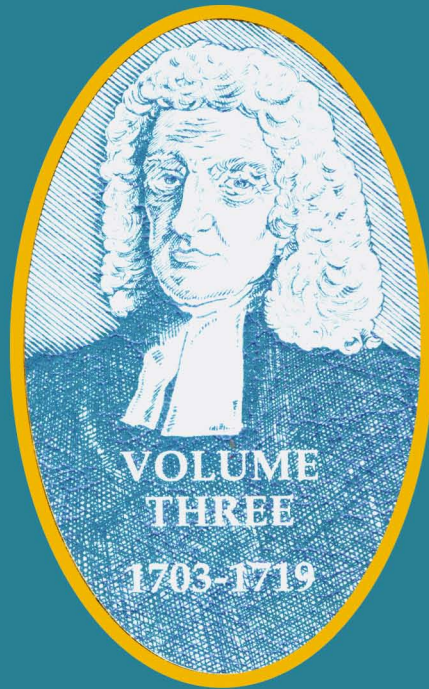
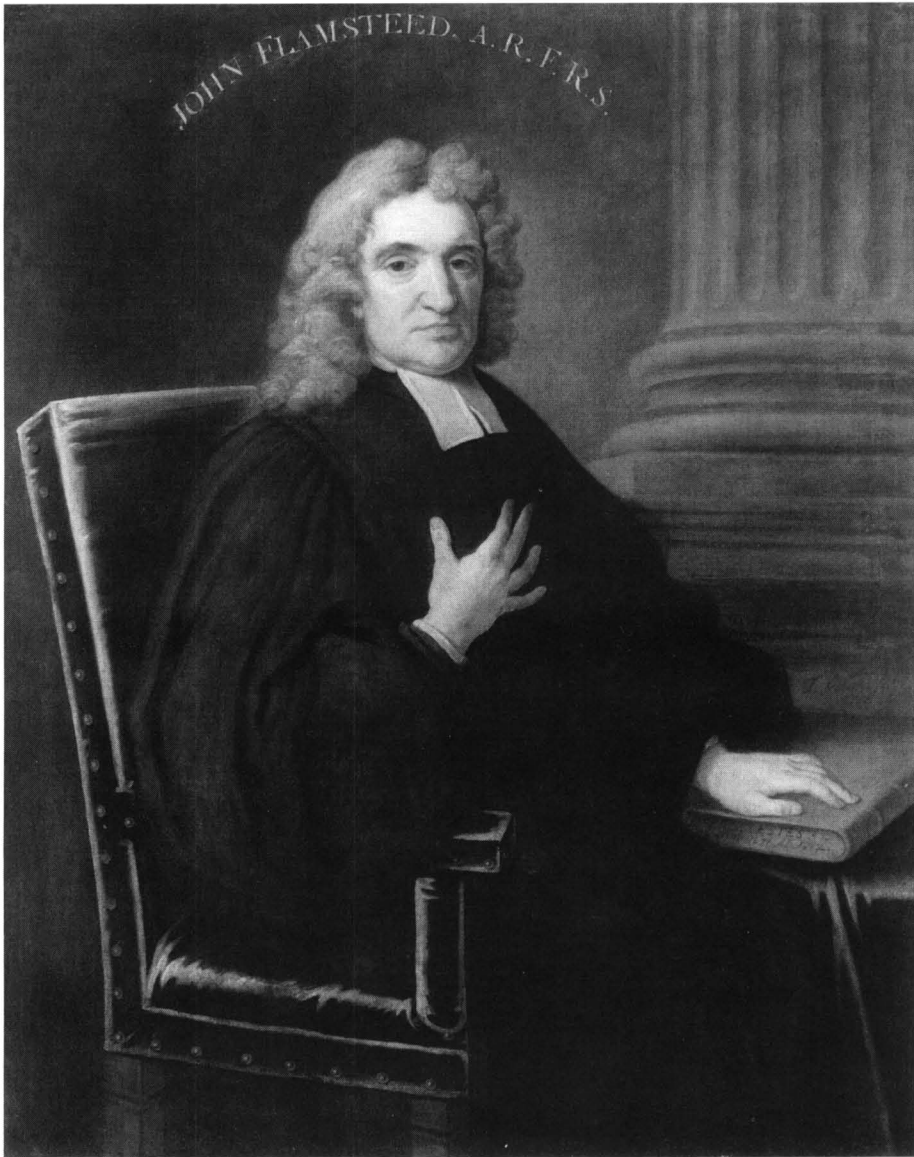


THE  
CORRESPONDENCE  
OF  
JOHN  
FLAMSTEED,  
FIRST ASTRONOMER ROYAL



Compiled and Edited by  
ERIC G FORBES  
LESLEY MURDIN  
and FRANCES WILLMOTH

**THE CORRESPONDENCE OF  
JOHN FLAMSTEED,  
THE FIRST ASTRONOMER ROYAL**



Frontispiece 1. Portrait of John Flamsteed by Thomas Gibson, painted in November 1712. Reproduced by permission of the President and Council of the Royal Society.

I had intended y<sup>e</sup> of y<sup>e</sup> 25<sup>th</sup> past as soon as I could out that  
 I was then troubled y<sup>e</sup> hand been under hand with y<sup>e</sup> gravel which  
 gives me frequent fluxe but short paines I am very glad to hear  
 y<sup>e</sup> y<sup>e</sup> July and in such forwardness and profit goes on with  
 my catalogue in which some errors of y<sup>e</sup> Edition in your  
 hands will be corrected some few stars added & a Catalogue  
 of all the good stars in it y<sup>e</sup> his right hon<sup>ble</sup> Board of the Chap-  
 tain for y<sup>e</sup> sake of y<sup>e</sup> Moon & planets especially to them, I hope  
 according to their Longitude will be added, which will save  
 Dr H y<sup>e</sup> pains of comparing with bits of Catalogue from it  
 Mr Whiston last week sent me his account of the Meteor  
 in which there is little more remarkable than in my Memoirs  
 found y<sup>e</sup> August us Mr Flinders figure of its way, which seem to  
 pass to y<sup>e</sup> south of y<sup>e</sup> whole constellation of Orion whereas he  
 says it passes under his Gridle & was taken towards his  
 South Mr Kepler told me, that it appeared at first  
but like a very big star that enlarged it self as it  
approach'd, and my own credit that for all y<sup>e</sup> great light  
it had seem'd y<sup>e</sup> stars very plainly, which I take to be  
is a very remarkable circumstance not noted by others  
& that y<sup>e</sup> brightness great y<sup>e</sup> light appeared it was infinite  
in y<sup>e</sup> light of y<sup>e</sup> Sun, fainter, consider how y<sup>e</sup> light of a  
fixed star is about 30 or 40 foot from y<sup>e</sup> in a pointed  
starlight but Moon like light, would hinder y<sup>e</sup> from seeing  
the fixed stars & y<sup>e</sup> will not mend y<sup>e</sup> Joseph from  
is not with standing y<sup>e</sup> light of y<sup>e</sup> Meteor I had a Map  
of Orion lately before him, y<sup>e</sup> has both y<sup>e</sup> Orion & Syrus in  
it, he then told me y<sup>e</sup> it shined upon it in y<sup>e</sup> right leg  
of Orion. compare this path of the meteor with that seen  
by Mr Flatio, at Worcester<sup>ST</sup> will find it almost all the same

Frontispiece 2. Flamsteed's draft of Letter 1505, 18 June 1719 (RGO 1/36, f. 99). Because of the deterioration of his handwriting, this, like most other letters written in the last few years of his life, was copied by an amanuensis before being sent. It is reproduced here by permission of the Syndics of Cambridge University Library and the Director of PPARC.



**THE CORRESPONDENCE OF  
JOHN FLAMSTEED,  
THE FIRST ASTRONOMER ROYAL**

**VOLUME THREE  
1703-1719**

**COMPILED AND EDITED BY ERIC G. FORBES,  
AND (FOR MARIA FORBES)  
BY  
LESLEY MURDIN AND  
FRANCES WILLMOTH**



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I hope that despite all vicissitudes the three volumes of this edition are reasonably consistent in style and quality, and faithful enough to Eric Forbes's conception that he would approve the result. By way of an informal dedication for the present volume, it seems appropriate also to pay tribute to the memory of Derek Howse, a kind friend to the project over many years, who died in 1998.

Frances Willmoth, May 2001

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## GLOSSARY OF ASTRONOMICAL AND OTHER TECHNICAL TERMS

Entries have been repeated, selectively, from the equivalent list in the previous volume. The definitions come from several sources, cited in the following short forms:

- Doctrine* - *The doctrine of the sphere* (London, 1680), published as the sixth part of Sir Jonas Moore's posthumous *A new systeme of the mathematicks* (London, 1681)
- Hill* - John Hill, *Urania: or a compleat view of the heavens; containing the antient and modern astronomy, in the form of a dictionary* (London, 1754), unpaginated
- Hutton* - Charles Hutton, *A mathematical and philosophical dictionary*, 2 vols (London, 1795-6); 2d edn, 2 vols (London, 1815).
- OED* - *The Oxford English Dictionary*, 2d edn, ed. J. A. Simpson and E.S.C. Weiner, 20 vols (Oxford, 1989)
- Phillips* - Edward Phillips, *The new world of English words: or, a general dictionary* (London, 1658; 5th edn 1696)

[It has been suggested that entries should be included from John Harris, *Lexicon technicum: or, an universal English dictionary of arts and sciences* (London, 1704). For the first of the terms listed here Harris's definition is plainly wrong, and some of his other entries appear woolly, at best; it thus seems better to leave readers to consult him at their own risk.]

acronical/achronycal: 'happening in the evening or at nightfall ... as the achronycal rising or setting of a star' (*OED*). 'When a Star rises when the Sun sets 'tis said to rise achronically; when it sets when the Sun sets, 'tis said to set achronically' (Phillips, *Achronical*). 'The achronycal is one of the three great poetic risings and settings of the stars; and stands as distinguished from Cosmical and Heliacal' (Hutton, I).

almicanters/almicantarahs/almucantars: 'small circles of the sphere parallel to the horizon, cutting the meridian at equal distances; parallels of altitude' (*OED*); 'certain circles, which are continued parallel with the horizon. The two kinds of circles dependant on the horizon, are the secondaries or verticals and the parallels. The first of these are ... called Azimuths, and the latter Almicantarahs, for astronomers are too fond of hard words' (Hill); 'from the Arabic almocantharat, are circles parallel to the horizon, conceived to pass through every degree of the meridian ... and are the same as the parallels of altitude' (Hutton, I).

anomaly: 'the angular distance of a planet from its last perihelion or perigee: so called because the first irregularities of planetary motion were discovered in the discrepancy between the actual

and computed distance (*OED*); 'From the Mean Motion of the Moon correct, subtract the true place of the Apogee, the remainder is the Mean Anomalie' (*Doctrine*, p. 36).

aphelion: 'that point of a planet's or comet's orbit at which it is farthest from the sun' (*OED*); opposite to perihelion. See also 'apogee'.

apoge, -gee, -geon, -gaeon, -geum: 'the point in the orbit of the moon, or of any planet, at which it is at its greatest distance from the earth; also, the greatest distance of the sun from the earth when the latter is in aphelion' (*OED*). 'That point of heaven where the Sun or any Planet is farthest from the Center of the Earth' (Phillips, *Apogaeum*). 'That point of the ecliptic, when the Sun is most distant from the earth, is called its apogee or if we speak of the Earth, its aphelion' (Hill, *Apogee*).

aspects: 'the relative positions of the heavenly bodies as they appear to an observer on the earth's surface at a given time' (*OED*); 'the position of the stars at such a distance in the Zodiack, wherein they mutually help or afflict one another, or have their Vertues encre's'd or deprav'd' (Phillips, *Aspect*); 'The greater Aspects were five, and they were distinguished by names answering to the number of degrees of distance. ... The conjunction is when they are together, the sextile when at sixty degrees distance, the quadrant when at ninety degrees, the trine when at one hundred and twenty, and the Aspect of opposition, when at ... one hundred and eighty degrees distance' (Hill, *Aspects*).

asymptote: 'A line which approaches nearer and nearer to a given curve, but does not meet it within a finite distance. A rectilinear asymptote may be considered as a tangent to the curve when produced to an infinite distance' (*OED*); 'a right line, which approaches continually nearer and nearer to some curve, whose asymptote it is said to be, in such sort, that when they are both indefinitely produced, they are nearer together than by any assignable finite distance' ... (Hutton, I).

azimuth: 'an arc of the heavens extending from the zenith to the horizon, which it cuts at right angles; the quadrant of a great circle of the sphere passing through the zenith and nadir, called an *azimuth-circle*', and 'the angular distance of any such circle from a given limit, e. g. a meridian' (*OED*); 'The Azimuth circles are those which meet in the vertical point, and pass through all the degrees of the Horizon (Phillips, *Azimuth*).

colure, solstitial and equinoctial: 'two great circles which intersect each other at right angles at the poles, and divide the equinoctial and the ecliptic into four equal parts. One passes through the equinoctial points, the other through the solstitial points, of the ecliptic' (*OED*); they are hence termed the equinoctial colure and solstitial colure. '*Colures*, two great Circles in the Globe of the World, which passing through the Poles and the four principal points of the Zodiack, cut themselves equally, and divide the Globe into equal parts' (Phillips). 'That meridian, or circle of declination, which passes through the poles of the equator, and those of the ecliptic. The

Colure of the equinoxes is that circle which passes through the poles of the ecliptic, and the intersections of the ecliptic with the equator' (Hill, *Colure*).

medium coeli, mid-heaven - 'the meridian, or middle line of the heavens; the point of the ecliptic on the meridian' (*OED*); 'that point of the ecliptic which culminates, or is highest, or is in the meridian at any time' (Hutton, 2); see also nonagesimal.

node: node: 'one of the two points at which the orbit of a planet intersects the ecliptic, or in which two great circles of the celestial sphere intersect each other' (*OED*); '... the Point where a Planet passes over the Ecliptick, out of Southern Latitude into Northern, is called its North [or ascending] Node; and when it descends from North to South, its South [or descending] Node; which change their Places in the Zodiack ... contrary to the succession of the signs; but those of the Moon are chiefly taken notice of' (Phillips, *Nodes*).

nonagesimal degree or point (from Latin 'nonagesimus', 'ninetieth'): 'that point of the ecliptic which is highest above the horizon at any given time, being 90° above the point at which the ecliptic intersects the horizon' (*OED*); 'called also the Mid Heaven ... and its altitude is equal to the angle that the ecliptic makes with the horizon at their intersection, or equal to the distance of the zenith from the pole of the ecliptic (Hutton, 2). Hence 'nonagesimary table'.

prosthaphaeresis: 'the equation of the centre; in a more specialised sense, the difference between the true and mean place of a planet or between the true and equated anomaly, so the correction necessary to find the true place from the mean' (*OED*). 'That part of the Eccliptick which is to be added or subtracted from the Mean Motion of the Planets to obtain the True, or from their True to obtain their Mean Motion' (Phillips, *Prostopherisis*). 'The difference between the true and mean motion, or between the true and mean place, of a planet or between the true and equated anomaly; called also the Equation of the Centre, or simply the Equation; and it is equal to the angle formed at the planet, and subtended by the excentricity of its orbit' (Hutton, 2, p. 298). See also *Newton's correspondence*, 4, p. 99, n. 3.

quadrature: 'one of the two points (in space or time) at which the moon is 90° distant from the sun, or midway between the points of conjunction and opposition' (*OED*); 'that aspect or position of the moon when she is 90° distant from the sun. Or, the Quadratures are the two middle points of the moons orbit between the points of conjunction and opposition ... at which times the moon's face shews half full, being dichotomized or bisected' (Hutton, 2, p. 316)

quartile/quadrature - 'the aspect of two heavenly bodies which are 90° distant from one another; a quadrature' (*OED*); 'the Distance of three Signs between one Star and another' (Phillips, *Quartile aspect*)

radix: 'a number or symbol which is made the basis of a scale of numeration'; in astronomy/astrology 'a basis of calculation, as a nativity, a certain point in time, position of a planet, etc.' (*OED*)

saros (σαρος) 'The Babylonian name for the number 3600, and hence for a period of 3600 years'. A misinterpretation by Suidas, who took the saros as eighteen and a half years, led to the adoption of the term by modern astronomers for 'the cycle of 18 years and  $10\frac{2}{3}$  days, in which solar and lunar eclipses repeat themselves' (*OED*); 'a period of 223 lunar months' (Hutton). *OED* gives 19C examples only, but see Letters 1491, 1494, 1495, 1498, for use by Flamsteed, Sharp and Halley.

superficies: 'a magnitude of two dimensions, having only length and breadth; that which forms the boundary or one of the boundaries of a solid ... ; a surface. The outer surface of a body which is apparent to the eye, or is immediately adjacent to the air or to another body; ... superficial area or extent' (*OED*); 'in Geometry, the outside or exterior face of any body ... considered as having two dimensions of length and breadth only, but no thickness' (Hutton, 2).

syzygy, pl. syzygies: 'originally = conjunction; now extended to include both conjunction and opposition of the heavenly bodies, or either of the points at which these take place, especially in the case of the moon with the sun ... Often opposed to *quadratures*' (*OED*); 'used by some of the Greek writers to express what our astrologers mean by their term aspects ... Some will have only the conjunction to be expressed by this term syzygy ... but the oldest writers use it to express aspect in general' (Hill); 'a term equally used for the conjunction and opposition of a planet with the sun. On the phenomena and circumstances of the Syzygies, a great part of lunar theory depends' (Hutton, 2).

