Bradley, James

(*bap*. 1692, *d*. 1762)

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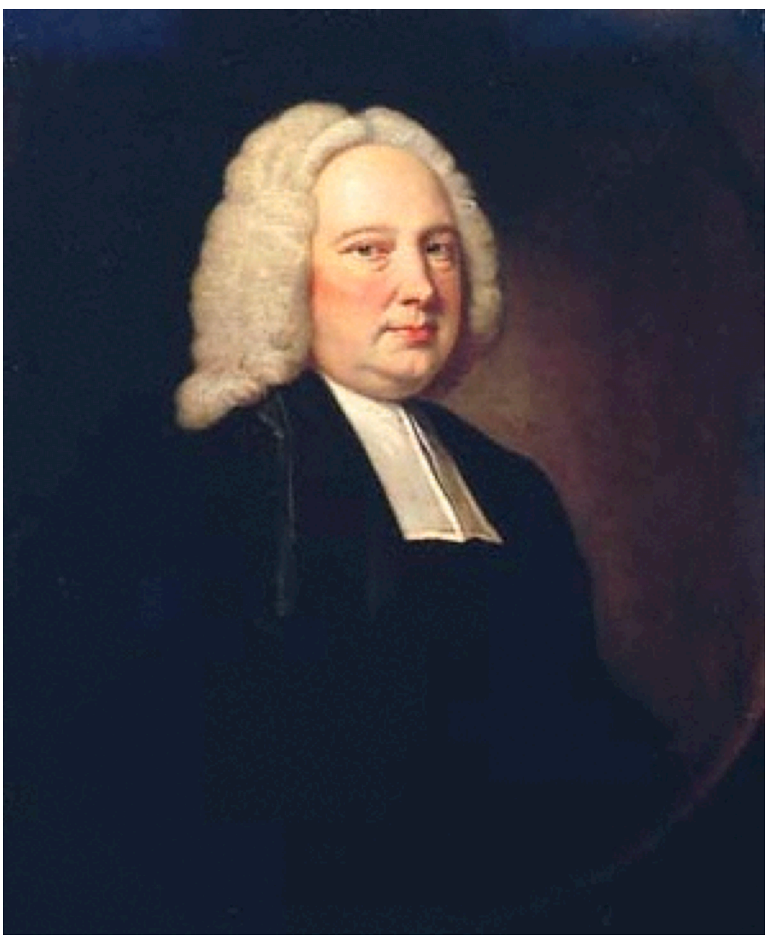

James Bradley (*bap. *1692,* d. *1762)

by Thomas Hudson, *c*. 1742–7

Bradley, James (*bap*. 1692, *d*. 1762), astronomer, was born in Sherborne, Gloucestershire, and baptized there on 3 October 1692, the third son of William Bradley, a descendant of a family from Bradley Castle, co. Durham, and Jane Pound, of Bishop's Canning, Wiltshire, whom William Bradley married in 1678.

Early years and education

Bradley was educated at Northleach grammar school and at Balliol College, Oxford, where he was admitted as a commoner in March 1711. He took his BA in October 1714 and his MA in June 1717, after which he initially pursued a career in the church. He was ordained deacon on 24 May 1719 by the bishop of London, and in July became vicar of Bridstow in Monmouthshire, immediately after being ordained a priest by Hoadly, the bishop of Hereford. The parish of Bridstow was in the gift of the bishop of Hereford, to whom Bradley later also became chaplain. In addition, he was presented with the sinecure from a small parish in Pembrokeshire, which was said to have been procured for Bradley from the prince of Wales with the help of the prince's secretary, the amateur astronomer Samuel Molyneux. However, from the point of view of his later career Bradley's early years were most significant for the contact he had with a maternal uncle, the Revd James Pound, one of the leading astronomical observers in England, who had worked both with Edmond Halley, the second astronomer royal, and with Sir Isaac Newton. From 1707 Pound was rector of Wansted in Essex, where he devoted much of his time to observing. From at the latest 1715 he was joined in this activity by his nephew; from that date Bradley's handwriting appeared regularly in the Wansted observing books. Pound provided the young Bradley with occasional financial assistance, and also nursed him through smallpox in 1717, but his most profound influence on his nephew was through the fostering of his interests in astronomy. In March 1716 Bradley wrote to the Royal Society about the aurora, and in 1718 Halley published two observations by Bradley in the *Philosophical Transactions of the Royal Society*, describing the young man's observing abilities in glowing terms. In November of that year Bradley was elected a fellow of the Royal Society. His duties as a clergyman were clearly light and, after his appointment as vicar of Bridstow, he continued to visit Wansted and to make astronomical observations from there.

