Summary Article: Halley, Edmond (1656-1742)
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Place: United Kingdom, England

English mathematician, physicist, and astronomer who not only identified the comet later to be known by his name, but also compiled a star catalogue, detected stellar motion using historical records, and began a line of research that - after his death - resulted in a reasonably accurate calculation of the astronomical unit.

Halley was born in Haggerton, near London, on 8 November 1656. The son of a wealthy businessman, he attended St Paul's School (in London) and then Oxford University, where he wrote and published a book on the laws of Johannes Kepler that drew him to the attention of the Astronomer Royal, John Flamsteed. Flamsteed's interest secured for him, despite his leaving Oxford without a degree, the opportunity to begin his scientific career by spending two years on the island of St Helena, charting (none too successfully) the hitherto unmapped stars of the southern hemisphere. The result was the first catalogue of star positions compiled with the use of a telescope. On his return in 1678, Halley was elected to the Royal Society: he was 22 years old. For some years he then travelled widely in Europe, meeting scientists - particularly astronomers - of international renown, including Johannes Hevelius and Giovanni Cassini, before finally returning to England to settle down to research. He also became a firm friend of Isaac Newton. It may have been through Newton's influence that Halley in 1696 took up the post of deputy controller of the Mint at Chester. Two years later he accepted command of a Royal Navy warship, and spent considerable time at sea. In 1702 and 1703 he made a couple of diplomatic missions to Vienna before, in the latter year, being appointed professor of geometry at Oxford. His study of comets followed immediately. He succeeded Flamsteed as Astronomer Royal in 1720 and held the post until his death, at Greenwich, on 14 January 1742.

In St Helena, Halley first observed and timed a transit of Mercury, realizing as he did so that if a sufficient number of astronomers in different locations round the world also timed their observations and then compared notes, it would be possible to derive the distance both of Mercury and of the Sun. Many years later he prepared extensive notes on procedures to be followed by astronomers observing the expected transit of Venus in 1761. No fewer than 62 observing stations noted the 1761 transit, and from their findings the distance of the Sun from the Earth was calculated to be 153 million km/95 million mi - remarkably accurate for its time (the modern value is 149.6 million km/92.9 million mi).

Astronomy was always Halley's major interest. In the 1680s and 1690s he prepared papers on the nature of trade winds, magnetism, monsoons, the tides, the relationship between height and pressure, evaporation and the salinity of inland waters, the rainbow, and a diving bell; for some of the time he was also helping Newton both practically and financially to formulate his great work, the Principia; but these activities were all incidental to the pleasure he took in observing the heavens.

One of Halley's first labours as professor at Oxford was to make a close study of the nature of comets. Twenty years earlier, the appearance of a comet visible to the naked eye had aroused great
popular excitement; yet somehow Newton's *Principia* had ignored the subject. Now Halley, with Newton's assistance, compiled a record of as many comets as possible and charted their progress through the heavens. A major difficulty in determining the paths of comets arose from their being visible for only short periods, leaving by far the greater part of their journey explicable by any number of hypotheses. Some authorities of the time believed that comets travelled in a straight line; some in a parabola or a hyperbola; others suggested an ellipse. In the course of his investigations Halley became convinced that the cometary sightings reported in 1456, 1531, 1607 and, most recently, in 1682, all represented reappearances of the same comet. Halley therefore assumed that such a traveller through space must follow a very elongated orbit around the Sun, taking it at times farther away than the remotest of the planets. On the parabolic path that he calculated it should follow - and making due allowance for deviations from its 'proper' path through the attraction of Jupiter - Halley declared that this comet would appear again in December 1758. When it did, public acclaim for the astronomer (who by that time had been dead 16 years) was such that his name was irrevocably attached to it. In 1710 Halley began to examine the writings of Ptolemy, the Alexandrian astronomer of the 2nd century AD. Throughout his life Halley was always keenly interested in classical astronomy (he made outstanding translations of the *Conics* of Apollonius of Perga and the *Sphaerica* of Menelaus of Alexandria), and having catalogued stars himself, he paid special attention to Ptolemy's stellar catalogue. This was not Ptolemy's original; it was in fact 300 years older than it appeared to be, being a direct borrowing of the list compiled by Hipparchus in the 3rd century BC. For all Ptolemy's shortcomings, however, Halley could not believe that he had been so negligent as to credit the stars with positions wildly at variance with the bearings they now occupied, 15 centuries later. The conclusion that Halley was forced to come to was that the stars had moved. Later Halley was able to detect such movements in the instances of three bright stars: Sirius, Arcturus, and Procyon. He was correct, too, in assuming that other stars farther away and consequently dimmer underwent changes of position too small for the naked eye to detect. More than a century had to pass before optical instruments achieved a sophistication sufficient to be able to detect such movement.

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