## LIST OF SYMBOLS

Several additions to the list of astronomical symbols used have proved necessary for the present volume. In the transcribed texts, symbols have generally been reproduced as symbols, because it is not always possible to determine how they should be read: in some cases it is unclear whether an English or Latin reading was intended. The complete list is now as follows:

Latin nominative (genitive)	English				
☉ Sol (Solis)	Sun	♈	Aries	♐	Sagittarius
☾ Luna (Lunae)	Moon	♉	Taurus	♑	Capricorn
☿ Mercurius (Mercurii)	Mercury	♊	Gemini	♒	Aquarius
♀ Venus (Veneris)	Venus	♋	Cancer	♓	Pisces
♂ Mars (Martis)	Mars	♌	Leo	♌	conjunction
♃ Juppiter (Jovis)	Jupiter	♍	Virgo	♍	opposition
♄ Saturnus (Saturni)	Saturn	♎	Libra	♊	node (ascending)
♁ Terra	Earth	♏	Scorpio	♋	node (descending)

Days of the week represented by astronomical symbols are stated in square brackets in their English form, although in some cases the Latin was probably intended. They are:

☉	die Solis	Sunday
☾	die Lunae	Monday
♂	die Martis	Tuesday
☿	die Mercurii	Wednesday
♃	die Jovis	Thursday
♀	die Veneris	Friday
♄	die Saturni	Saturday

## EDITORIAL NOTE

The conventions employed in this volume are those described in the 'Editorial Note' supplied for volume one, which will not be duplicated here.

An additional observation particularly relevant to these later letters is that from about 1712 Flamsteed sometimes ended the usual flourish beneath his signature with lower case Roman numerals representing the year of writing. Any reader concerned to confirm dates may find it worthwhile to check the flourishes in the original manuscripts, as they have not been reproduced in the printed transcriptions.

As noted in the addenda to the present volume, the manuscript originals of most of the letters included in the earlier volumes as 'in private hands' are now held by Cambridge University Library, as part of the recently purchased Macclesfield Collection, formerly at Shirburn Castle. Eric Forbes was granted direct access to these documents, but the present editor checked the transcriptions against photocopies in the custody of the Royal Society rather than against the originals.

## INTRODUCTION

This volume of letters covers the last sixteen years of Flamsteed's life, during most of which time his activity as a correspondent was undiminished. A simple averaging of entries reveals that about as many letters are recorded per year as in the first volume of the series (around 37), while in the second the figure is significantly lower (around 21). This may reflect the fact that the second volume covers the period of most intensive observational work at Greenwich, while Flamsteed's dealings with the outside world play a more prominent role in the other two. In the first, the main themes are the establishment of his reputation as an astronomer and the founding and early development of the Royal Observatory; the processing of its results and the long dispute over their publication play a large part in this third volume, with the complex early stages of negotiations over publication making 1705 and '06 the peak years within it for totals of surviving letters (92 and 85 respectively). But their content shows that even at its height the publication dispute did not totally disbar other topics from consideration; Flamsteed's other habitual concerns, intellectual and personal, continue to be well represented throughout. His undiminished commitment to practical astronomy is reflected in his contacts with other astronomers, in England and overseas, several of whom repeatedly sought and (almost invariably) obtained his advice and assistance. His position as a national figure-head for astronomy also brought with it other obligations: some welcome, such as his involvement with the founding of the Plumian chair of astronomy and observatory at Cambridge; some rather less so, such as the requirement to respond to demands by proponents of methods of finding longitude at sea.

The volume opens with a note by Flamsteed surveying the work so far completed for his star catalogue; the next item is a mathematical paper written by Leibniz and circulated to potential commentators by the Royal Society. The juxtaposition is coincidental but appropriate, as the Society's ambition to bring the star catalogue into the public domain was later to be a key factor in the bitter wrangle over the publication of Flamsteed's results. But at this point, in 1703 and for a few years afterwards, the potential for conflict remained in the background: Flamsteed had withdrawn from active participation in the Society's meetings but still had some contact with it, mostly by indirect means. Privately, to Abraham Sharp, he expressed his disapproval of Hans Sloane as its Secretary and editor: 'our Transactioneer has in a Manner ruind the reputation of the RS as he has done of his Transactions ... tis a bulky gentleman but his soule creeps onely amongst herbs and plants'.<sup>1</sup> In October 1704, again to Sharp, he added a criticism of Isaac Newton as the (relatively new) President: 'Our society decays. and produces nothing remarkeable. ... governed by persons that either value nothing but their own Interests or understand little but vegetables and how by makeing a bouncing Noyse to cover their own ignorance.'<sup>2</sup> But these were genuinely private remarks, which he was confident that Sharp would have no opportunity to pass on, and need not be interpreted as a total refusal to have any dealings with the Society. In fact, in the short term, the election of James Hodgson as a Fellow in 1702 effectively kept a channel of communication open.

Hodgson had then just left Flamsteed's employment but had married his niece, Ann Heming, who continued to live at the Observatory. Flamsteed trusted him as a messenger and inter-

mediary in other contexts, and noted his election quite calmly: 'they have a limbe of me ... but he is honest and discreet'.<sup>3</sup> His presence sometimes proved useful to both sides, for example when it led to the publication in the *Philosophical Transactions* of John Caswell's design for a new kind of baroscope, after Caswell had sent the description to Flamsteed.<sup>4</sup> In the same year (1704), a mathematical piece by Sharp, on the 'quadrature of the circle', was also transmitted to the Society by Hodgson, though it was subsequently rejected in favour of a similar paper written by Edmond Halley. Flamsteed's account of a study of the rebounding of balls in vacuo, undertaken in 1705 by Hodgson's close associate Francis Hauksbee, reveals that it was based upon experiments and discussions in which both Flamsteed and Hodgson participated; he seems to have attended a Society meeting for the purpose, perhaps by Hodgson's special request.<sup>5</sup> Some while later, Flamsteed's mind was still running upon experiments: he mentions the discovery that light could be produced by shaking mercury and that he had 'moved to have it tried whether the light or flame would fire gunpowder', though he had not heard whether this had yet been done.<sup>6</sup>

Hodgson was probably again the intermediary when a short account of Flamsteed's and his correspondents' observations of a partial solar eclipse seen on 12 May 1706 was printed in the *Philosophical Transactions*.<sup>7</sup> But this was the last occasion on which Flamsteed voluntarily allowed his own name to appear there. His regular opportunities for maintaining indirect contact with the Society through Hodgson came to an end when Mrs Hodgson moved out of the Observatory, in October 1706; at the same time, Flamsteed was becoming increasingly frustrated at the delays and difficulties that arose in connection with the printing of his works, held Newton responsible for them, and was increasingly inclined to argue that the President's conduct brought the whole Society into disrepute: 'Our Society is ruined by his close politick and cunning forecast I fear past retrieving for our Drs Transactions have been twice burlesqt publickly ...'.<sup>8</sup> The fact that other Fellows involved in the publication dispute escaped Flamsteed's condemnation began to fade into insignificance.

In January 1708/9 the Society's Council ruled that members whose dues were in arrears should pay for a year or be struck off the lists; this provided a mechanism for Flamsteed's expulsion on 9 November following. In interim, however, in June 1709, some kind of overture was made by William Derham, who had already corresponded with Flamsteed for some years on his own account and can be identified as one of a small group within the Society opposed to the dominance of Newton and Sloane. Now, 'not without the order of the R. Society', he sent a piece about the tides (by William Hobbs), in the hope that it might be compared with another document previously received from the same writer; there is no evidence that Flamsteed responded to the request.<sup>9</sup> Soon afterwards Derham suggested a meeting to talk 'about your Hist. Caelestis, and divers other matters; among the rest some relating to the R.S.'; his advice to Flamsteed to bear injuries patiently hints that he thought events might soon take a turn that they would both approve.<sup>10</sup> As Flamsteed then reported to Sharp, in tones of some satisfaction: 'Dr Sloan quarrells with Dr Woodward continually and is now for buying a house of 2000<sup>li</sup> price to remove the Society to in Crown Court in Fleet the President Joynes with Sloan and tis thought will prevayle: which will blow them up I hear of all their transactions and meddle not'.<sup>11</sup> But the outcome was rather different: the battle with Woodward in fact ended in his expulsion from the Society's Council, New-

ton and Sloane overrode objectors to accomplish the move to Crane Court, and the Society survived under the same management, in a relatively sound and solvent state.

On 14 December 1710 Flamsteed learned of the appointment of the President and Council members of the Royal Society as Visitors with supervisory powers over the Royal Observatory, by a royal warrant dated 12 December.<sup>12</sup> He was naturally appalled and before the end of the month had drafted a petition to the Queen seeking revocation of the decision; in proposing that alternative, better qualified Visitors might be appointed he appeared to concede that some limiting of his independence was now inevitable, though by including the Principal Officers of the Royal Ordnance amongst them he evidently hoped to substantially preserve existing arrangements.<sup>13</sup> He remained confident that he had ‘some freinds that I hope will give the Queen a true state both of the R. Observatory and R: S.’; Derham reported that as Boyle Lecturer he had taken the opportunity to speak with influential people on Flamsteed’s behalf, though he does not say whether this was about the Visitorship, the publication dispute, or both. In any case, all such attempts failed: the Society proceeded to wield its visitorial powers energetically, issued orders for the making and annual handing over of observations, and tried to interpret the command to give instructions about repairs to the Observatory’s instruments as authorisation to assume control of them.

Flamsteed complied with the order to supply observations only twice, and with conspicuous reluctance.<sup>14</sup> On the question of the instruments, he was from the outset resolved to fight and confident of victory. An initial skirmish at the end of a meeting with Dr John Arbuthnot in March 1711 – when Arbuthnot said the Royal Society would buy the instruments from Flamsteed and he retorted that he would not sell them – was followed by an encounter with Newton some seven months later: ‘I have had another contest with the PR. RS who had formed a plot to make my Instruments theirs and sent for me to a Committee where onely himselfe and two Physicians Dr Sloane and another as little skilful as himselfe [Richard Mead] were present the Pr[esident] ran himselfe into a great heat and very indecent passion I had resolved aforhand his kn—sh talke should not move me Shewed him that all the Instruments in the Observatory were my own ... this netled him ... and he sayd *as good have no Observatory as no Instruments*. I comp[lained] then of my Catalogue being printed by Raymer without my knowledg and that I was *Robd of the fruits of my labor* at this he fired and cald me all the ill Names Puppy etc [that he] could thinke of’.<sup>15</sup> By this stage, the role played by Newton and Halley (‘Raymer’) in the publication dispute, shortly to culminate in the appearance of the ‘spurious’ *Historia coelestis* (1712), had poisoned the atmosphere to the point where these different issues could no longer be separated, at least in Flamsteed’s mind. In complaining about the way the Greenwich observations obtained by virtue of the warrant had been edited for the *Philosophical Transactions*, he said of Halley: ‘the Theivish Editor his and S.I.N.s designes are by these abstracts to prevent and obstruct the publication of the whole. he has robd them of all their certeinty and by giveing them the name of My observations made me or endeavord to make my observations appear as little worth as his owne are and as little to be desired.’<sup>16</sup> In 1713 Halley succeeded Sloane as the Society’s Secretary.

The extraordinary lengths to which Flamsteed was then prepared to go to demonstrate his independence of the Society, and to thwart Halley’s plans, is reflected in one of his accounts of the

famous total solar eclipse of 22 April 1715: 'I fear our R: S: and their Dr Hally ... had no instrument ready for finding the error of their clock. for their Dr. has tried severall ways to get copys of mine but vaine. my provident servant had set the clock a few minutes out of the way, and when the Eclipse was over the company was told the times they had copied from his paper the Counts [of] the clock were not the true times. this defeat troubled them exceedingly. there were above 100 people in the roome and I believe above a dozen that had taken. copys. all which to them are uselesse'.<sup>17</sup> Subsequent comments indicate that his hostility towards the Society never softened; the last such reference in a letter, written at the end of 1718, warned Sharp to reject a request to calculate tables of natural logarithms for them, 'who make all things they can lay hands on their own'.<sup>18</sup>

Most details of the publication dispute itself are already well known to historians of science and do not need to be repeated here, though a reminder of the dates of some of the key events may be useful. Following the precedent established by Francis Baily in his *Account of the Rev. John Flamsteed* (1835), a number of writers have described it at some length: Eric Forbes in *Greenwich Observatory, vol. 1: origins and early history*, Richard Westfall in *Never at rest: a biography of Isaac Newton*, and more recently Adrian Johns in *The nature of the book: print and knowledge in the making*.<sup>19</sup> Aspects of it have also been fairly frequently described and discussed in other writings about Newton and Halley, though inaccuracies have sometimes crept in. Most of the relevant documents have been printed at least once: Flamsteed's narratives and much correspondence were included in Baily's *Account*; key letters and some other items appear in the fourth and fifth volumes of *Newton's correspondence*; Flamsteed's principal attempt at a definitive account is presented in Allan Chapman's edition of *The Preface to John Flamsteed's Historia coelestis Britannica or British catalogue of the heavens*<sup>20</sup> (1982); and extracts from the outspoken letters Flamsteed sent to one of his most trusted friends during the course of the dispute appear in William Cudworth's *Life and correspondence of Abraham Sharp* (1889). It is not surprising, therefore, that the present edition includes little entirely new material relating to this topic; the chief contribution it can make is to print letters in full and in their proper chronological order with respect to those on other subjects, so that the context of particular events can be better appreciated. The viewpoint represented here is, of course, more solidly Flamsteed's own than in other collections; where a choice of versions of a text is available, a draft or copy kept by Flamsteed himself has often been selected in preference to an original that has already appeared in print elsewhere (with significant variations duly noted).