Savilian professor of astronomy

Bradley changed career in the autumn of 1721 when, following the death of John Keill, he was appointed Savilian professor of astronomy in the University of Oxford, with the support of the lord chancellor, Thomas Parker (later earl of Macclesfield), and of Martin Foulkes (later president of the Royal Society). On his appointment, on 31 October 1721, he resigned his livings in the church. By this time Bradley had already made significant contributions to observational astronomy. He was particularly interested in the motions of Jupiter's satellites, and used his own observations to correct available astronomical tables, potentially a very valuable activity for other astronomers, who all relied on such tables. In addition, he had made and published observations of two nebulae—at Halley's request—and observations of the double stars Castor and gamma Virginis, as well as observations of the planet Mars.

Having taken up the appointment at Oxford, it is not clear how much time during the first few years Bradley actually spent at the university apart from delivering his lectures; his inaugural lecture was read on 26 April 1722. However, following the appointment he was able to devote himself full-time to astronomy, for which he continued to use his uncle's observatory at Wansted. Nor did James Pound's death in November 1724 mark the end of Bradley's association with the place. Pound left no will, and Bradley continued to use the same instruments and to reside in Wansted with his uncle's widow.

Discovery of aberration

It was about a year after his uncle's death that Bradley began the work which led to his first major discovery in astronomy. His friend Samuel Molyneux was interested in trying to measure the annual parallax of the stars, a tiny apparent motion of the stars caused by the actual annual motion of the earth around the sun, from which it would be possible to calculate distances to the nearest stars. Detecting such a movement would, moreover, finally provide observational confirmation of Copernicus's heliocentric theory. In particular, Molyneux wished to repeat an attempt to measure the annual parallax of the star gamma Draconis, first made by the natural philosopher Robert Hooke in 1669. To do so, he installed a zenith sector specifically designed for the purpose on his estate at Kew, and in December 1725 he invited Bradley to assist him in observing. Gamma Draconis was selected because it crosses the meridian (culminates) almost overhead, thereby allowing observers to ignore the problem of the refraction of light through the earth's atmosphere, which affects the positions of all celestial objects nearer the horizon. Theory predicted that gamma Draconis would culminate at its most southerly point in December; its position at culmination should then gradually shift northwards every day over the following months, to its most northerly point in June, and back again over the following six months. To the astronomers' surprise, however, gamma Draconis did not do this. Instead, after December it continued to culminate at more southerly points, reaching its most southerly point in March and its most northerly point in September. The overall change in position over the six months was about 40 seconds of arc (that is, about one hundredth of a degree). In an attempt to identify the cause of this movement, Bradley decided to observe other stars and obtained his own zenith sector from the instrument maker George Graham, which he set up at Wansted. From August 1727 he observed a number of stars over a year and discovered that each displayed a comparable annual motion. A possible explanation apparently came to him while sailing on the Thames, when he noticed that the vane at the top of the mast changed direction as the boat turned although the wind continued to blow from the same direction. The analogous explanation for the apparent shift in position observed in the stars, he suggested, was that it resulted from a combination of the transmission of light at a finite speed from the star and the annual movement of the earth around the sun. This phenomenon—known as the aberration of light—was first described by Bradley in a letter to Halley, read to the Royal Society in January 1729. From his observations and theory, Bradley was able to calculate the speed of light: he stated that light took 8 minutes and 12 seconds to travel from the sun to the earth. He was also able to say with some authority that annual stellar parallax, the phenomenon he and Molyneux had set out to measure, must, in the stars observed, be exceedingly small (less than 1 second of arc, and therefore beyond the accuracy of the instruments available to Bradley and his contemporaries); otherwise, with the high precision instruments they had used, they would certainly have detected it. The consequence of this was that the distance to the nearest stars must be even more immense than had previously been believed.

