Biographical Encyclopedia of Astronomers

Bradley, James

Born Sherbourne, Gloucestershire, England, March 1693

Died Chalford, Gloucestershire, England, 13 July 1762

James Bradley discovered the aberration of starlight. He was the third son of William Bradley and Jane Pound. On 25 June 1744, at age 51, Bradley married Susannah Peach of Chalford, Gloucestershire, England, with whom he had a daughter in 1745. His wife died in 1757

Bradley attended Northleach Grammar School. He received his B.A. in 1714 and M.A. in 1717 from Balliol College, Oxford. Bradley was awarded an honorary D.D. degree by Oxford in 1742 upon his appointment as Astronomer Royal. In 1718, he was elected a Fellow of the Royal Society on the recommendation of Astronomer Royal Edmond Halley. He was also given membership in national academies of science in Berlin, Paris, Bologna, and Saint Petersburg. Bradley was ordained in 1719 and became vicar of the congregation at Bridstow, Monmouthshire

Bradley learned astronomy from his uncle, Reverend James Pound, rector at Wanstead, Essex, near London, with whom Bradley frequently stayed. Young Bradley adored his uncle James, who helped support him financially, nurtured him through smallpox in 1717, and ultimately fostered his love of astronomy. By the time Bradley was in his 20s, he and his uncle had formed a long-standing observing partnership. So respected were their skills that both Isaac Newton and Halley entrusted them on multiple occasions with observing projects. Working together, Bradley and Pound determined the positions of stars and nebulae, observed eclipses of Jupiter's moons, and measured the diameter of Venus (with a 212-foot-long telescope) and also the parallax of Mars. Bradley himself calculated the orbits of two comets

Bradley resigned his vicarage in Bridstow in 1721 upon his appointment as Savilian Professor of Astronomy at Oxford, a position for which he was recommended by Newton. Given his modest annual salary of 140 pounds, Bradley could not afford to live at the university. Instead, he moved in with Pound in Wanstead and visited the Oxford campus only to deliver the required lectures. In 1724, following the death of his beloved uncle, Bradley began to observe with Samuel Molyneux, a wealthy amateur astronomer and member of Parliament from Kew, outside London.

Having read of Robert Hooke's failed attempt to detect the annual parallax of the star Draconis in 1669, Molyneux asked Bradley to collaborate with him in a renewed effort utilizing a high-precision zenith telescope made by England's foremost instrument maker, George Graham (Detection of stellar parallax would provide observational evidence of the Copernican theory of the cosmos, wherein the Earth's orbital motion creates an annual oscillation of the stars; by this time, the Copernican theory already had a strong theoretical and mathematical foundation.) The telescope was fixed vertically to the face of a chimney in Molyneux's mansion bordering Kew Green. To accommodate its 24-foot-long tube, holes were cut through the roof and between floors. The Kew telescope was found to be exquisitely sensitive to environmental influences: The combined body heat of three people standing nearby disturbed the air enough to set the instrument's plumb line swaying. Cobwebs had to be regularly cleared from the plumb line, lest they shift the zero mark from which all measurements were gauged. Nevertheless,

Bradley determined that the telescope was capable of measuring star positions with better than 1 arcsecond accuracy.

Over 80 position measurements of y Draconis were obtained by Bradley and Molyneux over a two-year period commencing on December 3, 1725. The observations confirmed that y Draconis exhibits an annual 20-inch oscillation from its nominal position in the sky. However, Bradley and Molyneux noted that the timing of the oscillatory movement is three months out of phase with that expected for a parallax shift, and the degree of movement itself is far larger than they had anticipated. In August 1727, Bradley installed a smaller, wider-field version of the Kew telescope in the house of his late uncle in Wanstead and continued the zenith observations of y Draconis and other stars on his own. Even after his aunt sold the house in 1732, the new owner, Elizabeth Williams, permitted him free access to his now-famous telescope. (Molyneux died unexpectedly in 1728 at age 18.) 39.)

Bradley reportedly realized the true cause of Draconis's annual oscillation in the autumn of 1728 during a sailing cruise on the Thames. He noted how the wind vane on the boat's mast shifted its orientation with the boat's motion, even when the wind direction had not changed; that is, the vane's orientation was influenced not only by the wind but also by the movement of the boat. Similarly, Bradley reasoned that the apparent direction from which a star's light reaches the observer is altered by the forward movement of the Earth; thus, the position of the star seems to oscillate as the Earth revolves around the Sun. This phenomenon is known as the aberration of light. From his observations, Bradley calculated the speed of light: 295,000 km/s (183,000 miles/s), which is within 2% of the modern value Bradley also established an upper limit to the annual parallaxes of the stars he had observed: Were any parallax as large as 1", he would have observed it with the Wanstead telescope. Thus he estimated that even the nearest stars must lie at least 400,000 times farther than the Sun.

Continuing his zenith observations for another 20 years, Bradley detected a further oscillation of star positions, by as much as 9 arcseconds. This he attributed to a periodic nodding motion of the Earth's axis (nutation) stimulated by the Moon's gravitational pull. For this discovery, the Royal Society of London awarded him the Copley Medal in 1748.

In 1742, Bradley succeeded Halley as England's third Astronomer Royal and director of the Royal Observatory at Greenwich, a post he would hold for the next 20 years. Despite his ascendance, Bradley maintained his propriety: He refused the king's offer of the vicarage of Greenwich, together with its significant stipend, explaining that he could not in good conscience accept a job to which he would devote less than his full measure. Bradley found Halley's Greenwich instruments to be in disrepair He restored them and embarked on an ambitious observing program to measure the positions of stars and determine the precise means to correct such measurements for the effects of atmospheric refraction. In 1749, he persuaded government officials to provide a grant of £1,000 with which he upgraded the Royal Observatory's equipment, including two quadrants and a transit instrument by Bird, a precision clock by Graham, and a micrometer. Between 1748 and 1762, Bradley and his assistants carried out more than 60,000 individual observations of stars. He also accurately determined the latitude of Greenwich and carried out a detailed assessment of Tobias Mayer's lunar tables for determining longitude at sea.

In 1818, German astronomer Friedrich Bessel combined Bradley's observations with his own to produce a fundamental catalog of 3,222 stars with positions accurate for the year 1755. The Bradley-Bessel compilation formed the starting point for determining the proper motions of these stars. By setting a new standard of precision in observation, Bradley can rightly be dubbed the founder of high-precision positional astronomy.

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