The earliest of the few new additions are amongst the most significant. Two letters written by Flamsteed to Dr Martin Lister (now in the Bodleian Library) reveal that serious attempts to secure patronage for the printing of his works began as early as the summer of 1703, some months before Newton visited Greenwich to enquire about the 'forwardness' of Flamsteed's endeavours and offer his aid, and more than a year before Flamsteed's first report that 'the Prince has made some offers to print my workes'.<sup>21</sup> On the seventh of July 1703 he dined with Dr John Hutton, first physician to Queen Anne, who advised him to consult his colleague Lister about engraving star charts; these were from the start Flamsteed's chief concern, as potentially the most expensive element in the project and the one most likely to gain it an honourable place in the great library

collections of the world. The reason for the timing of the move was that ‘an offer is now made that tends to the publication both of them and my Workes’; we are not told where this offer originated, but what follows hints that it may have been transmitted through the courtier Francis Aston. Flamsteed tells Lister that he has given Hutton ‘two papers one of the short History of the Observatory and the other a list of what I have ready prepared for the press and under my hands preparing that he might shew it to you and Mr Aston. I must entreat you both to speake little of it till wee meet for their are some persons concernd who will have the business transacted with them before it passe into the Treasury ...’.<sup>22</sup> He also mentions planning to write to ‘Mr Humes at Hampton Court’ – probably Peter Humes, Yeoman of the Removing Wardrobe, who handled some royal expenditure. In a second letter, written on 28 October 1703, Flamsteed asks to meet Lister when he is next in London in order to show him the maps of the constellations and discuss costs, adding in a postscript: ‘I desire you not to let it be known that You have this letter from me You may burne it I shall give you my reason for this request when I have the happiness to see you’.<sup>23</sup> Even at this preliminary stage, then, Flamsteed was worried about secrecy and endeavouring to outmanoeuvre ‘some persons’ who might try to exert unwanted influence; Aston’s role as the preferred intermediary may explain why he was later adopted as a close associate by the Prince’s ‘Referees’.<sup>24</sup>

In November 1704 Flamsteed drew up an ‘Estimate of the Number of Pages, that the *Historia Britannica coelestis* may Contain, when Printed’ and ‘by J. Hodgson imparted it to the R. S. at one of their meetings’.<sup>25</sup> He later described the disclosure as accidental, evidently in an attempt to disclaim responsibility for the outcome; but he must have at least half intended it to happen.<sup>26</sup> As the Prince’s bounty had been promised for some time without materialising, it seems likely that Flamsteed was now beginning to reconcile himself to the idea that it could only do so with the Society’s participation. It may be significant that the key meeting took place a few days after Derham had written a letter to Flamsteed that concluded by urging him to some kind of action: ‘you must be accountable to God for [comple]ting what the Divine Providence seems to have laid upon [you ... where] a Talent is given a suitable return is due ...’.<sup>27</sup>

A letter from the Prince’s secretary addressed to Newton as President of the Royal Society ordered him, with Francis Robartes, Sir Christopher Wren, Dr [David] Gregory and Dr [John] Arbuthnot, and any other members they might choose, to inspect Flamsteed’s papers and ‘consider what is fitt for the press’; formerly described as undated, it was in fact written on 11 December 1704, according to the copy made for Flamsteed and a statement in the subsequent report to the Prince.<sup>28</sup> This latter is dated 23 January 1704/5; its approval left the committee with the task of supervising printing, and they soon added the courtier Aston to their number.<sup>29</sup> At first Flamsteed expressed himself content with this arrangement, even accepting quite philosophically that the engraving of his star charts was not to be covered by the Prince’s grant.<sup>30</sup> On 2 March 1704/5 Newton proposed an initial meeting to ‘set forward the printing’ and ‘agree with you about an Emanuensis and calculators’; on the strength of what was said there, Flamsteed gave an amanuensis the task of producing a fair copy of observations that were ready for the press and wrote to Sharp in Yorkshire and Luke Leigh via William Bossley, in Derbyshire, offering them paid work calculating places of the Moon and planets for comparison with calculations made at

Greenwich.<sup>31</sup> Once they had accepted, Flamsteed had much to do to ensure a satisfactory result: Sharp repeatedly asked questions about the techniques to be used and pointed out errors and discrepancies in the raw data supplied to him; Leigh may well have done the same, though few of his letters survive.

The 'Referees', meanwhile, with Flamsteed's co-operation, began to explore the practicalities of their task and obtained samples of work from prospective printers. Their increasing awareness of the difficulty of ensuring high quality reproduction of inherently complex material, perhaps reinforced by worries about the reliability of the tradesmen they had to deal with, soon led them to consider seeking the backing of a publisher; Flamsteed alleged that Aston had particularly promoted the idea and had put forward the name of Awnsham Churchill as 'such a one as will divide the gains with him'.<sup>32</sup> It took some months to negotiate, perhaps partly because of Flamsteed's determined opposition, but formal Articles of Agreement with Churchill as 'Undertaker' were eventually signed (by Flamsteed and the Referees, but not Aston) on 17 November 1705.<sup>33</sup> A further three months passed before the first printed sheet of observations was produced; it was October 1707 before all the sheets of the sextant observations intended for the first volume (with the accidental omission of one) were finished.<sup>34</sup>

The 'Referees' planned from the start that Flamsteed's star catalogue should appear as the first item in the whole work, reflecting its relative importance to most potential users. Flamsteed had stated at the outset that it was not yet completed and was determined to see the remainder of his observations printed first and all of them placed before the catalogue; however, in March 1705/6, when it became clear that the 'Referees' would not otherwise release money to pay his amanuensis and calculators, he offered to deposit an 'imperfect copy of the Catalogue' with them 'to be printed (or a More compleat Copy made in its Room) ... provided ... that it might be kept sealed up till all the observations were printed'.<sup>35</sup> This message was transmitted by James Hodgson, to whom Flamsteed then wrote again 'to order him to seale up the Catalogue and leave it with Sir Is: which he tells me he did'.<sup>36</sup> Much wrangling followed. In April 1707 Flamsteed rejected a proposed new agreement under which he would have received no money until all the expected final copy was delivered; on 20 March 1707/8 he accepted an agreement providing for payment in stages.<sup>37</sup> This required him to hand over observations made with the mural arc for inclusion in the second volume and to add stellar magnitudes to the existing catalogue, on complying with which he received part of the money due.<sup>38</sup> To secure the rest, he was to deliver 'the Catalogue of the fixed Stars as far as it can be Compleated at this Time'; but he chose to ignore this and concentrate his efforts upon finishing the catalogue completely.<sup>39</sup>

On 13 July 1708, a meeting of the 'Referees' decided 'that if Mr Flamsteed do not take care that the Press be well corrected and go on with dispatch, another corrector be employed'.<sup>40</sup> A few days later Flamsteed sent a detailed account of recent events to Sir Christopher Wren, rebutting the implied allegation and asserting that he would not agree to the catalogue being printed before the second volume, or to it being printed at all without a guarantee that he could personally correct the proofs.<sup>41</sup> The stalemate was now of a kind that even Flamsteed's completion of the catalogue could not have resolved. In the following November he told Sharp that four months more work would be needed to finish it, and commented upon the recent death of Prince George,

which might be assumed to put an end to the Referees' authority and access to funds: 'you will fear the decease of his R Hs may hinder the progress of the press. I hope not at all. tis at a full stop by Sir. I. Ns practises. the Dropt sheet is printed, but the printer has not yet sent me a proof of the next which is necessarily to be reprinted ...'.<sup>42</sup> He went on with the catalogue, began to think about adding material on the Moon and planets, and by March 1708/9 was hopeful that the patronage of the project might soon be placed on a new footing: 'I have all things in good readiness for the edition of my Works ... and since S. I. N. has put a full stop to the press shall not urge it forward againe till I see a good fund settled and secured to carry it on without any danger of impediment or obstruction from him or any of his tooles'.<sup>43</sup> It emerges that he expected to achieve this by accepting but subverting Newton's proposal to approach the Ordnance Office for funds: 'I am so to carry my selfe as not to decline the patronage of my very Good freinds at the Tower but to embrace it and at the same time to let them see how my old acquaintance would use them ... but this business will not come on till the Master of the Ordnance the D[uke] of M[arlborough] returns from Flanders'.<sup>44</sup> In a brief fit of optimism, Flamsteed imagined Ordnance patronage giving him the power to insist on the mural arc observations being printed and star charts engraved 'and then I shall part with the Catalogue and planets places derived from the Observations but not willingly before'. But this confidence was misplaced. The Duke and the Office declined to step in, perhaps chiefly for financial reasons: as Sharp commented, 'dureing the continuance of this expensive Warr there appeares very little probability since little money can be spared'.<sup>45</sup> They were surely also wary of becoming embroiled in any continuation of the battles fought over the *Historia coelestis*.

The revival of the publication plan in the spring of 1711 is usually attributed to action by Newton, in conjunction with the newly established Visitors of the Observatory. In fact the main catalyst seems to have been provided by Flamsteed in his petition to the Queen against the Visitors' appointment, as it also complained about Newton's conduct in delaying publication and asked for the Prince's grant to be reinstated and printing to be restarted.<sup>46</sup> On these last two points it succeeded, though the attempt to exclude Newton failed. Flamsteed may not have been certain about this last aspect of the matter when Arbuthnot wrote to him, on 14 March 1710/11, that the Queen had 'commanded me to take care that the *Historia Caelestis* ... should be finished ... Therfor I desire you would deliver into my hands as soon as possible a perfect copy of your Catalogue of the fixd starrs'; he replied as though the new situation made him an equal partner in the enterprise, asking for 'a few hours discourse with you ... at the Observatory; where ... we might consider together how to carry on the Work'.<sup>47</sup> He admitted that the catalogue was ready but kept it in his own hands, hoping by this means to ensure the printing of other material, including new planetary tables for which 'a great deale more help is requisite'. Arbuthnot responded that to consider any such additions was 'beyond my Commission' and that previous priorities were unchanged: 'if yow have nothing more to adde to the Catalogue, lett me know so much by a line and I shall order the press to proceed with what we have'.<sup>48</sup> By the time this was written, however, alarming news had reached Flamsteed by another route: 'O[Sunday] March the 25 at evening service Dr Gastrell told my Wife the Catalogue was printing ... after to forbid her telling me ...'.<sup>49</sup> Arbuthnot assured him the rumour was untrue and Flamsteed agreed to complete one

of the existing copies of the catalogue, 'but Aprill the 2d I got the printed 1st sheet and soon after the 3'. He was horrified by the nature and extent of the editorial changes that had been made; 'I learnt further that Dr Halley lookt after the press and was the Author of all this confusion. ... I sent Dr Arbuthnet an Account of his villanous outrage and desired he would permit me to print my own catalogue at my own charge.'<sup>50</sup>

Arbuthnot did not immediately abandon his role as a mediator, but tried to convince Flamsteed that his complaints were unjustified; to support the contention that most of the editorial amendments were beneficial (as modern commentators agree), he sent Halley sample objections supplied by Flamsteed and returned a copy of Halley's comments. The latter have previously been published, from the copy sent by Arbuthnot to Flamsteed, but Halley's complete original manuscript (now in the Library of St John's College, Cambridge) is here reproduced for the first time.<sup>51</sup> It includes a dismissive covering letter asserting: 'You will find by the inclosed how ground less and frivolous all these cavills and pretensions are'; it is not surprising, therefore, that Arbuthnot passed on only the document's technical content. Flamsteed rejected it totally in any case, first in general terms, then picking over specific points.<sup>52</sup> Arbuthnot finally gave up the argument, and on 23 June 1711 Halley sent Flamsteed the printed sheets of the whole catalogue, with a covering letter offering to correct errors and even reprint parts 'if the case require it'; extracts from the mural arc observations were then printed, with some additional material, particularly on the Moon, and the whole collection was published as *Historiae coelestis libri duo* towards the end of 1712.<sup>53</sup>

Flamsteed's response was to begin printing his own version of the catalogue, with new amendments, and then, in April 1712, to draft another petition to the Queen requesting to be allowed to publish it, 'and that no encouragement may be given to those who are putting out one, printed from a surreptitious and imperfect copy'.<sup>54</sup> By the end of the year his new catalogue was in print but he was concerned to keep it secret 'least they Copy it as Raymer very impudently told me he would when ever I publisht it'; he also delayed publication in order to add the mural arc observations, a preface, new tables, and other supplementary material.<sup>55</sup> Only some of these planned additions were printed during his lifetime, perhaps because of the fluctuating state of his health and increasing physical feebleness in his last few years. The collection, essentially as he had planned it though without the section of his preface attacking Newton, was completed by Sharp and Joseph Crosswait under the nominal editorship of Mrs Flamsteed and James Hodgson, and was finally published in three volumes as *Historia coelestis Britannica* (1725). The *Atlas coelestis* did not appear until 1729.

It would not be appropriate to play down the ferocity of the publication dispute at its most intense. Contemporary bystanders bore witness to it, as when William Nicolson, Bishop of Carlisle wrote to Ralph Thoresby, on 30 December 1712: 'Deadly feuds there are betwixt Sir Isaac Newton and Mr Flamstead. ... intra muros pugnatur et extra'.<sup>56</sup> Much was genuinely at stake: Newton was keen to demonstrate the effectiveness of the Royal Society under his Presidency and to make public the observations that had provided support for his own theories; Flamsteed was determined to maintain the Royal Observatory's independence and his own reputation in the face of perceived slurs, which by weakening the basis for trust in the published record threatened to

undermine the validity of the whole enterprise. Trust was crucial because the Observatory's instruments were unique and the observations made with them unrepeatably; huge amounts of time and effort had been invested in producing results that could claim to be trustworthy, and Flamsteed was proportionately committed to defending their integrity. His campaign reached a satisfactory conclusion only when a change of regime following the accession of George I enabled him to make an approach through John Lowthorp to then Lord Chamberlain, the Duke of Bolton, and obtain the three hundred unsold copies of the 1712 printing, 'which I intend to sacrifice to TRUTH ... saving some few ... that you may keep ... as Evidences of the malice of Godlesse persons'.<sup>57</sup> The parts printed without his approval were 'Committed ... to the fire' towards the end of April 1716.<sup>58</sup> But, despite the heated language and dramatic gestures employed at this and other stages of the conflict, it would be wrong either to portray it as having consumed his whole attention over the preceding dozen years or to present the occasional angry outburst as typical of his ordinary behaviour. Even at the height of the bitterest clashes and in letters to Sharp as his most trusted confidant, he might devote only a single paragraph to describing the dispute's progress, alongside several discussing work in hand and other news. Letters on other subjects altogether are interspersed at very frequent intervals throughout the series.

Flamsteed's letters to Sharp deal at greater length with topics of immediate practical concern to them both. At the start of their correspondence in 1702 and for the next couple of years, Sharp's instrument-making was the principal subject: examples of his work mentioned in this volume include spirit levels ('Never esteemed a good contrivance by any judicious person here', said Flamsteed), Caswell's new style of barometer, which Sharp constructed with apparent success, and a micrometer made for Flamsteed, which proved difficult to use and whose construction Sharp consequently discussed in some detail.<sup>59</sup> This last must qualify as an unusually early and revealing example of an experienced maker's commentary on an astronomical instrument. The micrometer's imperfections may have helped convince Sharp that his eyesight was no longer good enough for fine brasswork, and that he should instead give more attention to mathematics; in 1705 he accepted employment as one of Flamsteed's calculators. His tasks in this capacity included deducing lunar distances from observations and constructing tables eventually published in the 1725 *Historia coelestis Britannica*; soon he also agreed to calculate the predicted eclipses of Jupiter's satellites for each year, the results of which were not published but distributed by Flamsteed to selected potential observers. With exemplary and sometimes excessive conscientiousness, Sharp discussed the finer points of all this work with Flamsteed; he also occasionally made observations, particularly of eclipses, supplied barometric readings, and sent accounts of phenomena such as the aurora borealis. In return Flamsteed passed on information about mathematicians and astronomers and their new publications; his awareness of such matters is more fully evident here than in any other letters.