In 1729 Bradley assumed the added role of lecturer in experimental philosophy at Oxford, giving his lectures in the Ashmolean Museum. He continued presenting these lectures for more than thirty years, to groups of on average more than fifty students. Two years after this appointment he failed in an attempt to be appointed keeper of the museum, but in 1732 he finally moved to Oxford to occupy a house in New College Lane, to which his professorship entitled him. His aunt, Mrs Pound, accompanied him and stayed in Oxford until her death in 1737. Most of the astronomical instruments from the house in Wansted were also moved, with the exception of the Graham zenith sector, which remained in Essex. Bradley had good reason to leave the instrument where it was and he made regular visits back to Wansted to use it for the continued observation of the stars he had started to track in the work leading to his discovery of aberration.

Appointment as astronomer royal

By the early 1740s, therefore, Bradley was well established as a leading member of the astronomical community in Britain. During his years at Oxford he had also started to correspond with leading astronomers on the continent of Europe, including Pierre Louis de Maupertuis, through whom he became familiar with the work of Alexis Claude Clairaut and Pierre le Monnier, among others. Thus when Edmond Halley died in 1742, Bradley was an obvious candidate to succeed him. It has been reported that Halley himself was keen that Bradley should replace him, that he had been willing to resign in the younger man's favour, but that he died before he was able to do so. Bradley also continued to have the support of the earl of Macclesfield, who wrote in support of his candidature. On 3 February 1742 Bradley was appointed astronomer royal, and within three weeks the University of Oxford had awarded him a DD.

Bradley took up his new appointment in June 1742, but on his arrival at Greenwich he found the observatory and its instruments in a state of neglect. One of the main instruments, an 8 foot radius iron quadrant made by Jonathan Sisson under George Graham's supervision, was wedged against the roof of the quadrant house, and the sextant house had been taken over by pigeons. Before he could start a programme of observing from Greenwich, therefore, Bradley had to ensure that the instruments could be used. As well as inviting Graham and Sisson to reset the quadrant and the observatory's transit instrument, he and other fellows of the Royal Society petitioned the king for new instruments and a new building to house them. As a result a new quadrant and transit instrument were commissioned from John Bird, and a new building was started.

Meanwhile, during his early years at the Royal Greenwich Observatory Bradley both continued his previous programmes of work and turned his attention to the requirements of the new post. The observatory had been established in 1675 for a specific reason: to assist navigation, through the production of accurate tables of the positions of celestial bodies. Once the existing instruments were restored and placed in position, therefore, Bradley started to observe stellar culminations, using the transit instrument, and to help him in this he trained his nephew John Bradley. In the second half of 1742 more than 1500 transit observations were recorded. Much of the Bradleys' time was spent re-examining the positions of the brightest stars in the sky, as the astronomer royal grappled with the complexities of allowing for the different phenomena which cause the observed positions of celestial objects to appear to have shifted from their actual positions. In addition to taking into account the recently discovered effect of aberration, Bradley was aware of the need to consider precession (arising from the periodic movement of the earth's axis, similar to that of a spinning top) and the refraction of light through the earth's atmosphere. Refraction was a particularly difficult effect to allow for, as it varies according to the angular height, or altitude, of the object being observed and the local conditions (temperature and pressure) of the atmosphere. By concentrating on establishing, as far as possible, the positions of the brightest stars, Bradley would then be able to use the framework of those stars to increase the accuracy of the observatory's data on other celestial objects, especially those in the solar system. As well as concentrating on determining accurate positions for the brightest, so-called fixed, stars, during his early years at Greenwich, Bradley was responsible for a series of lunar observations and for observations of three comets (in 1743, 1744, and 1748). The observations of the moon were significant, as he corresponded about them with a number of astronomers in continental Europe. Through this correspondence he pursued his and the observatory's interest in the problem of determining longitude at sea and, it has been argued, sowed the seeds for the eventual launch of the *Nautical Almanac*, published by the Greenwich observatory annually since 1767.

