John Flamsteed | Encyclopedia.com

Complete Dictionary of Scientific Biography COPYRIGHT 2008 Charles Scribner's Sons
21-26 minutes

(*b*. Denby, England, 19 August 1946; *d*. Greenwich, England, 31 December 1719)

astronomy.

The only son of Stephen Flamsteed, a prosperous businessman, and Mary Spateman, he was raised in comfortable circumstances in Derby, England. During a childhood marred by the deaths of his mother and stepmother, he attended the Derby free school and received the normal preparation for university study. Unfortunately, his educational plans were forestalled by a serious breakdown of his health when, at the age of fourteen, he was afflicted with a severe rheumatic condition and complications therefrom, which left him so debilitated as to render his health a subject of grave concern for the rest of his days. His later correspondence is filled with allusions to periodic incapacity and reports of (generally unsuccessful) medication for it. The most immediate consequence of his frailty was his father's refusal to send him on to university in 1662. Flamsteed was deeply disappointed, but his misfortune may well have been a disguised blessing, since, left to his own devices, he was able to follow his own interests to a degree that would otherwise have been impossible. With his introduction to Sacrobosco shortly after leaving school, the direction of those interests was established for life.

The period between 1662 and 1669 was for Flamsteed one of education in the details of astronomical science. The major impediment to his progress seems not to have been the lack of instruction, in which respect he would scarcely have been better off at Oxford or Cambridge, but the fact that his "studies were discountenanced by my father as much in the beginning as they have been since."[1] As late as 1673, Flamsteed was receiving mail through a friend, "that my father might not see all the letters that come to me."[2] The ostensible basis of the father's attitude was, of course, the son's weak constitution; but various of Flamsteed's remarks betray a suspicion that he had been kept away from university more because of the help that a capable only son could render in tending a motherless home and a flourishing business than for any other reason. In spite of the time lost to business and illness, however, Flamsteed persevered. By the end of 1669, he was ready to put himself up for professional consideration.

Flamsteed's debut was a cautious one. Rejecting certain of his efforts that might be "beyond the capacity of the vulgar,"[3] he chose to submit—anonymously—to the Royal Society a small ephemeris of lunar occultations for 1670. He was soon engaged in extensive correspondence with Henry Oldenburg and John Collins, the scientific "clearinghouse" of the day. Through them he was introduced to Sir Jonas Moore, whose interest and influence were to be decisive in the launching of his career. Already from their first meeting in 1670, he emerged with a micrometer and the promise of good telescope lenses, which equipment enabled him to inaugurate his serious observational work. By the winter of 1674–1675 the enthusiastic master of the royal ordinance was attempting to organize patronage for an observatory. In the midst of his labors there appeared at court a French dilettante (sponsored by the king's mistress) who claimed to have solved the problem of determining terrestrial longitudes, long recognized as the principal desideratum for safer navigation. When Moore called upon his protège for judgment of the claim, Flamsteed replied convincingly that neither the positions of the stars nor the motions of the moon were well enough known to render the proposed method practicable. The result was the immediate realization of Moore's plans and more. The king founded an observatory and installed Flamsteed on 4 March 1675 as his "astronomical observator" at an annual stipend of £100.

With his appointment as astronomer royal and his removal to Greenwich, the pattern of Flamsteed's professional life was essentially established. At Easter of the same year he took orders, having the previous year taken the M.A. at Cambridge by letters-patent, after four years of nonresident enrollment. In 1684 he was granted the living of Burstow, in Surrey, not far from Greenwich; and in 1692, he was married to Margaret Cooke, the granddaughter of his predecessor at Burstow. At his death in 1719, he was succeeded at Greenwich by Edmond Halley and at Burstow by another astronomer, James Pound, an uncle of James Bradley.

The mandate of the newly created *mathematicus regius* was unequivocal: "Forthwith to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens, and the places of the fixed stars."[4] By no means a new idea, it was purely and simply the project conceived by Tycho Brahe a century earlier. The only thing at all remarkable about it was the extent to which it had been neglected during the intervening years. Incredible as it appears to later ages, the invention of the telescope had as yet had virtually no impact on fundamental astronomy. Two generations after Galileo's momentous discoveries, Tycho's star catalog remained the standard of excellence; and the one designed by Hevelius to replace it was likewise being constructed on the basis of naked-eye observations. With respect to the planets, the laws of Kepler were just winning general acceptance, while the observations from which they had been derived were being published (1666) because they still represented the most accurate information available. Flamsteed's assignment, then, was essentially that of dragging positional astronomy into the seventeenth century, of bringing it abreast of the new descriptive astronomy to which the telescope had thus far been almost exclusively applied. It was a project which coincided nicely with his own predilections and one to which he had already dedicated his efforts for some years before 1675. An indefatigable calculator and conscientious observer from the days of his youth, he had early learned that the existing tables and catalogs were unequal to the accuracy of even the most modest instruments. Unfortunately, however, it was one thing to recognize the scandalous state of astronomical science and quite another to do anything about it without professional apparatus. Prior to the fall of 1671, when he finally got his new micrometer-telescope fitted out, Flamsteed was able to do very little in the way of meaningful observation. What he did manage to do was to lay the foundation for his contributions to the solar and lunar theories.