It was to Sharp, too, that Flamsteed most often revealed his thoughts about theoretical issues relevant to observational astronomy. In 1704 he was eager to explain his objections to some of the claims made in Newton's *Opticks* (1703), and described an optical experiment of his own devising.<sup>60</sup> Over some years he investigated planetary motion in the light of Newtonian gravitational theory, finding some support for the latter in a recurring pattern of divergences between

observed and predicted places; he also noted that the constancy of Saturn's speed over two thousand years disproved Newton's suggestion 'that ... all the planets increased in their bulk continually by an accession of matter'.<sup>61</sup> In discussing Jupiter, he agreed with Sharp that 'mutuall gravitations' were the key, said they caused 'the place of the Aphelion' to alter, and added that 'This is the consequence of Keplers doctrine of Magneticall fibres, improved by Sir Chr. Wren and prosecuted by Sir I. Newton and I thinke I can lay some claime to a part of it.'; he also came to believe that the orbits of Jupiter's satellites were affected by the gravitational pull of Saturn.<sup>62</sup> Precise quantification of such influences, however, remained a highly complex matter, and his last word to Sharp on the subject was that 'the doctrine of gravitation and its effects are not as yet so perfectly understood as we imagined'.<sup>63</sup>

From time to time Flamsteed also returned to the notoriously difficult task of producing an adequate mathematical description of lunar motion. A long-standing resolve to examine the validity of Newton's 'Corrections ... to my Old Tables and Horroccian Theory' was finally implemented, with the help of two other calculators and Sharp, after the appearance of the second edition of the *Principia* in 1713. The verdict was unfavourable; the further revisions needed remained elusive.<sup>64</sup> A second stimulus came a few years later, with Halley's production of astronomical tables – which Flamsteed said included 'my correction of the saros or Revolution of Eclipses' – and publication of related material; this prompted Flamsteed to offer a detailed discussion of the 'saros' or 'eligmos' and its origins in ancient writings.<sup>65</sup> Virtually to the end of his life, he continued to observe lunar eclipses and to collect such observations from others; he also commissioned and collected observations of the satellites of Jupiter. The network of astronomers established for these purposes is an early example of the kind of national and international collaboration identified by Sven Widmalm as characteristic of European astronomy during the middle decades of the eighteenth century.<sup>66</sup>

Not all potential collaborators were equally enthusiastic or efficient. The record of their contacts with Flamsteed is often incomplete; his letters to them may survive only as notes or not at all. But the overall impression given is that most of the letters Flamsteed received from other English astronomers contained requests for help and advice without offering much in return. Derham, for instance, was one of the most demanding, though he eventually offered to reciprocate by using his influence on Flamsteed's behalf: his letters (written from 1700 onwards) asked for information about the planets, the size and diameters of the Sun and Moon, instruments, places of the fixed stars, the speed of sound, the timing of Easter, sunspots, tides, calculations, eclipse predictions, and distances in the solar system; most of this was for inclusion in his Boyle Lectures and related publications. Comparatively few of his letters discussed topics of genuinely mutual interest, and his usefulness as an observer of Jupiter's satellites was limited, hindered, he said, by: 'cloudy weather ... or company, or business, and sometimes forgetfulness, ... except about Midnight, which causeth too great an interruption of my rest when I rise then, besides some uneasiness to my bed-fellow.'<sup>67</sup> Flamsteed seems to have doubted Derham's competence as an astronomer, and later claimed that he 'got a prebendary of Windsor by the pretence of using the 80 foot glasse of the Society. tho some people are of opinion *he never saw thro it*'. Derham's last surviving letter, which suggests Flamsteed and his wife should 'take a ramble hither ... to

view some of the Planets through my glasses, all very good of 126f , 34 and 30 feet', may have been left unanswered.<sup>68</sup>

Stephen Gray of Canterbury, in contrast, was a more reliable observer and a less demanding correspondent. Writing fairly regularly from 1699 to 1716, he supplied observations of Jupiter's satellites, of eclipses, and of sunspots; he also readily described his observing methods and discussed his own theories, especially in respect of the sunspots, where he became an acknowledged expert. As an unexpected bonus, his presence in Canterbury allowed him to undertake an investigation of a different kind, into the story of Mrs Bargrave and the ghost of Mrs Veal, which attracted widespread public interest in the autumn of 1705 and was swiftly written up for publication as a pamphlet by Defoe. Flamsteed had custody of at least one earlier account, by an unidentified 'E. B.', which Arbuthnot saw or heard of and consequently passed on a request from 'a very great person' (probably Prince George of Denmark) for further information.<sup>69</sup> Gray accordingly sent Flamsteed a detailed account.<sup>70</sup> A couple of years later Gray left Kent for Cambridge, where he was briefly employed as assistant to the new Plumian Professor, Roger Cotes; Flamsteed must have been particularly curious to see his report on this experience, because of his own involvement as a largely disregarded adviser to the Plumian electors (he was excluded from being an elector because of the way Plume's Will was worded, probably contrary to the testator's intentions).<sup>71</sup> Gray was soon back in Canterbury, and then found a more congenial collaborator in John Godfrey of Norton Court, Kent, a cousin of Mrs Flamsteed's.<sup>72</sup>

James Pound was also an occasional contributor of satellite observations after 1706, when he returned to England from the Far East.<sup>73</sup> During his travels, from 1699 onwards, he was encouraged by Flamsteed to undertake a much more substantial task: Flamsteed reported that in June 1704, while at Pulo Condore (off the coast of what is now Vietnam), Pound had received 'a 3 foot Quadrant I saw made for him with which I hope he will attempt the rectification of the southerne fixed stars'.<sup>74</sup> Flamsteed sent him further detailed advice about the project and the need to improve upon Halley's earlier efforts, but Pound's next surviving letter describes how the plan was dramatically terminated by an armed revolt: 'In so great a surprize we who escaped ... could think of nothing but saving our lives; so that my Money, Goods, Books, Papers, Instruments, Cloths etc were all left behind'.<sup>75</sup> After his return to a quieter life as incumbent of Wanstead, Essex, '7 or 8 miles' from Greenwich across the Thames, he kept in touch with Flamsteed; Flamsteed referred to him as 'my freind', and said he would therefore keep private his doubts about the accuracy of some of Pound's published observations.<sup>76</sup>

Another English traveller who wrote to Flamsteed about astronomical issues was Henry Stanyan, one of his former pupils, who accompanied a relative in the diplomatic service to Switzerland, arriving there in August 1705. He described the instruments and clocks he was assembling, and volunteered to make observations if sent 'playn directions how to go to worke'; later letters contain numerous requests for information and advice, especially about timekeeping, and one for 'two or three of those Schemes you invented' to show places of Jupiter's satellites, 'that will please my young students'.<sup>77</sup> Flamsteed willingly supplied answers where possible, though Stanyan's apparently boundless optimism about his powers once led him to 'wish that you may meet with no more good wine nor drink any in quiet till you understand the method' of a par-

ticular analysis.<sup>78</sup> In return for this assistance, Stanyan sent observations of a total solar and a lunar eclipse, and detailed accounts of his journeys in the mountains; Flamsteed judged him a reliable enough observer to mention to Sharp that the 'blood red streak of light' Stanyan reported seeing as the sun began to emerge from its eclipse 'proves the ☽ has an atmosphere'.<sup>79</sup> The final letter in the sequence shows Stanyan cheerfully contemplating a serious plan for observing with 'half adozen astronomical friends at the publick liberary to assist me ... The Colledge and Liberary are just by me and I make all as Convenient as I can that one may be at ease and drink your health during our Observations'.<sup>80</sup>

Whilst the training of assistants and pupils was one of the most effective means of spreading knowledge of practical astronomy, to the end of his life Flamsteed habitually responded kindly to letters from any others who might possibly prove competent enough to join his network of observers and calculators. He went to considerable trouble to aid and encourage the most promising of them, such as George Young of Bere Regis, Dorset, whose ambitions extended from the study of planetary motion into the intricacies of lunar theory.<sup>81</sup> A link with future achievements was established in 1718, when the young Samuel Molyneux visited Greenwich and obtained advice about the construction and deployment of a quadrant, but Flamsteed was soon expressing disappointment in him: 'he is very Ambitious to be esteemed a Mathematician: as [his] father was, but he has faln into the same ill hands that his father did' (meaning Halley's and the Royal Society's).<sup>82</sup> Their contact appears to have ended when Molyneux asked for Greenwich observations to make up for his own inadequate timekeeping, and received what Flamsteed termed a civil refusal, for 'I cannot encorage such practises as would at last ... fill the world with faulty observations'.<sup>83</sup> After mending his ways (presumably), Molyneux was soon to begin an important collaboration with James Bradley, who later became the third Astronomer Royal.

The extent and range of links built up both through letter-writing and through personal contact with the Royal Observatory is revealed in the flurry of activity surrounding the total solar eclipse of 22 April 1715. To complement his own observations, those made at the Royal Society (already mentioned above), and the comments of 'my Carpenter' at Burstow, Flamsteed received data from Dr Theophilus Hill of Peterborough, Stephen Thornton of Ludsdown, Kent, Stephen Gray (who observed at Norton Court with John Godfrey and John Harris, and found that Harris then claimed the whole credit), James Pound at Wanstead, Essex, Sharp at Little Horton, Yorkshire, George Young in Dorset (whose companion 'our Minister Mr Wills' was not able to count the clock because he was 'helping and directing his wife'), and William Ella of Rampton near Retford, Nottinghamshire.<sup>84</sup> Not all their methods came up to Flamsteed's strict standards, but these records in conjunction with those published by Halley in the *Philosophical Transactions* provide important evidence of the spread of practical astronomy; the unprecedented amount of public interest generated is reflected in Flamsteed's reference to more than a hundred people having attended as spectators at Greenwich.<sup>85</sup>

As royal astronomer, Flamsteed was obliged to provide a hospitable reception for these and many other visitors. In the later decades of his life, his role as the leading figure-head of English practical astronomy brought additional demands, particularly with the explosion of interest in methods of finding longitude at sea once the 1714 Longitude Act had established a prize of

twenty thousand pounds and created the Commissioners (also known as the Board) of Longitude. Even before this, Flamsteed was often asked for advice on the subject by the Ordnance Office and by hopeful 'longitudinarians' themselves; in 1704, having been approached by 'Mr Sowter Merchant in London' and one 'Mr Coster', he commented that he had already seen at least twenty people seeking backing for their proposals, 'and ... there was but one of all this Number that really understood how it was to be found'. In 1705, when the Ordnance Office passed on a Mr Green with a method based on solar and lunar motion, Flamsteed sent in return 'directions ... how to manage the pretenders to the Longitude', in the form of a list of questions to be put to anyone claiming to find it from lunar observations.<sup>86</sup> A few years later, he was familiar with the plan put forward by William Whiston and Humphrey Ditton, involving the mooring of signalling-ships out at sea, which played a part in the genesis of the 1714 Act; he reported to Sharp various related conversations with Whiston, preserved a printed announcement of one of Whiston's experiments with manuscript notes of the results, and on Ditton's death expressed concern for his unprovided widow.<sup>87</sup> In 1714 he was appointed *ex officio* one of the Longitude Commissioners, though they appear to have held no formal meeting in his lifetime.

In the flurry of activity that followed he dealt with a throng of contenders: 'a couple of young Non conformist preachers from Worksop', whose method involved an air-pump, barometer and thermometer (one of them was probably Isaac Hawkins, who had previously written about a method based on the variation of clocks from mean time); William Hobbs 'a Watchmaker', who claimed to have a contrivance for keeping a pendulum clock steady on shipboard and published a proposal for a 'Decimal Horologe'; Conyers Purshall, who sent a printed proposal for measuring distances by towing a water-wheel behind the ship; Digby Bull, who offered a clock and dial, somehow linked to his mission against Popery; and one Signor Alimari, who was said to offer 'one of the worst contrivances for taking the height of the Sun or Stars that ever was thought of'.<sup>88</sup> Flamsteed was not impressed by any of these, but sent Sharp a collection of the published longitude tracts purely for their entertainment value.<sup>89</sup> Over the next few years the tally continued to grow: Sharp gave news of one William Palmer, author of *A great improvement in watch-work*; Matthew Randall of Chichester described a method involving lunar tables and a clock; Whiston appeared again, this time advocating 'a Map ... for the Inclination of the Dipping Needle'; schoolmaster William Burtal of Bungay rested his hopes on the Moon and a small instrument he had devised.<sup>90</sup> The writers of letters ostensibly on more general astronomical subjects often stated or hinted that they had the longitude problem in mind: this was true of George Young, for example, and of Henry Thomas, Lieutenant of the Humber, who consulted Flamsteed about eclipses.<sup>91</sup> At the level of general gossip, longitude pretensions were attributed to anyone who concerned himself with lunar astronomy; Halley was a regular suspect, therefore, as Sharp's comments about his paper on lunar appulses to the Hyades illustrate.<sup>92</sup> The mingling here of all these kinds of material – precise proposals, expressions of intent, informed comment and mere tittle-tattle – makes Flamsteed's correspondence an unusually rich resource for study of the longitude problem in general and responses to the 1714 Act in particular. The topic has been only patchily explored elsewhere, despite recent popular interest; there is as yet no complete bibliography of longitude publications, or list of related manuscripts, and a number of the 'pre-

tenders' who appear here are not recorded in W. Andrewes' *The quest for longitude*, or in other recent works.<sup>93</sup>

The combination of the publication dispute, the work required to prepare material for publication independently, and the extra demands associated with being the royal astronomer, may have left Flamsteed with less energy than before to devote to maintaining international contacts; European wars of the early eighteenth century may also have created political and practical hindrances. Whatever the reason, his overseas correspondence at this period was much more limited than it had been at times in the past, and leaves the impression that he was more often in touch with English travellers abroad than with actual foreigners. The contrast with earlier decades is illustrated by items appended here to remedy their omission from the previous volumes: the letter of introduction Flamsteed wrote to Cassini for Halley on 30 November 1680, and evidence of letters exchanged between Flamsteed and Gottfried Kirch in the late 1680s and early 1690s. In the main body of this present volume there is nothing at all comparable to these – no record of Flamsteed having any contact with the head of an overseas national observatory or with any well-known foreign astronomer.

Apart from the English travellers, Flamsteed's most regular overseas correspondent in the early 1700s was Thomas Brattle of Boston, New England, merchant and Treasurer of Harvard College, four of whose letters survive.<sup>94</sup> His first attempt to make contact had foundered through the unreliability of the carriers of post; in 1703 he tried again, encouraged by his friend Henry Newman, agent in London for Harvard and New Hampshire (and later Secretary of the S. P. C. K.). One letter describes how Brattle pursued the study of mathematics, a subject he was eventually to promote by a bequest to Harvard; his interest in astronomy centred upon eclipses, which he made serious attempts to observe, hoping to determine the difference in longitude between London and New England.<sup>95</sup> Flamsteed sent him details of predicted eclipses of Jupiter's satellites for 1705, though Brattle doubted his ability to observe them and there is no evidence that he did so.<sup>96</sup> He is not now remembered as an astronomer but for his connections with Harvard, for the founding of Brattle Street Church, Boston, and for his courageous public stand as a leading Episcopalian opponent of the Salem witch trials.

There are a few other isolated examples of foreign contacts. They sometimes followed from personal visits to the Royal Observatory, as when Flamsteed wrote to 'Captaine Jeuell at Copenhagen, Denmark', recalling their meeting and acknowledging the subsequent gift of two portraits of Tycho Brahe.<sup>97</sup> Jean Chardellou visited Greenwich in 1702 and wrote in French from Dublin two years later, offering to observe the satellites of Jupiter and asking for advice about using instruments belonging to the University of Dublin.<sup>98</sup> It also seems probable that a copy of eclipse observations sent by one 'Volfsborg' to his 'Cher Maître' 'Monsieur de Bresler et Aschenbourg ... currently at the Hague' (otherwise Von Breslau), reached Flamsteed because the recipient went on to London and called at Greenwich.<sup>99</sup> Another traveller, Johann Gabriel Doppelmayr, was responsible for conveying a relatively brief letter from Georg Christoph Eimmart of Nuremberg in 1704.<sup>100</sup> And finally, in June 1715, one Derrick Dobler of Hamburg sent a detailed discussion of the equation of time in response to a previous exchange conducted through 'Mr

Behm', tentatively identifiable as John van der Bemde, FRS.<sup>101</sup> This last seems to be the only piece of overseas correspondence to survive from the final decade of Flamsteed's life.