Discovery of nutation

In the course of this work Bradley also continued to pursue a personal programme of observing. Having made the discovery of aberration, he was still concerned about the observations of the stars he had made with the zenith sector at Wansted. In his initial analysis of the data he had considered a different explanation of the apparent motion exhibited: that it resulted from a periodic ‘nodding’, or nutation, of the earth's polar axis, brought about by the moon's gravitational pull on the earth, as predicted by Newton's theory. Bradley quickly eliminated this as the explanation of the particular observations he had made, but continued to wonder about the possibility of detecting evidence of such a nutation. Detecting and measuring the effect would provide a means of calculating the earth's spheroidicity and thus of settling the dispute between the Newtonians and those who followed the line of the French astronomer Jacques Cassini over whether the earth was elongated or flattened at the poles. From the observational point of view, one of the main problems was that, in theory, the earth's axis would take over eighteen years to complete a nutational cycle. Nevertheless, Bradley decided in the late 1720s to observe for what would be a full cycle; he continued the work for the necessary period, travelling to Wansted to make the observations, as all observations had to be made using the same instrument from the same spot. By early 1747 the observing programme was finished and the data analysed. Bradley then wrote to the earl of Macclesfield, a letter which was read to the Royal Society in February 1748. In it, Bradley announced his detection of nutation and confirmed the Newtonian model of the earth, flattened at the poles. By the time these results were published there was already separate observational confirmation of the shape of the earth from French expeditions to northern Sweden and to Peru to measure, by trigonometrical means, the length of a degree of arc of the earth's surface in each location. But Bradley's work in establishing the existence of a nutation of the earth's axis, together with his earlier detection of aberration, provided observational confirmation both of Copernicus's heliocentric solar system and of Newton's principle of universal gravitation. In 1748, following his announcement of nutation, Bradley was awarded the Royal Society's Copley medal.

Around the time of the announcement of nutation, Bradley started to receive formal international recognition for his achievements in astronomy. In 1746 he became a member of the Royal Academy of Berlin and in July 1748 a foreign associate of the Académie Royale des Sciences in Paris. Two years later he became a corresponding member of the Imperial Academy of Sciences in St Petersburg, and he subsequently assisted the academy by overseeing the construction by Bird of a quadrant made especially for them; in 1754 he became a full member of the academy. Three years later he was chosen to be a member of the institute in Bologna. Further recognition also came at home from the crown. When Bradley succeeded Halley in 1742 his income was £100 per annum, a rate which had not changed since John Flamsteed's appointment as the first astronomer royal in 1675. From this the incumbent had to pay for the running of the observatory. However, in the late 1740s Bradley received a single payment from the state of £1000 to meet the costs of re-equipping the observatory, and in 1752, in an acknowledgement of his skills and understanding as an astronomer and his contributions to navigation and trade, he was personally granted a pension from the crown of £250 per annum.

The Greenwich observations, 1750–1762

At about this point in his career Bradley was offered, but refused, the opportunity to return to work in the church by taking over the living from the parish of Greenwich. He preferred instead to continue at the Greenwich observatory, devoting himself full-time to the pursuit of astronomy. From 1750, almost until his death in 1762, he organized a very thorough programme of observations. Following the completion of the observations at Wansted, and of the building work at Greenwich, the zenith sector was moved to the Greenwich observatory. From then, Bradley concentrated all his effort on Greenwich and on gathering many volumes of observations. Over the twenty years for which he was astronomer royal, more than 900 folio pages in thirteen volumes were filled, the majority being recorded in the second half of his tenure. However, the observations were not published during his lifetime, and on his death they were removed from the Greenwich observatory by the executors of his estate. Their claim was that, since the pension awarded to Bradley in 1752 was in recognition of his personal abilities as an astronomer, and not a result of his office, the observations were not the property of the crown.

