Biographical Encyclopedia of Astronomers

Hooke, Robert

Born Freshwater, Isle of Wight, England, 18 July 1635

Died London, England, 3 March 1703

Robert Hooke was one of the foremost experimenters of the 17th century and a remarkable inventor of astronomical instruments. He was among the first to suggest the inverse-square law of gravitation and the periodicity of comets.

Hooke was the son of John Hooke, curate of All Saints Church in Freshwater, and his second wife, Cicely Giles. A sickly child, he was not expected to survive childhood

At a young age, Hooke showed artistic and mechanical talent; he could draw and paint and build wooden models of working machines. When he was 13, his father died, and Hooke was sent to London to be apprenticed to the portrait painter Sir Peter Lely, but the smell of the oil paint made him sick. He was then sent to Westminster School. The headmaster, Dr. Busby, immediately recognized the boy's genius when Hooke learned the first six books of Euclid in a week, taught himself to play the organ, and learned several languages besides Latin and Greek. Mathematics, however, was his favorite subject

In 1653, Hooke was admitted to Oxford University (Christ Church). Oxford was then scrutinized by a parliamentary committee. Its atmosphere would have been restrictive, but for men like John Wilkins, Warden of Wadham College, Hooke became a protégé of Wilkins, who gathered around him an extraordinary group including Christopher Wren and Robert Boyle, regardless of political or religious affinities. Their purpose was to study the natural world through experimentation and observation. When Boyle set up his chemical laboratory, Hooke became his assistant and designed and built an air pump. He also succeeded in proving the relation of gas pressure to volume, known as Boyle's law. At the same time, Hooke studied astronomy under the guidance of Seth Ward, Savilian Professor of Astronomy.

Charles II was restored in 1660, and the newly formed Royal Society of London soon after received its charter. On Wilkins's recommendation in 1662, Hooke was appointed Curator of Experiments at the Royal Society, essentially sustaining its existence with his lectures and experiments; he was elected fellow in 1663. In 1665 he was appointed Professor of Geometry at Gresham College, London, where he was given lodgings.

The Royal Society met in his rooms. In 1677, Hooke became secretary of the society when Henry Oldenburg died, while retaining his curatorship throughout his life. He contributed significantly to physics, astronomy, chemistry, geology, biology, paleontological and biological evolution, meteorology, horology, architecture, cartography, and many other areas.

In 1691, Oxford honored him with the degree of "Dr. of Physics." Because during his life Hooke had been involved in some scientific disputes over priority, notably with Isaac Newton, history has not been kind to him, so that his name is known today only for his eponymous law

In astronomy, Hooke sought to improve instrumentation for more accurate measurements. Hooke's inventions in horology were designed to assist in the determination of longitude. In 1656, he invented the anchor escapement to replace the verge or crown wheel for better accuracy in clocks. In 1658, he invented the balance wheel for pocket watches using springs instead of gravity for vibrations in any position. Hooke designed micrometers and devised the technique of screw turns to measure minute differences in angles and distances. He invented the universal joint for more efficient ways to operate telescopes and other instruments where accurate rotational movement is needed. In addition, Hooke invented the use of telescopic sights, the clock-driven telescope, and the iris diaphragm. When Greenwich Observatory was built in 1675, he supplied it with instruments he designed

On May 9, 1664, using his 12-foot telescope, Hooke discovered a giant spot on Jupiter. He observed that within two hours the spot had moved from east to west about half the planet's diameter, demonstrating the planet's rotation. Studying rotating bodies, Hooke devised experiments that indicated the shape of the Earth to be an oblate spheroid with the longer dimension around the equator. This shape was the cause of the slowing of pendulum clocks carried on ships as they approached the equator. The Earth's shape is relevant to geology, a science for which he essentially laid the foundation

Hooke observed the lunar surface and theorized on the causes of crater formation. To produce craters, he shot bullets onto a clay surface and boiled a pan of liquid alabaster, demonstrating that the cause was either impact or steam explosions, two ideas that were hotly debated by geologists long afterward. He published these findings in his famous book *Micrographia*, which contained a wealth of ideas and depictions of never-before-seen things he saw through the microscope he built. Hooke tracked the path of comet C/1664 W1 and lectured on it at the Royal Society, suggesting it was the return of one of the 1618 comets. This was many years before Edmond Halley proposed the periodicity of comets

During the years 1666-1667, Hooke was deeply involved in rebuilding London after the Great Fire. As City Surveyor, he worked in partnership with Christopher Wren, having designed the Great Dome of Saint Paul's Cathedral and other famous structures without credit. As busy as he was, however, Hooke continued to improve his instruments, give lectures and demonstrations, and observe the skies deep into the night. His 30-foot telescope went through two floors of his lodgings at Gresham College, with a wooden trapdoor for poking the telescope through the roof.

The vertical position was chosen to minimize tube flexure and atmospheric effects in his unsuccessful effort to measure stellar parallax.

The most profound disappointment of Hooke's career was not having been accorded credit for his part in discovering the nature of planetary motions, the law of gravitation. As early as 23 May 1666, Hooke wrote:

> I have often wondered why the planets should move about the sun according to Copernicus... [being not] tied to it, as their center, by any visible strings,... nor yet move in a straight line, as all bodies that have but one single impulse ought to do: But all the celestial bodies [moving in] circular or elliptical lines, and not straight, must have some

> other cause, besides the first impregnable impulse, that must bend their motion into that curve...

Notice that implicit in this statement is Newton's first law. By 1670, he was certain that the cause of deflecting a body into a curve is "an attractive property of the body placed in the centre whereby it continually endeavours to attract or draw it to itself," and planetary motion can be explained by mechanical principles and calculated "to the greatest exactness and certainty that can be desired." Hooke communicated this important idea of a centripetal force to Newton in a letter in 1679. Newton admitted in his reply that he had never thought of such a concept before receiving Hooke's letter. Hooke noted in his diary for 4 January 1680, "perfect Theory of Heavens," with obvious satisfaction that he had solved a universal mystery. In Richard Westfall's opinion, universal gravitation was inconceivable without the concept of centripetal force, and that was Hooke's contribution. Newton, however, would never acknowledge this debt in the several editions of the Principia

Ellen Tan Drake

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