Already several years before his post was created for the express purpose of "find[ing] out the so much-desired longitude of places for the perfecting the art of navigation,"[5] Flamsteed was "esteeming [him] selfobliged" to publish predictions of the moon's occultations of stars. In the process of computing these "annual preadmonitions of the lunar appearances,"[6] he necessarily became very familiar with the various accounts of its motion. Since all were conspicuously inadequate, he took considerable interest in the news that the legendary Jeremiah Horrox had left writings pertaining to the lunar theory. Despite the fact that the material involved had been deemed so fragmentary as to be unworthy of publication in the *Opera posthuma* of Horrox—in press at the time—Flamsteed journeyed to Lancashire to look at it. What he found was two letters that together contained a sketch of the proposed model, some computing rules from which he was able to infer the mechanism, and some opinions as to the constants that would be appropriate. Intrigued by the scheme (which stemmed basically from Kepler's ruminations on the subject and featured an elliptical orbit with a librating line of apsides and a variable eccentricity), Flamsteed brought the constants up-to-date and constructed enough tables to put the theory on trial. When observational comparison convinced him that "Bullialdus's, Wing's and Streete's theories were erroneous, and Horrox's near the truth,"[7] he naturally relayed the information to Collins, and ultimately Wallis, who was editing Horrox' works. The result was a last-minute inclusion of the lunar theory as reworked, tabulated, and elucidated by Flamsteed. Together with it was his defense of the equation of time, which restored it to its rightful status after three generations of confusion involving the annual equation of the lunar theory.

The lunar theory continued to occupy a special place in Flamsteed's work throughout his life. As a result of intermittent reconsiderations of the subject, he revised Horrox' orignial account at least three times: in 1680 for his *Doctrine of the Sphere*, in the late 1690's, and again about 1703 after the publication of Newton's second efforts on the theory. It was his model in terms of which Newton conceived the moon's motion, his observations by means of which Newton improved the theory, and his incorporation of Newton's revisions that rendered them subject to test, modification, and use. As late as 1746, Flamsteed's last version was published in Lemonnier's *Institutions astronomiques*. To his profound disappointment, however, neither it nor his similarly inspired work with the satellites of Jupiter ever achieved the accuracy requisite for longitude determinations.

Among the various features of Flamsteed's work on the motion of the sun, by no means the least interesting is the fact that he bothered to do it at all. Inherently simple and tractable by virtue of its small eccentricity and unique relation to the earth, the sun remained down to Flamsteed's day the least trouble-some of the planets. Yet, for Flamsteed, relative virtue was not sufficient. Every aspect of astronomy had to be as perfect as his researches could make it; and since the solar theory figured in, and hence determined the upper limit of accuracy of, all the other planetary theories, it had a prior claim to the utmost precision attainable. For that reason, Flamsteed issued no fewer than three different sets of tables during his lifetime. The first, published with Horrox' lunar theory, amounted to little more than a computing exercise, since it was constructed before Flamsteed had any original observations on which to base his parameters. The second, computed to a new determination of the eccentricity which pegged it at almost exactly its true value of .01675, appeared in his *Doctrine of the Sphere* (1680). The third was printed in Whiston's *Praelectiones astronomicae* (1707). Common to all three versions was Flamsteed's unique denial of the reality of the generally accepted secular changes in the longitude of apogee and the obliquity of the ecliptic. Strictly a modern in such matters, Flamsteed held that neither the accuracy nor the coherence of the ancient determinations justified their being taken seriously.[8]

That the existing planetary theories were far from any respectable standard of accuracy was one of the early lessons in Flamsteed's astronomical education. Already with the acquisition of his micrometer-fitted telescope the began to look into the possibility of improving them; but neither those investigations nor any of his numerous subsequent attempts yielded the degree of satisfaction he demanded in his work. Aside from a tract on the angular diameters of the planets, composed in 1673 and given to Newton for his preparation of the *Principia*, all that resulted from his efforts was an occasional determination of an isolated orbital element. The hundreds of observations he published in his *Historia coelestis Britannica* were no doubt useful to succeeding generations, but even they have been overshadowed by the six inadvertent observations of Uranus later found in his star catalog. An interesting concomitant of his planetary work was his determination of solar parallax from observations of Mars's perihelion opposition of 1672. Using the rotation of the earth for a base line, he arrived at values of "certainly not 30″" for Mars, and accordingly, "not more that 10″" for the sun's parallax[9]— results essentially indentical with those later released by the French and quite reasonably approximate to the true figures.