On 25 June 1744 Bradley had married Susannah Peach (*d.* 1757) of Chalford, Gloucestershire, and in 1746 a daughter, also named Susannah, was born. On her father's death, therefore, she inherited the Greenwich observations, held in trust for her until she came of age. When she reached the age of twenty-one, however, Susannah handed the papers to an uncle, the Revd Samuel Peach, who refused a request from the board of longitude to surrender them. He left them to his elder son, John, who was equally unwilling to relinquish such valuable documents without what he regarded as due recompense. A legal case claiming ownership of the observations was prepared by the crown, but in 1776 John's younger brother, Samuel junior, who had become the legal heir of the papers on his marriage to Susannah Bradley, presented them to Lord North, chancellor of the University of Oxford. North gave them to the university on the condition that they be published by the Clarendon Press. The press, however, took more than twenty years to produce any publication. It was thus 1798 before the first volume of Bradley's observations appeared. When the volume was finally published, it included tables of aberration (in the equatorial plane) of sixteen stars, a catalogue of over 380 of the brightest fixed stars, and lunar latitudes and longitudes from the 1750s. A second volume, covering observations from the last six years of Bradley's time at Greenwich, appeared in 1805. By this time, one of the main problems associated with publishing was that the raw data, up to forty years after the observations were made, were not especially useful. The task of ‘reducing’ the data—that is, allowing for all the phenomena, including aberration, nutation, precession, refraction, and all the characteristics of the instruments used for observing, which affect the apparent position of the object on the celestial sphere—was not started until after the second volume was published. Then the young German astronomer Friedrich Wilhelm Bessel was encouraged by his fellow countryman and mentor Wilhelm Olbers to tackle the huge complexities. The work took Bessel more than ten years and resulted in his *Fundamenta astronomia* (1818), recognized by his contemporaries as one of the most significant contributions to positional astronomy; it confirmed Bessel as a leading authority. Starting with Bradley's observations, Bessel established a degree of accuracy previously unknown in positional astronomy. Bradley's observations were also revisited in the second half of the nineteenth century by the astronomer Arthur Auwers, who carried out a new reduction involving more data than had been known to Bessel. The outcome was three volumes of Bradley's observations, published between 1882 and 1903, and, it has been argued, marking the foundation of all modern star positions.

Interests in astronomical precision

Bradley's significance in the history of stellar positional astronomy is therefore clear. But his responsibilities as astronomer royal went beyond keeping track of the fixed stars, and his personal interests in astronomy were not limited to observing stellar positions. One of his keenest concerns, closely allied to his primary work in gathering celestial positions, was in the accurate measurement of time. In the early 1730s the instrument maker George Graham built a clock which beat sidereal seconds, and used it in London to gather data on the clock's time-keeping at that latitude and temperature. He sent the results to Bradley. The clock was then shipped to Jamaica to one Colin Campbell, who carried out similar tests and also sent the results to Bradley. From the data, Bradley, then at Oxford, was able to demonstrate that, having allowed for differences in temperature, in Jamaica the clock slowed by about two minutes per day in comparison with its performance in London, in keeping with Newton's theory of gravity for the earth as an oblate spheroid. Bradley was also able to calculate how much the length of the pendulum would have to be altered at different latitudes to compensate for the associated differences in gravitational pull. A decade later, shortly after his appointment as astronomer royal, Bradley returned to the question of the length of a clock's pendulum, and set up a series of experiments to determine the length of a seconds pendulum at Greenwich as part of his programme to establish the observing ground rules for his tenure at the observatory. Later still in his career he must have been involved once again in the question of time-keeping, but in a wider context. Although there is no clear documentary evidence of Bradley's participation, as astronomer royal he is very likely to have had a role in England's adoption of the Gregorian calendar in 1752.

Bradley's fascination with accuracy of time and position led him to investigate the physical phenomena affecting both. In addition to the new phenomena he himself identified, he turned his attention to refraction, and derived a set of tables for use at the observatory. His main work in this area came in the early 1750s, after the new instruments were in place, when he made use of the new Bird quadrant and analysed the effect of temperature and pressure on the observations. Over the same period, and with the same instrument, he also set about determining as precisely as possible the latitude of the Greenwich observatory, a fundamental measurement for all observing programmes.