Another notable feature of this final volume is that it contains an unusually plentiful assortment of incidental details, peripheral to or unconnected with astronomy. Glimpses of domestic life at the Observatory are rare, but one is recorded in connection with the arrival of a 'great Meteor' in March 1719: 'being then set by the fire in my Chamber a Table before me with Candle upon it blaseing, the flash on my window made the light of the Candle dissappeare but I saw the Map of the world, and all things in the room much plainer then in the bright day. ... my Spouse (who sat by me with her face toward the Window) rose hastily and ran to it, to see what was the matter but by that time shee was got thither it was fallen darke againe, and we saw the light of the Candle as before'.<sup>102</sup> Another revelation concerns the letters themselves: in replying to a letter from Sharp, in the summer of 1710, Flamsteed confessed that it had 'hung on my unanswerd string ever since it arrived'; this could be merely a figure of speech, but is more probably evidence that the standard medieval method of filing documents was in actual practice in Flamsteed's study.<sup>103</sup> By 1705 he was using spectacles for reading, and blaming them for faults of transcription; in 1712 he complained that his gout made writing painful, and the shakiness of his hand in later years meant that he often relied on his wife or assistants to write or make fair copies.<sup>104</sup>

The presence of Mrs Flamsteed was politely acknowledged by all those correspondents who had met her. A few, from amongst the assistants and pupils, showed personal friendliness: John Witty, for instance, sent 'Madam' a memoir of his experiences in the past month with apologies for not having 'inserted a catalogue of all the dishes we have had to dinner and supper'.<sup>105</sup> Stanyan wrote a brief letter to her about a solar eclipse; elsewhere he describes proposing the drinking of her health as 'a well wisher to the Mathematicks, and understood them perfectly well', and mentions meeting a lady who 'would have pleased Madam Flamsteed' with her learnedness in astronomy. The tone of his remarks is humorous and slightly patronising, but there is some evidence that the descriptions were justified: in 1705, for instance, 'Mr Dittons book' (*An institution of fluxions*) came out and Flamsteed commented that his wife had 'seized' the copy he intended for Sharp.<sup>106</sup> In September 1708 Derham wrote: 'I here send your Lady some of her Glasses set, in return of the favour of the Glasses she presented me with. I have set them as near as I could to fit her Microscope'; the implication seems to be that Mrs Flamsteed had tried her hand at lens-grinding, an occupation not uncommonly taken up by astronomers' wives.<sup>107</sup> That there were lens-grinding tools at the Observatory at one time is shown by Flamsteed's having presented some (for making microscope lenses) to Gray.<sup>108</sup> Amidst all these interests, Mrs Flamsteed was undoubtedly an efficient housekeeper, since the subject is never mentioned; she had Ann Hodgson's aid until 1706, and there is a single reference to a domestic servant: Flamsteed explained that some visitors had arrived at an awkward moment, around the time of evening prayers, when 'the Mayd governs with her brush mop and bucket'.<sup>109</sup>

Other members of the Observatory household, past and present, are also occasionally mentioned. The resident assistants were Thomas Weston, whose serious illness was a source of worry, then Isaac Woolferman, who soon took an Ordnance job and left for Minorca, and lastly

Joseph Crosthwait, who served faithfully from 1708 until after Flamsteed's death. For something over a year, from March 1705, Witty was employed as an additional calculator; he kept in touch for a while afterwards, and was on good enough terms with Flamsteed to ask him to send a message 'to Upjohn about the wigg', a prospective purchase, with reflections upon keeping it in curl.<sup>110</sup> The former assistant James Hodgson still came to the Observatory sometimes and is recorded as making observations there in 1709, but this probably seemed noteworthy as a rare occurrence; he was busy pursuing his career as a teacher of mathematics in London and then as Master of the Royal Mathematical School at Christ's Hospital.<sup>111</sup> It was upon Crosthwait, therefore, that responsibility for observing principally devolved when Flamsteed's unsteadiness and poor eyesight made him incapable of managing instruments (though he continued to supervise whenever practicable).<sup>112</sup> Weston may have assisted sometimes, as he still lived in Greenwich; the supply of potentially useful pupils seems to have declined, but one may briefly have carried on a family tradition: in the summer of 1719, Flamsteed ended one letter with the note 'Mr Hodgson's son not 12 years old is my scribe'.<sup>113</sup>

Some of Flamsteed's personal concerns beyond the walls of the Observatory continued much as before. He communicated with the Ordnance Office occasionally, particularly over 'some difficulty in renewing my Warrant' on the accession of Queen Anne, and wrangled with other officials over the payment of taxes.<sup>114</sup> He had dealings with tenants and agents in Derbyshire and corresponded with his relatives there and elsewhere; he regularly visited Burstow, rebound the parish Bible, rebuilt the parsonage house there, and kept a careful eye on his curates: Timothy Stileman, dismissed for his High Church sympathies in 1715, Francis Peck, appointed on Bishop White Kennett's recommendation, and finally Sacheverell Bookey.<sup>115</sup> Closer to home, he wrote to insist upon his right to a pew in the newly-rebuilt Greenwich parish church of St Alfege.<sup>116</sup>

In the last decade of his life, the question of mobility dominated Flamsteed's accounts of his fluctuating state of health. Some time before he had noted that 'my horse grows old (above 30 as I thinke)', and there was no suggestion that he might buy a new one.<sup>117</sup> In 1710 he reported that 'I travell to London and about there in a Hackney Coach. and cannot meet my freinds nor wait on them as formerly'; in 1714 'I enjoy my health ... much better then I have done for many yeares I am onely troubled with a small gout in my ankles and knees ... which makes me *walk feebly* and yet neverthelesse I footed it yestarday in London from Funchurch Street to the Old Bayly, a very Long mile, without any stop by the way. I have been free from the stone above 19 yeares'.<sup>118</sup> In 1716 he confessed to relying upon Crosthwait's help – 'I cannot goe to London much less travel about without him' – and soon afterwards 'found my selfe so tired with getting up the hill when I returne from Church that at last I have bought a sedan, and am carried thither in state on Sunday momeings and back', though on flatter ground 'I can still I prayse God for it walke from my dore to the Blackheath gate and back with a little resting at some benches I have caused to be set up betwixt them'.<sup>119</sup> From the beginning of 1718 he suffered from recurrences of the stone, for which he took 'spaw waters with other usuall remedies', a slight giddiness, and the occasional attack of gout, but he showed no signs of any more serious illness until a few days before his death.<sup>120</sup>

For the purposes of the present edition, the correspondence is taken as ending at Flamsteed's death. The first three of Crosthwait's letters to Sharp, in which he announced the sad event and described Mrs Flamsteed's departure from the Observatory, are included, as they mark the end of an era in the institution's history; but subsequent exchanges over preparations for the publication of the *Historia coelestis Britannica* (1725) and *Atlas coelestis* (1729) are not. Anyone interested in this later history may find the complete series of original letters in the Royal Society's Library. Flamsteed's and Mrs Flamsteed's Wills have been included in the appendix of official documents, however, since they contain useful information both about financial matters and about their family and other contacts.

Eric Forbes's plan has thus been fulfilled, some twenty-six years after he first announced in print that this edition was forthcoming. Anyone who examines the dates and prefaces of comparable publications will discover that this kind of time-scale is not unprecedented. In the interim, of course, the horizons and perspectives of historians of science have altered, with growing interest in the social settings of science and (for the seventeenth century) in the complex relationship between natural philosophy, the mathematical sciences and new technology. As Flamsteed's long career as a leading practitioner of the mathematical science of astronomy, in charge of some of the world's most sophisticated astronomical instruments, placed him at the forefront of two of these three fields and the results he produced supported key advances in the third, these developments have only enhanced the value of the present work.

The extent and multifarious nature of the material included here (read in conjunction with his other papers, now in the Royal Greenwich Observatory Archives at Cambridge University Library) reveals the inappropriateness of accounts that portray Flamsteed as an isolated figure with little influence, excluded from London intellectual life by the physical distance of Greenwich and by his tendency to engage in battles with potential colleagues. While both the geography and the quarrels were real enough, the bitterness of the conflicts actually reflects the importance of Flamsteed's activities to his peers as well as the strength of his commitment to the advancement of astronomy as he saw it. In providing the Royal Observatory with the great mural arc and making it the centre of an expanding network of observers, he launched developments that were to characterise European astronomy for decades after his death. For virtually the whole of his tenure, the Observatory was a place where much valuable work was undertaken and largely completed, by Flamsteed himself and by a variety of assistants under his direction, with the essential though often unrecorded support of his wife, family and friends.

In a similar if more modest way, this edition embodies the work of many people and has benefited from the goodwill of others. Their contributions have all helped to ensure that progress continued whatever obstacles and hindrances were encountered, and I hope that my satisfaction in seeing it reach a successful conclusion will be widely shared. Deo Gloria.

Frances Willmoth, May 2001

1. Letter 905, 3 July 1703.
2. Letter 949, 21 Oct. 1704.
3. Letter 922, 18 Dec 1703.
4. Letter 931, early 1703/4 [before 2 Feb.].
5. Letter 1011, 6 July 1705.
6. Letter 1034, 9 Oct. 1705.
7. *Phil. Trans.*, 25 (No. 306, for Apr.-June 1706), pp. 2237-41.
8. Letter 1250, 25 Oct. 1709, where see n. 6 for the satirist William King.
9. Letter 1242, 27 June 1709.
10. Letter 1256, 16 Jan. 1709/10; Richard S. Westfall, *Never at rest: a biography of Isaac Newton* (Cambridge, 1980), pp. 672-75, for Derham and the general scenario.
11. Letter 1269, 20 Sept. 1710.
12. The warrant and covering letter, both dated 12 Dec. 1710, appear as Letters 1271 and 1272.
13. Letter 1273, 29 Dec. 1710.
14. *Phil. Trans.*, 28 (for 1713), pp. 65-79, and 29, (No. 344, for June- Aug. 1715), pp. 285-94.
15. See Letter 1281, 28 Mar. 1711, n. 4; Letter 1309, 22 Dec. 1711, describes the meeting on 26 Oct. 1711.
16. Letter 1374, 1 Feb. 1714/15.
17. Letter 1385, 3 May 1715.
18. Letter 1494, 9 Dec. 1718.
19. E. G. Forbes, *Greenwich Observatory, vol. 1: origins and early history* (London, 1975), pp. 53-59; Westfall *op. cit.* (n. 10), pp. 655-67, 688-97; Adrian Johns, *The nature of the book: print and knowledge in the making* (Chicago, 1998), ch. 8.
20. National Maritime Museum [Greenwich], Maritime Monographs and Reports no. 52, 1982.
21. Letters 938, 4 May 1704, and 949, 21 Oct. 1704.
22. Letter 906, 8 July 1703. Flamsteed's account of the Observatory's history survives in several different versions: see Letters 803, late 1699, and 824, 9-10 Oct. 1700 (in vol. 2).
23. Letter 915.
24. Letter 990, 22 Mar. 1704/5.
25. Letter 952, [8 Nov. 1704]; for the printed version of the Estimate see Adrian Johns, *The nature of the book: print and knowledge in the making* (Chicago, 1998), p. 578.
26. Compare Baily, *Flamsteed*, pp. 70 and 75 (from RGO 1/35 and 1/32C, respectively)
27. Letter 951, 3 Nov. 1704.
28. Letters 961 and 977.
29. Baily, *Flamsteed*, pp. 77-78.
30. Letter 993, 24 Apr. 1705.
31. Letters 985 and 986b, 6 and 8 Mar. 1704/5.
32. Letter 1031, 25 Sept. 1705.
33. Letter 1047, with draft at 1046; the blanks in the latter may indicate items that Flamsteed thought were still negotiable. For the first (unhappy) references to Churchill in the letters see Letter 990, 22 Mar. 1704/5; for further objections see, e.g., Letter 1024, 29 Aug. 1705.
34. Letters 1068, 2 Feb. 1705/6, and 1186, 21 Oct. 1707. Since it was a folio volume, each sheet contained four pages.
35. As stated in a note about a letter written to Hodgson: Letter 1076, 4 Mar. 1705/6.
36. Letter 1079, mid Mar. 1705/6 [between 15 and 23].
37. Letters 1169, 15 Apr. 1707, and 1198, 20 Mar. 1707/8.
38. Letters 1199, 1200 and 1201, of 26 Mar., 10 and 19 Apr. 1708.

39. As he reported to Sharp in Letter 1205, 3 July 1708.
40. Letter 1206.
41. Letter 1208, 19 July 1708.
42. Letter 1219, 22 Nov. 1708.
43. Letter 1230, 24 Mar. 1708/9.
44. Letter 1241, 13 June 1709.
45. Letter 1251, 4 Nov. 1709.
46. Letter 1273, 29 Dec. 1710.
47. Letters 1278 and 1279, 14 and 23 Mar. 1710/11.
48. Letter 1280, 26 Mar. 1711.
49. Note in RGO 1/33, f. 141<sup>r</sup>.
50. Letter 1296, 15 May 1711.
51. Letter 1295, 6 May 1711.
52. Letters 1298 and 1300, 23 and 29 May 1711.
53. Letter 1302.
54. 1315. There is no evidence as to whether the petition was ever submitted.
55. Letters 1324, 25 Nov. 1712, and 1334, 24 Jan. 1712/13.
56. Rev. Joseph Hunter, ed., *Letters of eminent men, addressed to Ralph Thoresby* 2 vols (London, 1832), p. 295; translation: 'the battle is fought within and outside the walls'.
57. Letter 1418, 29 March 1716.
58. Letter 1421, 8 May 1716.
59. Letters 938, 940, 946 and 955, of 4 May, 6 June, 15 Aug. and 25 Nov. 1704.
60. Letters 935 and 936, 25 and 30 Mar., and 947, 2 Sept. 1704. For details and a reconstruction of the experiment see Adrian Johns, 'Flamsteed's optics and the identity of the astronomical observer', in Willmoth, ed., *Flamsteed's stars*, pp. 77-106.
61. Letters 1195, 2 Mar. 1707/8, 1261, 11 Feb. 1709/10, and 1333, 17 Jan. 1712/13.
62. Letters 1269, 20 Sept. 1710, and 1348, 31 Oct. 1713.
63. Letter 1444, 4 May 1717.
64. Letters 935, 25 Mar. 1704, 1340, 16 July 1713, 1348, 31 Oct. 1713, 1354, 20 Mar. 1713/14, and 1360, 31 Aug. 1714.
65. Letters 1487, 7 Oct. 1718, 1491, 20 Nov. 1718, and 1498, 3 Feb. 1718/19.
66. In 'A commerce of letters: astronomical communication in the 18th century', *Science Studies* 5 no. 2 (Helsinki, 1992), pp. 43-58.
67. Letter 1063, 27 Dec. 1705.
68. Letters 1361, 10 Sept. 1714, and 1486, 13 Sept. 1718.
69. Letters 1027, 13 Sept. 1705, and 1031, 31 Oct. 1705.
70. Letter 1045, 15 Nov. 1705.
71. Letter 1212, 8 Sept. 1708; for Flamsteed's involvement see Letters 1070, 13 Feb. 1705/6, 1073, 26 Feb. 1705/6, and 1146, 2 Dec. 1706.
72. Letters 1409 and 1411, 4 and 11 Jan. 1715/16.
73. His return is noted in Letter 1125, 14 Sept. 1706.
74. Letter 949, 21 Oct. 1704.
75. Letters 953, 15 Nov. 1704, and 1012, 7 July 1705.
76. Letter 1486, 13 Sept. 1718.
77. Letters 1061, 25 Dec. 1705/5 Jan. 1706, 1114, 13/24 July 1706, and 1131, 12/23 Oct. 1706.
78. Letter 1095, 24 May 1706.
79. Letters 1088, 1/12 May 1706, and 1131, 12/23 Oct. 1706; Letter 1104, 11 June 1706.

