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(*b*. Laneast, Cornwall, England, 5 June 1819; *d*. Cambridge, England, 21 January 1892)

astronomy, mathematics.

John Couch Adams was born at Lidcot farm, seven miles from Launceston. He was the eldest son of Thomas Adams, a tenant farmer and a devout Wesleyan, and Tabitha Knill Grylls. The family circumstances were modest but respectable: Tabitha Adams' cousin was the headmaster of a private school in Devonport, and in 1836 her adoptive mother left her some property and a small income which helped support John's education.

Adams had his first schooling in a Laneast farmhouse. In 1827 he was tutored in calligraphy, Greek, and mathematics, but quickly outpaced his teacher. He developed an early interest in astronomy, inscribing a sundial on his window sill and observing solar altitudes with an instrument he built himself. In 1831 he was sent to his cousin's academy, where he distinguished himself in classics, spending his spare time on astronomy and mathematics. Teaching himself, he finished the standard texts on conic sections, differential calculus, theory of numbers, theory of equations, and mechanics. Adams' precocity convinced his parents that he should be sent to a university, and in October 1839 he sat for examinations at St. John's College, Cambridge University, and won a sizarship. He went on to win the highest mathematical prizes in his college and took first prize in Greek testament every year that he was at Cambridge.

In July 1841, Adams, having read about the irregularities in the motion of the planet Uranus, decided to investigate them as soon as he had taken his degree. He graduated from Cambridge in 1843 as senior wrangler in the mathematical tripos and first Smith's prizeman; shortly afterward he became a fellow and tutor of his college. At the beginning of the next long vacation he returned to Lidcot and began the longdeferred investigation of Uranus.

By October 1843 Adams had arrived at a solution of the inverse perturbation problem: given the mass of a body and its deviations from the path predicted for it by Newtonian mechanics, find the orbit and position of another body perturbing it through gravitational attraction. This problem required, among other procedures, the solution of ten simultaneous equations of condition for as many unknowns. Although Adam's first result was approximate, it convinced him that the disturbances of Uranus were due to an undiscovered planet.

In February 1844, Adams applied through James Challis to the astronomer royal, Sir George Biddell Airy, for more exact data on Uranus. Using figures supplied by Airy, Adams computed values for the elliptic elements, mass, and heliocentric longitude of the hypothetical planet. He gave his results to Challis in September 1845, and after two unsuccessful attempts to present his work to Airy in person, he left a copy of it at the Royal Observatory on 21 October 1845. Although Airy wrote to Adams a few weeks later criticizing his paper, he did not institute a search for the planet until July 1846.

In the meantime a French astronomer, Urbain Jean Joseph Leverrier, independently published several papers on the theory of Uranus and reached the same conclusions as Adams had regarding an exterior planet. Although Leverrier began his investigation later, he pressed his case more aggressively, and on 23 September 1846 the perturbing body—Neptune—was discovered as a result of his efforts. Johann Gottfried Galle, an astronomer at the Berlin Observatory, found the planet less than one degree distant from the point where Leverrier predicted it would lie.

Leverrier was immediately showered with honors and congratulations. Adams' earlier prediction, which agreed closely with Leverrier's, was thus far unpublished. It was first publicized in a letter from Sir John Herschel to the London *Athenaeum* on 3 October 1846 and provoked a long and bitter controversy over priority of discovery. The two principals took little part in the feud, but the issue became a public sensation. It still seems remarkable that Airy suppressed Adams' work for so long and that Adams was so reticent about pressing his claims. This behavior was, however, characteristic of Adams. The modesty that temporarily cost him some glory endeared him to colleagues and friends throughout his life.

The disparity between the credit accorded to Leverrier and that accorded to Adams was not made up for some years, but the two men met at Oxford in 1847 and became good friends. Adams was offered a knighthood by Queen Victoria in 1847 but declined it; the following year the Adams Prize, awarded biennially for the best essay in physics, mathematics, or astronomy, was instituted at Cambridge. The Royal Society gave Adams its highest award, the Copley Medal, in 1848.

In 1851 Adams was elected president of the Royal Astronomical Society and shortly afterward began to work on lunar theory. After much laborious calculation he finished new tables of the moon's parallax which corrected several errors in lunar theory and gave more accurate positions. In the meantime, since he had not taken holy orders, his fellowship at St. John's expired in 1852. He was elected a fellow of Pembroke College in 1853, and shortly afterward he presented to the Royal Society a remarkable paper on the secular acceleration of the moon's mean motion. This quantity was thought to have been definitively investigated by Pierre Simon de Laplace in 1788, but Adams showed that Laplace's solution was incorrect. In particular, Laplace had ignored a variation in solar eccentricity that introduces into the differential equations for the moon's motion a series of additional terms. Adams calculated the second term of the series, on which the secular acceleration depends, as $3771/64m^4$ the value computed from Laplace's work was $2187/128\ \mathrm{m}^4$. The effect of the correction was to reduce the figure for the moon's secular acceleration by about half, from 10″.58 to 5″.70.

This paper caused a sharp scientific controversy, marked by angry chauvinism on the part of several French astronomers. Their attacks stimulated a number of independent investigations of the subject, all of which confirmed Adams' result. The matter was definitely settled in his favor by 1861, but not without hard feelings.

In 1858 Adams occupied the chair of mathematics at the University of St. Andrews, vacating it the following year to accept the appointment as Lowndean professor of astronomy and geometry at Cambridge. In 1861 he succeeded James Challis as director of the Cambridge Observatory, and in 1863, when he was forty-four, he married Eliza Bruce of Dublin. In 1866 the Royal Astronomical society awarded Adams a gold medal for his work on lunar theory.

The brilliant Leonid meteor shower of November 1866 stimulated Adams to investigate the elements of the Leonid system. By dividing the orbit into small segments, he calculated an analysis of perturbations for the meteor group, resulting in improved values for its period and elements. This work provided another demonstration of Adams' extraordinary ability to manipulate equations of great length and complexity without error.

In 1870 the Cambridge Observatory acquired a Simms transit circle. In order to exploit it fully, Adams undertook—a rarity for him—the direction of a program of observational astronomy. The circle was used to map a zone lying between 25° and 30° of north declination for the *Astronomische Gesellschaft* program. This work was first published in 1897.

In 1874 Adams was elected to a second term as president of the Royal Astronomical Society. His scientific interest at this time turned to mathematics. Like Euler and Gauss, Adams enjoyed the calculation of exact values for mathematical constants. In 1877 he published thirty-one Bernoullian numbers, thus doubling the known number. With sixty-two Bernoullian numbers available, he decided to compute a definitive value of Euler's constant; this required the calculation of certain logarithms to 273 decimal places. Using these terms, Adams extended Euler's constant to 263 decimal places. This result was published in the *Proceedings* of the Royal Society in 1878; in the same year Adams published expressions for the products of two Legendrian coefficients and for the integral of the product of three.

Adams was a fervent admirer of Isaac Newton. In 1872, when Lord Portsmouth presented Newton's scientific papers to Cambridge University, Adams willingly undertook to arrange and catalog those dealing with mathematics. He was also an omnivorous reader in other fields, especially botany, history, and fiction. He usually kept a novel at hand when working on long mathematical problems.

In retrospect Adams' many mathematical and astronomical achievements pale in comparison to his analysis of the orbit of Uranus and his prediction of the existence and position of Neptune at the age of twenty-four. Much of his later work has been superseded, but as the co-discoverer of Neptune he occupies a special, undiminished place in the history of science.

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Morton Grosser