Throughout his career in astronomy, Bradley addressed himself to issues of instrumentation. Having early on proved his skill in the use of telescopes with very long focal lengths, in 1723 he helped James Pound carry out trials with a reflecting telescope designed by James Hadley. After this Bradley himself experimented with grinding his own specula. He was not particularly successful in this, but he achieved a level of skill and understanding which allowed him personally to undertake many of the necessary repairs to the instruments at Greenwich. Although he was not especially successful at making mirror surfaces, unlike many of his contemporaries he was interested in using reflecting telescopes. In 1732 he was involved in trials at sea of a sextant made by Hadley and was very impressed with the instrument. By the time he succeeded Halley at Greenwich he was adept at assessing the performance of individual instruments. As in his approach to all aspects of his work, accuracy was the key, and he worked assiduously during the early years at the Greenwich observatory to reform and improve the performance of its range of instruments. For instance, in 1745 he added an improved micrometer screw to the 8 foot Graham quadrant to enable readings accurate to half a second of arc to be made.

Interests in the solar system

Much of the remainder of Bradley's working life was spent in observing the solar system. Following his early work on the motion of Jupiter's satellites, he returned in the mid-1720s to observing the satellites, using his own observations from London of the eclipses of the four main satellites (the ‘Medicean’ stars discovered by Galileo) and comparing them with similar observations made from New York and Lisbon. From these observations, and the differences in the times of the disappearance and reappearance of each as it passed behind the body of Jupiter, he was able to deduce the differences in longitude between the three observing places. He reported his results to the Royal Society in 1726. During the programme of observations, he also noted the very different paths followed by each of the satellites. In keeping with his approach to all observing programmes—driven by a wish to improve the accuracy of all observational data—he set out to improve existing tables of the satellites' motions and to understand why the moons moved as they did. His investigations continued into the 1730s, when he deduced a formula interrelating the motions of all four satellites based on their mutual gravitational attraction.

Bradley's interests extended to the rest of the solar system. In 1719, with his uncle James Pound, he observed the planet Mars when at opposition (that is, directly opposite the sun) with the aim of obtaining an improved value for the solar parallax, and hence of the distance between the earth and the sun. The value they obtained suggested the sun was further away than had previously been supposed. In addition, throughout his career as astronomer, in common with almost all astronomers of the period, Bradley followed the paths of comets as they passed within observing distance of the earth. For three, those passing in 1723, 1737, and 1757, he wrote short papers, presenting his raw observations and his reductions of them, calculating the comets' elements, and giving details of their physical appearance, including the tail and nucleus and the comets' magnitudes. Bradley also made detailed notes of his observations of the comet of 1744, which was extremely bright, equalling the brightness of Jupiter at times, and that of 1748. He exchanged information on comets with several overseas astronomers, including Benito Suarez, a Jesuit observer in Paraguay, and the French astronomer Abbé de Lacaille.

Other solar system phenomena and characteristics also attracted Bradley's attention. Early on in his work in astronomy he measured the diameters of the visible discs of the planets; as early as 1715 he measured Jupiter using a telescope with a focal length of over 200 feet, indicating a significant level of skill as an observer. Four years later he attempted to make measurements of Saturn, including the diameters of the inner and outer rings, observations which required a great deal of care. His interest in Saturn was rekindled more than a decade later when he observed the planet around the time when the rings were edge on to the earth, and therefore invisible for a while. His observations of the reappearance of the rings in 1730 are the only ones to have survived from that date. These observations are also of interest historically, as, unusually for the period, Bradley used a reflecting rather than a refracting telescope to make them. Bradley was also interested in Mercury and Venus, and made measurements of the diameters of both in 1722. Towards the end of his time as astronomer royal he returned to a consideration of Venus as, in 1761, a rare transit of the planet was due (a transit, an apparent crossing of the sun's surface by a planet, is an event which takes place in pairs, eight years apart, about every century). Bradley's particular interest in this phenomenon, apart from its rarity, came from his wish to use the observations to improve the accuracy of the value of the solar parallax. He was aware of the need to observe the transit from two widely separated locations, and decided that Java and the island of St Helena should be chosen. By the late 1750s Bradley himself was too frail to contemplate such a journey. Instead he sent his then assistant at Greenwich, Charles Mason, to Java, and persuaded the Royal Society to send the young astronomer Nevil Maskelyne to observe the transit from St Helena. In the event, neither expedition was destined to produce results: Mason failed to reach Java in time, as he travelled through areas involved in the Seven Years' War and was delayed by enemy action, and for Maskelyne the weather in St Helena was unfavourable. Maskelyne's career in astronomy, however, had much brighter prospects: by the mid-1760s he was himself astronomer royal.