In 1676, two months after his installation at the Royal Observatory, Flamsteed inaugurated the observations that were to culminate in his celebrated 3,000-star "British Catalogue" (in volume III of his *Historia*). From the beginning, the task proved troublesome. King Charles's initial enthusiasm had sufficed only to the appropriation of funds for an observatory. Flamsteed was left to worry not only about such details as hiring computing assistants and obtaining instruments for the facility, but even whether he would receive his stipulated salary; by the close of 1676 some of it was already overdue, and as late as 1679 it was seventeen months in arrears and "in danger of a total retrenchment"[10] The prestige of the post ameliorated Flamsteed's pecuniary problems by drawing some 140 pupils to him for private mathematical instruction over the years. Sir Jonas Moore eased the want of instruments by giving him two clocks and a seven-foot sextant.

Between 1676 and 1689, Flamsteed made about 20,000 observations with the sextant. Accurate to about 10″, they constituted an improvement on Tycho's work by a factor of perhaps fifteen. Unfortunately, they consisted exclusively of relative distances, having no "anchor" in the celestial sphere. Refusing to refer his star places to Tycho's much less accurate bases, as he had criticized Halley for doing, Flamsteed resolved to underwrite a fixed-meridian instrument himself. A mural quadrant completed in 1683 proved too fragile; but a 140° mural arc made possible by the inheritance from his father's estate solved his problem. In the years following 1689, he did fundamental astronomy with an accuracy unsurpassed before Bradley. He achieved precise determinations of the latitude of Greenwich, the obliquity of the ecliptic, and the position of the equinox and then bypassed them all by devising an ingenious scheme for observing absolute right ascensions. Using matched occasions at which the sun had identical meridian altitudes near each equinox, he measured the time intervals between the passage of the sun and a bright star across the meridian. Halving the difference between the two time intervals then located the solstice and gave the star's right ascension. It is difficult to overstate the advance represented by this method. Not only did it do away with the errors formerly introduced by using an intermediary planet to measure the angle between sun and star, but it eliminated all uncertainties caused by parallax, refraction, and latitude. After using this method to obtain the positions of forty reference stars, Flamsteed computed the rest of his 3,000-star catalog from the intermutual readings already taken with the sextant.

Long before he had readied his observations for publication, Flamsteed had become resigned to the likelihood that he would have to underwrite the end of the project as he had every other aspect of it. Unfortunately, before he could carry the plan through to his own ideal of completion, his long-simmering relations with Newton and Halley boiled over. The wrangle began in 1704 and ended only with the unauthorized printing of Flamsteed's work in 1712. Because the perpetrators of this unorthodox operation were who they were, the incident has received more attention than it deserves. The essence of the situation seems to be that Newton and Halley, who lacked Flamsteed's passion for astronomical precision, felt that Flamsteed was being unnecessarily dilatory in the publication of his observations. Regarding the observations of the publicly supported astronomer royal as public property, they took steps, as officers of the Royal Society, to expedite the entrance of these observations into the public domain. Whatever their motives (and it is difficult to believe that they were purely objective), their action was quite questionable; and in any case, since Flamsteed had disbursed well over half of his life's salary for computing service, construction and repair of instruments, and other operating expenses, their basic premise was open to dispute. In 1714 a turn of the political wheel of fortune gave Flamsteed the satisfaction of burning all but ninety-seven pages of three-quarters of the spurious edition. By the time he died, he had pushed the work far enough that the three-volume *Historia coelestis Britannica* could be published in 1725. The companion *Atlas coelestis* appeared in 1729.

There can be little doubt that Flamsteed's reputation rests on his observational work. As Grant expressed it, "In carrying out views of practical utility, with a scrupulous attention to accuracy in the most minute details, in fortitude of resolution under adverse circumstances, and persevering adherence to continuity and regularity of observation throughout a long career, he had few rivals in any age or country." As is usually the fate of practical scientists, his other qualities and achievements have been either overlooked or denigrated. The fact is that no other astronomer royal until Airy manifested anything like the same concern for the reduction and manipulation of data. Far from bequeathing a mass of raw observations in the manner of Bradley, Flamsteed converted and applied his.