80. Letter 1131, 12/23 Oct. 1706.
81. Series starts with Letter 1218, 4 Oct. 1708.
82. Series starts with Letter 1458, 17 Feb. 1717/18; quotation from Letter 1471, 22 June 1718.
83. Molyneux's last is Letter 1481, 30 Aug. 1718; quotation from Letter 1486, 13 Sept. 1718.
84. Letters 1394, 27 June 1715, 1378, Apr. 1715 [before 25], 1379, 26 Apr. 1715, 1383-85, late Apr. and 3 May 1715, 1391 and 1392, 5 and 8 June 1715.
85. See n. 17.
86. Letters 944-45, 17 and 20 June 1704, and 1056, 5 Dec. 1705; note written on Letter 1052, 30 Nov. 1705.
87. Letters 1360, 31 Aug. 1714, 1366, 22 Oct. 1714, 1374, 1 Feb. 1714/15, and 1386, mid May 1715 [before 15].
88. Letter 1360, 31 Aug. 1714; for Hawkins see also Letter 1346, 17 Oct. 1713, and for Hobbs Letter 1363, 15 Sept. 1714; Letters 1365 and 1366, 13 and 22 Oct. 1714.
89. Letter 1366, 22 Oct. 1714.
90. Letters 1447, 28 May 1717, 1479, 11 Aug. 1718, 1492, 25 Nov. 1718, and 1501, 20 Apr. 1719.
91. Letter 1370, 11 Dec. 1714, 1391, 5 June 1715, and 1282, [Mar. 1711].
92. Letter 1482, 6 Sept. 1718.
93. W. Andrewes, ed., *The quest for longitude* (Cambridge, Massachusetts, 1996).
94. Letters 921, 15 Dec. 1703, 979, 8 Feb. 1704/5, 1175, 31 May 1707, and 1211, 24 Aug. 1708.
95. Letter 979, 8 Feb. 1704/5; all four letters gave details of eclipse observations.
96. Acknowledged in 979, 8 Feb. 1704/5; doubt expressed in 921, 15 Dec. 1703.
97. Letter 911, 18 Sept. 1703.
98. Letter 943, 13 June 1704.
99. Letter 1092, 11/22 May 1706.
100. Letter 914, 13/24 Oct. 1703.
101. Letter 1390, 4 June 1715.
102. Letter 1503, 25 Apr. 1719.
103. Letter 1265, 14 July 1710.
104. Letters 998, 21 May 1705, and 1324, 25 Nov. 1712.
105. Letter 1121, 5 Sept. 1706.
106. Letter 1051, 28 Nov. 1705.
107. Letter 1213, 9 Sept. 1708.
108. Letter 926, 26 Dec. 1703.
109. Letter 912, 21 Sept. 1703.
110. Letter 1143, 9 Nov. 1706.
111. Letter 1232, 29 Mar. and 5 Apr. 1709.
112. Letters 1209, 23 July 1708, and 1230, 24 Mar. 1708/9.
113. Letter 1505, 18 June 1719.
114. Letters 927, 27 Dec. 1703, and 939, 22 May 1704.
115. Letters 958, 1 Dec. 1704, and 1430, 25 Aug. 1716; for curates e.g. 1174, 30 May 1707, 1403-04, 1 and 17 Nov. 1715, and 1478, 10 Aug. 1718.
116. Letter 1507, 1719 [probably summer].
117. Postscript to Letter 1068, 2 Feb. 1705/6.
118. Letters 1269, 20 Sept. 1710, and 1355, 22 Mar. 1713/14.
119. Letters 1434, Nov. [1716], and 1444, 4 May 1717.
120. Letter 1456, 25 Jan. 1717/18.

901

## MEMORANDUM BY FLAMSTEED

21 JUNE 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/35, f. 15b).

New view<sup>1</sup>. Juny 21. 1703

943	γ . .	66	Perseus	57		92
413	δ	135	Auriga	71	967	90
<u>381</u>	Π	94	Coma	44	1142	<u>65</u>
1737	Ϟ	67	Bootis	57		247
	ϙ	96	Corona	22		
	π	86	Hercules	120		
	Ω	33	Cygni	108		
	π	60	Lyra	22		
	✓	49	Ursa Major	247		
	ϝ	53	Draco	56		
	Ϟ	113	Ursa Minor			
967	κ	115	Vulpecula	10		
	Cetus	78	Lupus	3		
	Eridanus	73	Centaur	8		
	Orion	70	Cassiopea	55		
	Lepus	19	Cepheus	<u>36</u>		
	Canis Major	25		665		
	Minor	17		<u>2109</u>		
	Navis	25		2774:		
	Monoceros	33		59		
	Hydra	94	Sit summo Deo sola et			
	Cornus	9	summa Laus <sup>2</sup> .			
	Crater	12		<u>2833</u>		
	Sextans	35				
	Serpentis	61				
	Serpentarius	76				
	Aquila Antinous	72				
	Sagitta	23				
	Delphinus	18				
	Equuleus	10				
	Pegasus	96				
	Trianguli	24				
	Andromde	21	esset 80			

Annotations to Letter 901  
 MEMORANDUM BY FLAMSTEED  
 21 June 1703

This was written as an addendum to one version of Flamsteed's 'Notes on the Account of the Observatory', for which see Letter 824, 9-10 October 1700.

1. That is, a survey of the work completed so far for Flamsteed's star catalogue, expressed as the total number of stars processed for each constellation.
2. Translation: 'let the sole and highest praise be to almighty God'.

902

## SLOANE TO FLAMSTEED

22 JUNE 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/35, f. 94<sup>r</sup>; enclosure at RGO 1/36, f. 11<sup>r,v</sup>).

London June 22. 1703.

Sir

Mr. Hill<sup>1</sup> the other day gave me your letter to Mr. Casewell<sup>2</sup> to be read at a meeting of the society which was accordingly done<sup>3</sup>. The society were very willing and desirous any part of it that may relate to your own Justification or the<sup>4</sup> information of the world should be printed in the transactions. if you think it proper. I therefore send it you herewith that you may fitt it as you please for the publication<sup>5</sup>

I also transmitt you part of a letter from Mr. Leibnitz to me, concerning which especially that part of it relating to a new starr the society will be very glad to have your opinion<sup>6</sup>. I am

Sir

Your most humble servant

Hans Sloane

**Enclosure in Letter 902:**

LEIBNIZ TO SLOANE, 17 April 1703

Vir celeberrime atque honoratissime,

- Gaudeo Wallisium consummatissimum Virum adhuc vivere, imo quantum ea aetate licet, valere<sup>7</sup>.

Soleo ego ad usus Theoreticos adhibere Arithmetica simplicissimam, fundatam in progressionem binaria, quam et alij ignotam non puto (etsi fortasse minus quam mihi usurpatam) ubi non alij occurrunt characteres quam *0* et *1*.

0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

Hanc communicavi R. P. Bouvet Jesuita ad Sinenses reverso<sup>8</sup>; is deprehendit figuras Fohy<sup>9</sup> antiquissimi Sinarum Regis Philosophi, cum mea adjecta Tabula, usque ad 64 continuata, easdem esse. Et sufficit considerare rem in octo lineationibus, notando tantum — seu lineam integram significare 1 et -- lineam in medio interruptam significare 0.

Ipsius autem Fohy octo figurae quae creduntur Fundamentales Sinensibus, et quae constant tribus lineis, ut 64 lineis sex, ita habent

≡	≡	≡	≡	≡	≡	≡	≡
000	001	010	011	100	101	110	111
0	1	10	11	100	101	110	111
0	1	2	3	4	5	6	7

et octo et 64 lineationes in Confutio Parisijs edito<sup>10</sup>, reperientur, ordo tantum figurarum 64 est perturbatus. Ita habemus solutum aenigma, quod Sinenses a non uno annorum millenario non intellexerunt, amissaque genuina significatione, interpretationes peregrinas sunt commenti.

Dominus Kirchius Observator noster Berolinensis, diligenter observavit an aliquot annis, fixum mutabilem in Collo Cygni<sup>11</sup>. Anno 1686. primum observavit ubi paulatim decrevit tandemque evanuit. Augusto anni 1687. iterum per tubum quatuor pedum apparuit, Novembri, nudo visui. Aprili 88 nec tubo 8 pedum potuit agnosci: itaque judicavit periodum esse anni, mensis, et septimanae; cum illa in Collo Ceti ii mensibus solum indigeat. Observavit deinde servari quidem Periodum huic Stellae Cygni sed maximam magnitudinem non semper esse eandem; aliquando nudo visui insensibilem manere, ita annis 1688 fine, et 1689 initio. Sed 1690, notabilior fuit majorque vicina, quam ipse Hebraica λ litera designavit. Tandem, Martio, primisque diebus Aprilis anni 1702, hanc Stellulam (Bayero in ...<sup>12</sup> litera χ Graeca notatum) per tubum, 19 Aprilis primum nudis oculis vidit majorem vicinula λ, et φ, sed minorem quam η. Vestrum de hac periodo, et reliquis, judicium desidero. Vale et fave. Dabam Berolino 17 April 1703.

deditissimus

Godefridus Gulielmus Leibnitius.

**Translation of enclosure in Letter 902**

Most famous and honoured Sir,

I am glad that that most distinguished man Wallis is still alive, and is as well as his great age allows<sup>7</sup>.

For theoretical purposes I habitually use the simplest arithmetic, based on binary progression., which I think is not unknown to others (although perhaps less used [by them] than by me), where no characters occur other than 0 and 1.

0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

I communicated this to the Jesuit R. P. Bouvet after his return to China<sup>8</sup>. He found that the figures of Fohy<sup>9</sup>, the most ancient Royal philosopher of the Chinese, were the same as those in my adjoining table, continued to 64. It is enough to consider the matter in 8 groups of lines, noting only that — or a whole line represents 1 and —, a line broken in the middle, represents 0.

The 8 figures of Fohij, however, which are believed by the Chinese to be fundamental, and which are contained in 3 lines, so that 64 is in six lines, are shown thus:

000	001	010	011	100	101	110	111
0	1	10	11	100	101	110	111
0	1	2	3	4	5	6	7

And 8 and 64 lines are to be found in the Confucius published in Paris<sup>10</sup>, only the order of the 64 figures is confused. Thus we have solved the enigma which the Chinese have not understood for more than one thousand years, and for which, missing its true significance, they have invented strange interpretations.

Mr Kirch, our observer at Berlin, has for several years diligently observed the variable star in the neck of Cygnus<sup>11</sup>. He first observed it in 1686, when it gradually decreased and eventually disappeared. In August 1687 it was visible again, through a 4 foot telescope; in November to the naked eye. In April '88 it could not be distinguished through an 8 foot telescope. Thus he judged the period to be of a year, a month and a week, just as the star in the neck of Cygnus requires one of only two months. He then observed that this periodicity of the star of Cygnus was indeed preserved, but the greatest magnitude was not always the same; it sometimes remained imperceptible to the naked eye, as at the end of 1688 and the beginning of 1689. But in 1690 it was markedly brighter and greater than the neighbouring star, which he designated by the Hebrew letter  $\lambda$ . Eventually, in March and in the early days of April 1702 he saw this small star (marked by Bayer in [...] with the Greek letter  $\chi$ ) through a telescope. On 19 April he saw it for the first time with the naked eye, bigger than its small neighbours  $\lambda$ , and  $\phi$ , but smaller than  $\eta$ . I wish to know your judgment about this periodicity and the other matters. Farewell and think kindly of me. Berlin, 17 April 1703

Your most devoted

Gottfried Wilhelm Leibniz

Annotations to Letter 902  
 SLOANE TO FLAMSTEED  
 22 June 1703

Leibniz's original letter is now in the British Library (Ms. Sloane 4039, ff. 116<sup>r</sup>-117<sup>v</sup>). The full text and a brief commentary upon it have been published in E.J. Aiton, 'An unpublished letter of Leibniz to Sloane', *Annals of Science*, 38 (1981), pp. 103-107; Aiton's translation, however, contains a few inaccuracies. See also Leibniz's 'Nouvelle arithmétique binaire', in the *Histoire de l'Académie Royale des Sciences* for 1703 (Paris, 1705), communicated to the Académie in 1702; a French version of the present text appears as 'Explication de l'Arithmétique Binaire' in the *Mémoires* section of the same volume, pp. 85-89. Sloane's covering letter appears in Baily, *Flamsteed*, p. 215.

1. Probably Abraham Hill, F.R.S.
2. Letter 873, 5 Sept. 1702 (in vol. 2) a copy of which is preserved with this present letter at RGO 1/35, ff. 92<sup>r</sup>-93<sup>r</sup>.
3. Its reading on 9 June 1703 is recorded in the Royal Society's Journal Book vol. 10, p. 37.
4. Here 'publick' was miswritten and deleted.
5. It was never published, probably because Flamsteed thought it unwise to provoke controversy.
6. The letter from Leibniz was read to the Society on 2 June and was referred to Halley, Wallis and Flamsteed for their consideration: Journal Book, vol. 10, pp. 35-36. The first two eventually submitted their replies to the Society, but there is no record of Flamsteed's having done so.
7. Dr John Wallis died on 28 Oct. 1703 at the age of 86.
8. Bouvet was one of the six Jesuits sent to China by Louis XIV in 1685. He came back to France in 1697 to report on the mission, then returned to China in 1699. His reply to Leibniz's enquiry was published as 'Extrait d'une lettre écrite à M. de Leibnitz ... par le P. Bouvet ... A Peking, le 4 Novembre 1701', in *Mémoires de Trevoux* (Jan. 1701); two letters to Leibniz also appeared in the *Recueil de diverses pièces, sur la philosophie, les mathématiques, l'histoire etc...* (Hamburg, 1734).
9. That is, the diagrams of the I-Ching or 'Book of Changes'. Western interpretations of these, their possible origins in an ancient Chinese counting system, and Leibniz's interest in the topic are discussed in Joseph Needham *et al.*, *Science and Civilisation in China*, 6 vols in 17 (Cambridge, 1954-96), vol. 2, pp. 340-343.
10. P. Couplet (*et al.*), *Confucius Sinarum philosophus sive scientia Sinensis Latine exposita* (Paris, 1687). Aiton (see main note above) states that here 'the hexagrams are arranged in the Wang Wen order and not in the Fu-Hsi order that was the basis of Bouvet's discovery'.
11. These with other observations by Kirch were published in the *Miscellanea Berolinensia*, vol. 1 (1710), pp. 202-18, and in *Phil. Trans.* 25 (No. 343, for Mar.-May 1715), pp. 226-228.

12. Blank; 'Uranom.' in the original from which the present copy was taken, standing for Johann Bayer, *Uranometria, omnium asterismorum continens schemata, nova methodo delineata, aereis laminis expressa* (Augsburg, 1603).

903

## GRAY TO FLAMSTEED

24 JUNE 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/37, f. 8<sup>r</sup>).

Canterbury June 24th 1703

Honoured Sir

Having lately seen a spot in the sun<sup>1</sup> which I know not whether you may have taken notice of I thought it not amiss to advertise you of it though it have at present left the suns vizable Disk yet it may Probaly return it in a few days when you may have an oportunity to observe it<sup>2</sup>

I first Discoverd this spot the 15th of June between 4 and 5 a'clock in the afternoon with a 6 foot Telescope Receiving the suns Image on a white paper and after wards towards the seting of the sun with a Telescope of 16 foot by looking directly at the sun I judged it might be about 6 or 7 minuts from the suns western limb twas in the lower Right hand Quadrant of the suns Disk but I had not the conveniency of measuring its Distance from our position to any of the immagenary lines of the sun I belive it might be a bout 10 or 12 seconds in its diameter if not more the 16th I saw the spot again and found it now neare to the limbe of the sun the 17th was Cloudy and soe was the night which Hindered me from seeing the Moons Eclips but the 18th in the afternoon it Cleard up and between 4 and 5 a Clock threw thin Clouds I saw the spot with the 16 foot glass twas now very neer the limb of the sun I judged little more then half a minute twas now very narrow whereas when I first saw it twas nearly Circuler but this I know proceeds from the spherical superfic[ies] of the sun the 19th in the Morning I looked again but Could not see the spot soe I suppose it went off in the night soe I need not tell you its Return to the suns vizable Heamesphear may be expected the 2d of July next.

I hope to be in London in a short time and make my self soe happy as to see you at the observatory<sup>3</sup> who am

Sir

Your most Humble Servant  
Stephen Gray

## ADDRESS

For Mr John Flamsteed at the Royal Observatory in Greenwich London

Annotations to Letter 903  
 GRAY TO FLAMSTEED  
 24 June 1703

1. Extracts from two of Gray's letters to the Royal Society giving an account of this spot, in terms similar to those of the present letter, and of a second spot first seen on 27 June 1703, were published in *Phil. Trans.* 23 (No. 288, for Nov./Dec. 1703), pp. 1502-04.
2. A comment in Letter 905, 3 July 1703, indicates that Flamsteed and/or his assistant observed spots in May and June.
3. There is no evidence in subsequent letters to show whether this visit took place.

904

## SHARP TO FLAMSTEED

29 JUNE 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/34, f. 25').

Horton June 29 1703

Sir

I have been again discoursing my Fr[ien]d<sup>1</sup> about the Aurora Borealis though ever since that very night<sup>2</sup> have found him much averse to any discourse about it, probably because so many extravagant reports were spread abroad concerning it by the ignorant Countrey people here, that saw it, to which he would not seem in the least to contribute; but your account of the originall and reason of it<sup>3</sup> rendred him more free: I perceiv it was through my misapprehensions that I mentiond the Colours for he affirms he did not observe any neither near the black Cloud where the light was more resplendent and intense, nor in any of the Rays. and I am very much satisfyd, you put me upon this further inquiry least the mistake should be dispers't and perpetuated. The time of its disappearance as I remember was about 9 $\frac{1}{2}$ <sup>h</sup><sup>o</sup> and the Moon did not shine with us till near 11, though I saw the black Cloud and a light above it like the Crepusculum<sup>4</sup> from 10 till some time after 11, when the ☽ shone clearly enough, but as I hinted it seemd to be mov'd considerably more Eastward.