Final years

During his period as astronomer royal Bradley employed four assistants, the first of whom was his nephew John Bradley, who worked with him for nine years. He was succeeded in 1751 by Gael Morris, who was Bradley's assistant for five years, and then Charles Mason, who worked at Greenwich from 1757 until he set off for Java in 1760. By the time Bradley was joined by the last of his assistants, Charles Green, he had been suffering for some time from a variety of ailments; he also became increasingly concerned that he was losing his powers of reasoning. After his wife's death in 1757 he maintained close contact with her family, and as physical illness set in he went to stay with them at Chalford in Gloucestershire. He was cared for there by a local doctor, Dr Lewis, and by Dr Daniel Lysons from Oxford. On 13 July 1762 he died from the illness, a chronic abdominal inflammation. He was buried near his wife and his mother at Minchinhampton, Gloucestershire. A brass plate, with an inscription by Dr Blayney (later regius professor of Hebrew in the University of Oxford) was fixed to an altar tomb in the churchyard and later moved into the church to protect it from thieves. Almost seventy years after Bradley's death a dial was erected at Kew to mark the spot where he began the observations which led to the discovery of aberration and of nutation.

During his lifetime Bradley was held in high esteem by his peers. Halley recognized his talent very quickly, and Newton once described him as the best astronomer in Europe. From the eulogies to Bradley following his death, it is equally clear that he was held in considerable esteem by his contemporaries. He was reported to have been humane, benevolent, and kind, a dutiful son, an indulgent husband, a tender father, and a steady friend. Although he was not particularly wealthy, he supported members of his family when he could. In his will he left annuities to his widowed sisters, Mary Mills and Elizabeth Jenner, and ensured his daughter, Susannah, was properly educated and cared for until she came of age. His books were left to Samuel Peach junior, and his nephews William Dallaway and John Peach were appointed as executors of his will and as joint guardians to Susannah.

For most of his life Bradley was healthy and must have had considerable stamina to sustain such a heavy programme of observing for so many years. When not observing, much of his work involved the meticulous, methodical, but unglamorous reduction of the data gathered. To identify the phenomena of aberration and nutation he needed a great deal of determination and patience, as well as enormous skill as an observer. These particular strengths he called upon in all his astronomical endeavours, which meant that his legacy to later astronomers was highly significant. Although he published comparatively little during his lifetime, his papers on aberration and nutation were key publications for the discoveries themselves and for the development of the notion of precision in astronomy; he also produced a number of papers, mainly concerning comets and other solar system objects. Moreover, the observations he made laid the basis for positional astronomy for over a century and a half. Knowing how and the precise extent to which the positions of celestial objects were affected by what could be termed ‘local’ phenomena—that is, those resulting from the instrument, the conditions around the observatory, and the motions both of the earth's axis and of the earth's orbit—allowed Bradley and later astronomers to concentrate upon characteristics intrinsic to the objects themselves. While, as has been pointed out by late twentieth-century historians, Bradley was not alone in Europe in taking positional astronomy so seriously, he was known to be a leading authority throughout his years as astronomer royal. Moreover, through his diligence in recording data at Greenwich, his legacy was tangible, reappearing in the form of basic astronomical tables in the early nineteenth and early twentieth centuries—tables which were heralded, literally, as epoch-making by astronomers of those eras.

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Likenesses

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- oils, 1747, NMM, Greenwich, Royal Observatory
- oils, 1833–1840 (after T. Hudson), NPG
- oils, 1833–1840 (after J. Faber), NPG
- J. Faber junior, engraving (after T. Hudson), repro. in *National Portrait Gallery catalogue*, pl. 80

Wealth at Death

£360; plus sufficient to fund three annuities totalling at least £135 p.a.: will, *Miscellaneous works*, ed. Rigaud