In addition to the numerous efforts already mentioned, one can cite tables of atmospheric refraction and tides. The first tabulation in England of the moon's elliptic inequality according to Kepler's second law was carried out under him.[11] Nor did Flamsteed lack his share of inventiveness in an age in which speculation was rife. He argued vigorously with Newton in behalf of the proposition that two comets of 1680–1681 were in fact appearances of the same comet. Prior to that, he had already noted that the comet of 1677 had appeared in the same place as those of 1653 and 1665. In publishing his observations of it, he posed the question of "what conformity there is betwixt the motions of this and them and whether it may probably be the same returned hither after two revolutions."[12] From reports of the coronal phenomena during a solar eclipse, he inferred the existence of a lunar atmosphere. He has been criticized for his "discovery" of stellar parallax in 1694: what he actually found was aberration of starlight, "the maximum value of which is deducible with an astonishing degree of accuracy" from his observations. The truth remains that whatever interpretive shortcomings might be attributed to him must also be laid at the door of Newton, Halley, Gregory, Wallis, and everyone else who could read the published account of his findings.[13]

One respect in which Flamsteed was conspicuously deficient was an aptitude for dealing with his fellowman. Possessed of an attitude that can only be described as uncompromising, he was an intemperate man even by the standards of an intemperate age. The particular and enduring subject of his passion was Edmond Halley. The last thirty years of Flamsteed's extensive correspondence is infused with vituperous remarks about the man who should have been his most natural and valuable ally. No single cause of such animosity has been convincingly advanced. Professional jealousy was, no doubt, an element: rare indeed was the occasion on which Flamsteed praised any third party, and even rarer was it that he passed up an opportunity to criticize. Basically, however, it was simply a personality clash. Halley's flamboyant nature, frivolous attitude toward religious matters, and hit-and-run approach to astronomy offended the dour Flamsteed, who took everything he did very seriously. Lurking behind it all was Flamsteed's perpetual ill health, which would surely have tried the patience of any man. That he managed to accomplish so much in spite of it and its effect on his relations with his contemporaries is a real tribute to his industry and ability.

NOTES

1. Baily, p.10.

2. Rigaud, p.130.

3. Bayle.

4. Baily, p.III.

5.*lbid*.

6. Rigaud, p.120.

7. Baily, p.31.

8. Flamsteed MS, XXXVIII, 149.

9.*Philosophical Transactions*, 7, 5118.

10. Baily, p.118.

11. Baily, p.704.

12.*Philosophical Transactions*,**12** , 873.

13. Wallis, III, 704.

BIBLIOGRAPHY

I.Original Works. Flamsteed's three major printed works were *The Doctrine of the Sphere* (London, 1680); *Historia coelestis Britannica* (London, 1725); and *Atlas colestis* (London, 1729). Other lesser works appeared in Horrox' *Opera posthuma* (London, 1673); John Wallis' *Opera mathematica* (London, 1699); and the *Philosophical Transactions of the Royal Society*.

The bulk of the extant Flamsteed MSS is contained in his seventy-odd notebooks preserved at the Royal Observatory and recently published in microfilm, *Observations of the Royal Astroonomers* (London, 1969). The most significant material in it is a serialized autobiographical statement, which was published in Francis Baily's *Account of the Revd*. *John Flamsteed* (London, 1835). Along with it was Baily's revision of the "British Catalogue" according to researches conducted by William and Caroline Herschel.

Flamsteed's extensive correspondence with various of his contemporaries provides a very interesting view of the scientific activity of his day. Many letters were published as early as 1738 in the English version of *Bayle's General Dictionary*. A large number were found in the nineteenth century. Baily printed about 200, while vol. il of Rigaud's *Correspondence of Scientific Men of the Seventeenth Century* (London, 1841) contains numerous others. See also Cudworth's Life and Correspondence of Abraham Sharp (London, 1889), and *The Correspondence of Isaac Newton* (London, 1959-). J.L.E. Dreyer found (*Observatory*, **45** [1922], 280–292) some seventy unpublished letters written to Richard Townley preserved in the rooms of the Royal Society at Burlington House. The Southampton Record Office contains Flamsteed's letters to Molyneux, while numerous other unpublished letters are preserved in the notebooks at the Royal Observatory.

II. Secondary Literature. The best secondary account of Flamsteed's work is Robert Grant, *History of Physical Astronomy* (London, 1852). Important additional material is presented in Agnes Clerke's article in the *Dictionary of National Biography*; and in E. F. MacPike, *Hevelius Flamsteed, and Halley* (London, 1937).

Victor E. Thoren