I have had De La Hire's Conick Sections<sup>5</sup> by me this 10 years or upwards, but in reading his first book had entertaind such a prejudice, being disgusted at his method, that I cast it by, and never so much as look't at it since, nor should I now, had I not been invited by the informacion you give of his handling your question<sup>6</sup>; which I find he constructs by two opposite Hyperbolas, but considers the lines differently, Vizt that part intercepted between the Axis and Section as the least that can be drawn to the Curve from that Point in the Axis, which though it seem not directly to answer your question, yet results in the same: but whether this consideracion may contribute any thing to the facilitating the numerall operation I have not had leizure to try, though have reason to suspect it will not, since I never did yet meet with a question to the Construction wherof

two Conick Sections were necessarily requird, that would result in any easier than a Biquadratick Æquation; but shall make the tryall if yow judge it convenient and have not allready done it; I presume Mr Caswell and D'moivre were sensible it was allready solv'd by La Hire, therefore were willing to spare their pains, but then it had been an ingenuous part to have given you speedyer notice (as I should certainly have done had I known as much) and not have kept you so long in suspence, but indeed it never entred into my thoughts to look into La Hire nor had I the least expectation of any such thing from it.

I suppose D Moivre's answer to Dr Cheynes book<sup>7</sup> is like to be long enough deferr'd since the book it self hangs still in the Presse, it has indeed stuck so long in the birth that I fear 'twill at last prove abortive; there is I hear a piece of Physick lately set forth by a person of the same name<sup>8</sup>, which 'tis very probable is the same Author, since he proceeds by way of Mathematicall demonstration. I hope that tract of Mr Hayes<sup>9</sup> goes forward, but indeed have but very low expectations from these Scotchmen, who I perceiv have much of the French vein large boasts and little performance; but hope better things from our English Mr Ditton<sup>10</sup>, I imagine it will be no great difficulty to procure the printing of something of this nature in the Transactions which have been so long barren of Mathematicall (and indeed of any other valuable) matter, but it seems strange when he is about to print another piece of a nature so little different, that this of tangents to Curvs should rather then be annext to that, be inserted alone in the Transactions<sup>11</sup>, unless he expect it should thereby be recommended to the world, and by appearing sooner be as an introduction and recommendation to the other when these or anything of like nature is publisht hope you'll please to give notice to

Sir Your most obligd humble Servant  
Abr Sharp

To Facilitate the Construction of your Problem according to La Hire have calculated some of the necessary Termes For the Ellipsis which for want of room and time to make a Scheme have expresst in words at length and in the same species as in my former Figures<sup>12</sup> to which referr you. Distance from the Center of the Ellipsis to that Assymptote thats parallel to the

$$\left. \begin{array}{l} \text{Conjugate} \\ \text{Transvers} \end{array} \right\} \begin{array}{l} \text{Axis} \\ \text{Axis} \end{array} = \frac{bbf}{bb-dd} = \frac{ddc}{bb-dd}$$

$$\text{The Transverse} = \text{Conjugate Semiaxis of the Hyperbola} = \frac{bd\sqrt{2cf}}{b^2-d^2}$$

$$\text{Distance from the Center of the Ellipsis to the perpendicular that falls on its Transvers Axis from the Vertex of the nearer Hyperbola} = \frac{bbf-bd\sqrt{cf}}{b^2-d^2} = \frac{bbf-bd\sqrt{cf}}{b^2-d^2}$$

$$\text{Length of the Perpendicular} = \frac{bd\sqrt{cf} - ddc}{b^2-d^2}$$

These I had not leizure to apply to all Cases but suppose with a little consideracion they may be easily accommodated to any

## ADDRESS

To the Reverend Mr John Flamsteed M: R: at the Observatory in Greenwich Park ner London present

Annotations to Letter 904  
SHARP TO FLAMSTEED  
29 June 1703

Part published in Cudworth, *Sharp*, pp. 72-73. The original was endorsed by Flamsteed: '17. Mr Sharp June 29 1703 Retracts the Colours mentiond to have been seen in the Aurora borealis described in his of March 30 past'[Letter 894, in vol. 2].

1. Probably his nephew, John Sharp: see Letter 894, 30 Mar. 1702/3 (in vol. 2).
2. 24 March 1702/3.
3. Given in Letter 895, 8 Apr. 1703 (in vol. 2).
4. Twilight.
5. Philippe de la Hire, *Sectiones conicae in novem libros distributae* (Paris, 1685), in French *Nouveaux élémens des sections coniques*; translated into English by B. Robinson as *New elements of conick sections* (London, 1704).
6. The question was first put to Sharp in Letter 885, 14 December 1702 (in vol. 2), in the following terms: 'a point A being given. on the superficies of the sphere. and an Arch of any conicall line described on it. (suppose it an Ellipsis) BCD. from the point given to draw a perpendicular to the curve AB or the longest and shortest arches of great Circles Ab AB that can be drawn from the point given to the Curves'. Possible solutions were discussed in several subsequent letters, La Hire's being mentioned in Letter 900, 8 June 1703 (in vol. 2).
7. George Cheyne, *Fluxionem methodus inversa* (London, 1703), was the book; Abraham de Moivre's answer *Animadversiones in D. Cheynaei tractatum de fluxionum methodo inversa* (1704).
8. [George Cheyne], *A new theory of ... fevers* ([Edinburgh] 1702; 2nd edn London, 1702). Cheyne's authorship was acknowledged in a later edition (*DNB*).
9. Charles Hayes, *A treatise of fluxions: or an introduction to mathematical philosophy* (London, 1704).
10. Humphrey Ditton produced *An institution of fluxions: containing the first principles, the operations, with some of the uses and applications of that admirable method ...* (London, 1706).
11. Ditton's 'De Curvarum Tangentibus e Maximorum ac Minimorum Theoria immediate deductis: Una cum Theorem ...' appeared in *Phil. Trans.* 23 (No. 284, for Mar.-Apr. 1703), pp. 1333-45.

12. Diagrams and mathematical workings were sent with Letter 889, 30 Jan. 1702/3, but have not been reproduced with that letter in vol. 2 because of their complexity.

905

## FLAMSTEED TO SHARP

3 JULY 1703

From the original in the Royal Society Library, London (MS. 798.11).

The Observatory ♪ [Saturday] July 3. 1703

Sir

I returne an imediate Answer to yours of the 29th past<sup>1</sup> because this week since Monday last<sup>2</sup> I have seene spots in Sun. which tho they are no novelty to me may be so to you they are advanced a little beyond the middle of the sun so that if this letter meets with a speedy conveyance you may find them before they turne out of him tho they change their shape dayly which makes me thinke they are shallow and will scarce continue another revolution.

Wee have seene<sup>3</sup> of them ever since the middle of May and in June one of them returned that was a pretty dense one I expec[t] to see it within his antecedent limbe againe this day or to morrow.

There is nothing to be learnt from them but that the sun turnes round an axis inclined to the plane of the Ecliptick about 83 degrees over the 7th or 8<sup>d</sup> degree of ♁ and makes a simple revolution ad fixus<sup>4</sup> in about  $25\frac{1}{4}$  days as I have told in the praeface to my<sup>5</sup> Doctrine of the Sphere<sup>6</sup>. and therefore I am not carefull to take any further Notice of them since they seeme to signifie little or nothing to us. Now to your letter.

I am glad you have rectified your account of the Aurora borealis the Colours you told me of perplexed me much how to salve them. wee see no halos about the Moon with colours at the distance wherein your Arch appeared. but wee see some faint ones in<sup>7</sup> circles at lesser distances you have leasure and may doe well when you see them againe to consider them Well and the reason of them I want leasure for such an enquiry.

I am glad you have la Hire's Conicks<sup>8</sup>. I told our people here<sup>9</sup> that he had indeed the Construction but they might doe well to shew the Algebraick investigation as you had done. but this they spoke slightly of with their usuall confidence. and tho I told them that I had youres Yet I would not shew it to any of them. that they may try their skill in finding it out. but it will be long I fear ere I shall see any thing of that Nature from them.

Mr Hayes<sup>10</sup> is the cunningest of all of the Scotchmen. Rowly<sup>11</sup> would needs have the probleme to try his skill which I gave him in Latin in these words. Describantur Evolutae Gg Ff et per punctum datum P. ducantur Pg, Pf, occurrentes curva Ellipsis in D et C, et tangentes Evolutas in g et f Dico PD brevissimam fore, PC longissimam omnium rectorum quae ad datam Ellipsin duci possint ab eodem dato puncto P<sup>12</sup>.

I wrote under it. Cujusnam Curvae?

a quibus punctis?  
et quibuscum proprietatibus?

Frustra fit per plura quod fieri potest per pauciora<sup>13</sup>.

and returned it to him. this stung him he sayd the Evolutae must be of the same Ellipsis and pass through the foci you will see that they may as well proceed from any point in the Axis, to justifie his way of constructing it he vouched Mr Hugens<sup>14</sup>. and L Hopital<sup>15</sup> the last is the Author whose worke I am told is the Parent of his and the Issue will be extremely like. I have lent the booke to Mr Hudson<sup>16</sup>. and so cannot refer you to the place in him but Mr Huygens I have by me and if you turne to the 10 prop. of the 3d part of his booke pag 79 you will see what he sayes of the Evolutas of the Conicall Curves and apprehend that Mr Hayes has onely turnd the Probleme from himselfe to his Author and bids us doe the thing and tis done but how to describe the Evoluta. if you desire he should shew you he begs your pardon: tis enough he refers you to a couple of good Authors. you affront him in urging further

I am mistaken if I told you not in some of my letters along while agone that Dr Cheynys booke<sup>17</sup> was extant tis a thin quarto not so bigg as Dr Pells Algebra<sup>18</sup>. a fayre large print in<sup>19</sup> latin on good paper I hear but little said of it since it came out De Moivre is in London. discourses often of it and hinders the Scotchmens and their confederates applauses of it from haveing the effect they designed<sup>20</sup> tis sold at 7. or 8sh I feare you would think your Monys ill layd out to have it at so dear a rate in a little time you may perhaps have it cheap enough from some bulke.

J Hudson gives me a very good Charecter of Mr Ditton<sup>21</sup>. something better may be expected from him. but our Transactioneer<sup>22</sup> has in a Manner ruind the reputation of the RS as he has done of his Transactions and I doe not expect that he should print any thing of that Nature tis a bulky gentleman but his soule<sup>23</sup> creeps onely amongst herbs and plants he wants a person of Raymers<sup>24</sup> sharpness and skill to direct him. but Mons[ieu]r Raymer is now returned into Germany to visit<sup>25</sup> the Gulfe of Treist againe<sup>26</sup> and fortifie it and till his returne the Transactioner dares not venture on any thing of Mathematicks. I must acquaint you with Mons[ieu]r Raymers good fortune he has got the title of the Queens Hydrographer a pension of 200<sup>li</sup> per Annum and a promise of an addition<sup>27</sup>. I pray God this may make him a better Man. and then I am so far from envying him that I shall joyce at it. I wish you health and am ever Sir

Your affectionate freind and obliged servant  
John Flamsteed M R

#### ADDRESS

To Mr Abraham Sharp at Little Horton near Bradford in Yorkshire

Annotations to Letter 905  
FLAMSTEED TO SHARP  
3 July 1703

Part published in Cudworth, *Sharp*, pp. 73-74. On the verso of the original are the shorthand notes of Sharp's reply of 24 July (Letter 907).

1. Letter 904.

2. 28 June 1703.
3. Here 'some' appears to have been intended but omitted.
4. Written thus for 'ad fixas': 'with respect to the fixed stars'.
5. This word was written over 'the'.
6. John Flamsteed, *The doctrine of the sphere* (London, 1680), formed the sixth part of Sir Jonas Moore's posthumous *A new systeme of the mathematicks* (London, 1681).
7. This word was written over 'at'.
8. Philippe de la Hire, *Sectiones conicae in novem libros distributae* (Paris, 1685), appeared in French as *Nouveaux élémens des sections coniques*, and eventually in English, translated by B. Robinson, as *New elements of conick sections* (London, 1704).
9. Probably including Abraham de Moivre, who is mentioned in several recent letters.
10. Charles Hayes, the author of *A treatise of fluxions* (London, 1704).
11. Probably John Rowley, engraver and mathematical-instrument maker.
12. Translation: 'The evolutes Gg Ff are described and through a given point P are drawn Pg, Pf, running to meet the curve of the ellipse at D and C, and touching the evolutes at g and f I say PD will be the shortest, PC the longest of all right lines which can be drawn to the given ellipse from the same given point P.'
13. Translation: 'Of what curve? from which points? and with what properties? Let it be vain to do by more what can be done by fewer'.
14. Probably Christiaan Huygens, *Theorematica de quadratura hyperbolis ellipsis et circuli* (Leiden, 1651).
15. Guillaume François de l'Hospital [later written as l'Hôpital], *Analyse des infiniment petits pour l'intelligence des lignes courbes* (Paris, 1696).
16. James Hodgson, Flamsteed's former assistant.
17. George Cheyne, *Fluxionem methodus inversa* (London, 1703).
18. John Pell was partially responsible for editing *An introduction to algebra translated out of the High-Dutch into English by Thomas Brancker, M.A. much altered and augmented by D. P.* (London, 1668). The original was J. H. Rahn, *Teutsche algebra oder algebraische rechenkunst* (Zurich, 1659).
19. This word was written over 'of'.
20. He published his criticism as *Animadversiones in D. Cheyneri tractatum de fluxionum methodo inversa* (1704).

21. Humphrey Ditton had recently published a mathematical paper, in *Phil. Trans.* 23 (No. 284, for Mar.-Apr. 1703), pp. 1333-45.
22. Hans Sloane edited the *Philosophical Transactions* from 1695 to 1713.
23. Written 'sould', but *OED* does not record this as a possible variant spelling. The final 'd' may be simply a distorted 'e', or a mistake on Flamsteed's part.
24. That is, Halley's; Flamsteed took the name from Nicolaus Raymarus Ursus (otherwise Nicolai Reymers Bär), plagiarist of Tycho, as explained in Letter 908, 5 Aug. 1703.
25. Here Flamsteed began to write 'and for[tifie]' as an insertion above the line, but thought better of it.
26. Colin A. Ronan, *Edmond Halley: genius in eclipse* (London, 1970), pp. 183-85, describes Halley's trips to Vienna and Trieste, in 1702 and 1703. He returned home from the second in November 1703.
27. This rumour was unfounded. It is possible that rewarding Halley in this way was considered, but his appointment to the Savilian chair of astronomy swiftly made it unnecessary.

906

## FLAMSTEED TO LISTER

8 JULY 1703

From the original at the Bodleian Library, Oxford (MS. Lister 37, f. 74<sup>v</sup>).

The Observatory 4[Thursday] July 8. 1703

Sir

I have sometimes thought of waiteing upon you at Ebsham<sup>1</sup>. but tis a long Journey and a busy time with you at the Wells<sup>2</sup> which makes me decline my first intentions. yesterday Dr Hutton<sup>3</sup> enterteind me at dinner and told me you come sometimes to town I desire therefore that you would please to let me know by any short note directed hither when you come next that I may meet you with my Mapps of the Constellations and consult with you both how to get them better drawn and engraved for an offer is now made that tends to the publication both of them and my Workes. I gave Dr Hutton two papers one of the short History of the Observatory<sup>4</sup> and the other a list of what I have ready prepared for the press and under my hands prepareing that he might shew it to you and Mr Aston<sup>5</sup>. I must entreat you both to speake little of it till wee meet for their are some persons<sup>6</sup> concernd who will have the business transacted with them before it passe into the Treasury and tis reasonable it should doe so: I shall write the same thing this day<sup>7</sup> to Dr Hutton and Mr Humes<sup>8</sup> at Hampton court. Tell my old acquaintance I wish him health the same is heartily wisht both to your selfe and Lady by Sir

Your affectionat freind and humble servant  
John Flamsteed M R

I enjoy my health I bless God for it better then formerly and he raises me freinds on every occasion where I expected not. I prayse him for it. My Wife gives yours her humble services.

