced by Moulton had become somewhat obsolete. Observational astrophysics held far greater research promise than theoretical astronomy. The booming business and stock market of the 1920s, in which Moulton's younger brothers were participating, offered an alluring alternative career, and Moulton resigned his position at the University of Chicago in 1926 to become director of the Utilities Power and Light Company in Chicago, where he remained until 1937. His company barely survived the Great Depression. Moulton also served as a trustee and director of concessions for Chicago's Century of Progress Exposition (1933/1934). He closed the concession books in 1936 with a profit.

In the 1930s, after leaving the University of Chicago, Moulton retained his interest in popularizing astronomy. He conducted a weekly radio broadcast of interest to aspiring amateur astronomers that was heard throughout the midwestern United States. On each broadcast, Moulton offered copies of his books as a prize for the best weekly essay he received. More than a few of the recipients of these books went on to pursue careers in science and engineering, including Hugh M. Johnson, who had a distinguished career as an X-ray astronomer.

Afterwards, Moulton undertook another major career move, serving as Permanent Secretary of the American Association for the Advancement of Science (AAAS) from 1937 to 1946, and as Administrative Secretary from 1946 to 1948. Under his direction, the Association doubled its membership and gained control of the Association's journal, Science, from the J. McKeen Cattel family. The archives of the AAAS contain records of Moulton's work there from 1937 to 1948

Moulton was married and divorced twice: to Estelle Gillete, from 1897 to 1938, with whom he had four children; and to Alicia Pratt, from 1939 to 1951.

Norriss S. Hetherington

Selected References

Brush, Stephen G. (1978). "A Geologist among Astronomers: The Rise and Fall of the Chamberlin-Moulton Cosmogony." Parts 1 and 2. *Journal for the History of Astronomy* 9: 1-41, 77-104.

Gasteyer, Charles E. (1970). "Forest Ray Moulton." *Biographical Memoirs, National Academy of Sciences* 41:341-355.

Hetherington, Norriss S. (1994). "Converting an Hypothesis into a Research Program: T. C. Chamberlin, His Planetesimal Hypothesis, and Its Effect on Research at the Mt. Wilson Observatory." In *The Earth, the Heavens and the Carnegie Institution of Washington: Historical Perspectives after Ninety Years*, edited by Gregory A. Good, pp. 113-123. *History of Geophysics*, vol. 5. Washington, D.C.: American Geophysical Union.

Hoyt, William Graves (1987). *Coon Mountain Controversies: Meteor Crater and the Development of Impact Theory*. Tucson: University of Arizona Press, esp. pp. 264-293, 306-317.

Osterbrock, Donald E. (1997). *Yerkes Observatory, 1892-1950: The Birth, Near Death, and Resurrection of a Scientific Research Institution*. Chicago: University of Chicago Press

—— (1999). "Moulton, Forest Ray." In *American National Biography*, edited by John A. Garraty and Mark C. Carnes, Vol. 16, pp. 27-28. New York: Oxford University Press.

Tropp, Henry S. (1974). "Moulton, Forest Ray." In *Dictionary of Scientific Biography*, edited by Charles Coulston Gillispie. Vol. 9, pp. 552-553. New York: Charles Scribner's Sons