Wee have seen great variety of spots in the sun. since May last<sup>9</sup>. On tuesday last he was cleare and had none. but I expect a return of some this day. there is nothing to be learnt by them more then we know already and therefore. I should not have mentioend this but that since the year 1684<sup>10</sup> to the present I have seen none on him. J F:

#### ADDRESS

For Dr Lister at his house near the Church at Ebsham these Epsom in surry

#### Annotations to Letter 906

#### FLAMSTEED TO LISTER

8 July 1703

1. Epsom (see address).
2. Lister based his medical practice at Epsom because of the attractiveness to patients of the town's spa waters, celebrated by Nehemiah Grew in *A treatise of the nature and use of the bitter purging salt contain'd in Epsom and such other waters* (London, 1697).
3. John Hutton, M.D., first physician to Queen Anne.
4. Flamsteed's account of the Observatory's history survives in several different versions: see Letters 803, late 1699, and 824, 9-10 Oct. 1700 (in vol. 2).
5. Francis Aston, courtier, who was to be involved in producing the 1712 *Historia coelestis*.
6. The allusion may be to an expected intervention by Newton and/or the Royal Society, although according to Flamsteed's notes (Baily, *Flamsteed*, pp. 66, 73) Newton attempted this only in April 1704.
7. There is no evidence as to whether he wrote those further letters.
8. The Court was at Hampton Court between June and Aug. 1703: W. Page, ed., *Victoria county history of Middlesex*, vol. 2 (London, 1911), p. 363. This enables 'Mr Humes' to be identified as Peter Hume(s), the Yeoman of the Removing Wardrobe: *Calendar of treasury books* 19 (1703), p. 123, 29 Jan. 1702/3. He was an appropriate person to consult about sponsorship, at least on the evidence of a record of 19 May 1703 which shows him acting as the intermediary for a payment of £500 'to Thomas Rymer, Historiographer Royal, and Awnsham Churchill Esq., bookseller' for transcribing and printing a volume of 'Leagues and Treaties': *ibid.*, p. 274.
9. Compare the account of these in Letter 905, 3 July 1703.
10. See the last paragraph of Letter 512, 2 May 1684 (in vol. 2).

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## SHARP TO FLAMSTEED

24 JULY 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/34, f. 26').

Horton July 24 1703

Sir

Yours<sup>1</sup> came to hand the 6 instant but could not obtain a sight of the Sun till the 8 or 9, and then though I lookt very diligently with the 10Ft glasse yet could not perceiv any appearance of a spott, suppose they were turnd off to the opposit side; have observ'd it every day since when it shin'd clear, especially this week when I expected their return, but believe they are quite vanisht, the face of the ☉ seems perfectly clear: though I have formerly seen such when with you in 84 as I remember, yet should have been glad to have seen and observd these and made some tryalls having at length fitted my Micrometer for use (had I but a good convenience for managing the Tube), 'tis considerably different from, and in my apprehensions somewhat more convenient than yours<sup>2</sup>; and now that I find its performance answer expectation, shall adventure to give you some account of what is peculiar therto: I make the upper as well as the under plate or bottom slide each in two groves in the Sides which therefore are somewhat thicker then yours, this permits the upper plate to be broader and renders the crosse barrs fixt on yours needless, so that have liberty to draw a Diagonall Scale of revolutions upon it a sufficient breadth to distinguish the parts to a competent exactness, this scale I look upon to be the Standard at all times, and chiefly to be rely'd on in case the Screws wear; the parts in the Diagonals are cut by the Streight edge of a narrow brasse Rule fixt at right angles on the Sides under which the Plate Slides: Now because (upon more experience perhaps and stricter examination (I presume) then any common Workmen use) I find it exceeding difficult to make two Screws so fine and long as these to agree exactly in the Number of revolves at the same length, which are not wrought in the same hole in the Stocks or screw Plate, as 'tis impossible yours should be, the one being a right the other a left hand screw (as they are usually termd,) therefore I use two Right hand Screws which being both made in the same hole are most likely to agree (though I find notwithstanding different thicknesses and tempers of the Mettall will occasion some variation) near the end of each screw close to the Numbring Plate is a Nutt of the same substance both the same Number mine are 5 each being the least possible that the motion may be quicker their Diameters lesse, and so run nearer each other, that the Nut by which the bottom plate is drawn may be as near the Middle as possible, both these Screws are turned together by two perpetuall Screws or Worms cutt upon one and the same Axis, which runs close and parallell to the Plane of the Numbring Plate, Inclined to the Plane of the Micrometer about an angle of 30° that worm which turns the longer Screw that draws the upper Plate hath a double thread, the other single that moves the bottom, so that both Screws are turnd the Same way onely the former with double swiftness, this running in the Center of the Numbring Plate carries an Index as in yours that Shews the parts of a revolv upon its limb to 100, under which (by two wheels, one on the inside and the other on the outside of the

Plate concentrick therwith) is turnd another Index which upon the same divisions Numbers the revolves to 100 moving but one division while the other runs round the Circumference, the handle by which they are turnd is upon the inclined Axis, on which are the two Worms, which I find in any position better adapted to the hand and with more ease and convenience turned, than if upon the face; besides it having more command of the 2 Screws they are easily turned though they goe very tight fitt in the Nutts (which cannot be allowd in yours) and are lesse apt to wear which must necessarily vitiate the account given by the Indices. If this contrivance please you, shall at your desire prepare another for your service, having all materialls ready. I find not that you did in any before your last directly affirm Dr Cheyne's Book<sup>3</sup> was extant, but I conjectur'd it from some of your expressions; I am not yet in despair of Mr Raphson's performing his promise in sending me One, provided I had but any Person I could intrust to put him in mind of it, and receive it from him, but since old Mr Speidell's death<sup>4</sup> who did me the like office for the last Edition of his Book<sup>5</sup>, I have no freind in London whom I could employ, except I could prevail with your quondam Servant Mr Hudson who probably knows where to meet with Mr Raphson, but I am utterly at a losse how to direct<sup>6</sup> to either of them, therfore am forc'd to lay aside those thoughts till some other opportunity offer; If this fail, I shall not be hasty to purchase it at so dear a rate: I hope Mr Dittons<sup>7</sup> will come easier, or better deserv the expence, am sorry 'tis not likely to be printed alltogether, but that which is reservd for the Transactions<sup>8</sup> will probably be delayd till Mr Raymers return, but who this Mr Raymer is except by that name you intend Mr Halley (as seems probable) and why his name is changd<sup>9</sup> should be glad to understand: I am informd from a freind<sup>10</sup> of Mr Townley's, that there are two very valuable Mathematicall peices in 4<sup>o</sup> lately put forth by a French Author, but haveing this onely at 2d hand, could not learn either the Authors Name or the Subject treated of, possibly you may have a better account what they are<sup>11</sup> and whether to be had in London, with which if you please at leizure to favour me it will further oblige

Sir

Your most assured humble Servant  
Abr Sharp

ADDRESS

To the Reverend Mr Flamsteed M R at the Observatory in Greenwich Park near London present

Annotations to Letter 907

SHARP TO FLAMSTEED

24 July 1703

Endorsed by Flamsteed: '18 Mr Sharp. New Micrometer July 21. 1703'.

1. Letter 905, 3 July 1703.

2. See Letters 77 and 443 (in vol. 1) for Flamsteed's comment on his improvements to the micrometer and a description and diagram of its use.

3. George Cheyne, *Fluxionem methodus inversa* (London, 1703).

4. Euclid Speidell senior had died in 1702.
5. This appears to mean a book of Raphson's, in which case it probably refers to his *A mathematical dictionary* (London, 1702), translated and abridged from Ozanam.
6. Here 'write' is deleted and 'direct' inserted.
7. Humphrey Ditton eventually published *An institution of fluxions: containing the first principles, the operations, with some of the uses and applications of that admirable method ...* (London, 1706).
8. Ditton's 'De Curvarum Tangentibus e Maximorum ac Minimorum Theoria immediate deductis: Una cum Theorem ...' appeared in *Phil. Trans.* 23 (No. 284, for Mar.-Apr. 1703), pp. 1333-45.
9. Sharp's deduction was correct. See Letter 908, 5 Aug. 1703, for plagiarist Nicolaus Raymarus Ursus (Nicolai Reymers Bär); Flamsteed had earlier levelled charges of plagiarism against Halley with regard to the magnetic work of Peter Perkins: see Letter 569, 4 Nov. 1686 (in vol. 2).
10. Unidentified.
11. Sharp's shorthand notes of his reply, written on the verso of Letter 905, conclude with a remark in longhand: 'the Authors name is Carra treats of Curves Center of Gravity and de vis percussiois'. This must mean Louis Carré, *Méthode pour la mesure des surfaces, la dimension des solides, leurs centres de pesanteur, de percussiois et d'oscillation, par l'application du calcul intégral* (Paris, 1700).

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## FLAMSTEED TO SHARP

5 AUGUST 1703

From the original in the Library of the Royal Society, London (MS. 798.12).

The Observatory Aug[ust] 4[Thursday] 5.1703

Sir

I am going into Surrey to Morrow or saturday God spareing me life and health to take care of my affaires there and therefore returne a speedier answer to yours of the 24th past<sup>1</sup> that so I may neather concerne you for the want of one, nor my sêlfe for not haveing given it, dureing my absence.

I doubt not but your New contrivance of the Micrometer is very good. and thank you for your description of it which I must confess I doe not well understand for want of a figure of it if you had added a small scetch it had made your description easily intelligible. I am sure tis well wrought as every thing is that passes under your hands and I will onely mind you of one thinge which you will apprehend on my bare mentioning of i[t] tis that since screws and sockets weare and the Measureing table that moves in your groves can not be supposed to glide equally by reason of the friction. the best and onely way to obviate an[y] error might be committed on this ac-

count is to<sup>2</sup> engrave a diagonall scale on the Measureing plate that may answer the revolves of your screw<sup>3</sup>, or (which In my opinion is better) 2 or 3 diagonall Inches. according to the breadth of your Eye glasses. for the Measureing plate being broad the parts of an Inch will be distinguished<sup>4</sup> Nicely and knowing the length of your tube you may Make tables easily. that shall give you the Angle that any partes of an Inche or inches subtend. in a tube of any length.

I had this fully in my view when I made my Micromet[e]r but did not put it in practise 1st by reason the revolves served my purpose well, 2d because I could not get a workman<sup>5</sup> to worke that as I would have. it. Your micrometer thus orderd will have this further advantage of mine over and above the truth and goodness of the Work

I shewed Mr Hudson your letter yesterday who will speake to Mr Ralphson<sup>6</sup> about Mr Sheenes book<sup>7</sup>. You may direct your letters to him at Jones Coffe house in Finch lane Cornehill<sup>8</sup> and I will undertake for him hee shall doe any business for you carefully and faithfully. he has Sheen. and would lend it you two or 3 moneths if he knew how to send it. If you send to him for the book and like it a[t] the price when you see it I shall pay him 8sh. for it. if not you may returne it

I have no news. save that Mr Dittons Tract about Tangents is in the Transactions Now newly published<sup>9</sup> and Mr De Moiver was yesterday in company with learned and ingenious Dr Sloan<sup>10</sup> I am apt to think about printing something of his<sup>11</sup>: you have judged right who I ment by Mr Raymer<sup>12</sup>. tis the name of The person who made it his business to depreciate T Brahe after he had been curteously enterteind by him and assured him of his inviolable freindship.<sup>13</sup> I know of No new french books of Mathematicks save the Histoir del Academy de sciences<sup>14</sup> which are very scarce and dear [the second volume] I have not yet seen when I shall see it I will give you an account of its contents.

In the mean time I wish you all health and am ever Sir

Your reall freind to serve you  
John Flamsteed MR

#### ADDRESS

To Abraham Sharp at Little Horton near Bradford in Yorkshire these present Bradford in Yorkshire

Annotations to Letter 908

FLAMSTEED TO SHARP

5 August 1703

On the verso of the sheet are Sharp's shorthand notes of his reply of 4 September (Letter 909).

1. Letter 907.

2. Here 'divide' is deleted.

3. Flamsteed had encountered exactly this problem with the Observatory's sextant, where graduation by revolves of a screw had to be replaced by a diagonal scale of degrees and minutes: Howse, *Greenwich Observatory*, 3, p. 76.

4. Written thus for 'distinguished'.
5. Here 'that' is deleted.
6. The mathematical author Joseph Raphson.
7. George Cheyne, *Fluxionem methodus inversa* (London, 1703).
8. Listed in Bryant Lillywhite, *London coffee houses* (London, 1963), p. 309, as existing in 1702-14 and mentioned by Defoe in 1704.
9. Humphrey Ditton, 'De Curvarum Tangentibus e Maximorum ac Minimorum Theoria immediate deductis: Una cum Theorem ...', appeared in *Phil. Trans.* 23 (No. 284, for Mar.-Apr. 1703), pp. 1333-45.
10. Hans Sloane was the current editor of *Phil. Trans.*
11. In fact nothing further by Abraham De Moivre was printed in *Phil. Trans.* until 1707. His criticism of Cheyne appeared as a separate publication: *Animadversiones in D. Cheyneri tractatum de fluxionum methodo inversa* (1704).
12. That is, Edmund Halley.
13. Nicolaus Raymarus Ursus, otherwise Nicolai Reymers Bär.
14. Flamsteed had evidently seen the first volume of what was to be a substantial series: *Histoire de l'Académie des Sciences ... Avec les mémoires de mathématique et de physique. Année 1699 [-1790]* (Paris, 1702-97).

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## SHARP TO FLAMSTEED

4 SEPTEMBER 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/34, f. 27').

Sir

I deferred my answer to yours of the 5th past<sup>1</sup>, to this opportunity of a private hand<sup>2</sup>, I am very sensible of the obligation you have laid upon me by your engaging Mr Hodgson to undertake my small concernes<sup>3</sup> at London, particularly with Mr Raphson, whose civil offer I would not seem to slight, though indeed I have very little expectation from him: upon your encouragement have enclosed a letter to Mr Raphson in one to Mr Hodgson; If the Book<sup>4</sup> come this way it will be acceptable; If not, (by the account I have had of it as obscure and encumbered with troublesome series not sufficiently explained) I judge it will scarce compensate the charge, therefore lay aside the thoughts of purchasing it except it come at an easier rate. I have already got the Transaction

wherin is Mr Ditton's discourse of Tangents<sup>5</sup>, which in some places I find by reason of presse faults (as I suppose) is not easily intelligible, however it seems very ingenious and gives encouragement to hope for something very considerable in his treatise of Fluxions<sup>6</sup> when it comes out: I am glad to hear Mr D'Moivre intends to print something in the Transactions<sup>7</sup>, which will I hope come out more correct, since himself will be at hand to inspect the presse.

I have since my last got a better account of the two French pieces I mentiond therein, the Gentleman who owns them<sup>8</sup> having been lately with me, who tells me the Authors name is Carra and the subject chiefly the doctrin of Fluxions, and something de Centro gravitatis et de Vi Percussionis and other things of that nature<sup>9</sup>, he gives them a very high Character, as much preferable to any thing of that kind yet extant, and I have had some reason to confide in the sufficiency of his Judgement, he hath promis'd to lend them me, if they come shall send you a further account. If they be not to be mett with in London.

I did apprehend my Micrometer (differing onely in some circumstially parts from yours) would not have needed a Scheme for its explication, but indeed I have so little accustom'd my self to such kind of draughts, that I should be at a losse how to render it any more intelligible thereby: but may I hope ere long find an opportunity to give you better satisfaction then from thence can be expected. I have done in part what you propose (which I think I intimated before) Vizt have drawn a diagonall Scale of the revolves of the Screw upon the measuring Plate, the breadth of two inches, on which I allways intended to relye being aware of the wearing of the Screws (though I have used all possible caution to prevent that) I had some thoughts indeed of a Diagonall Scale of inches but that being more troublesome to graduate, and the other of revolves no lesse generall and applicable to a Tube of any length by the help of a Table easily computed, I judg'd it sufficient: but you seem to suppose the Scale of Inches should lye in view of the Eye Glasse, but<sup>10</sup> how that can be without obstructing the sight of the Object I cannot apprehend; I content my self to number the Diagonalls either by the Eye Glasse screw'd off, or by another; the workmanship hereof being much different from any thing of that nature I have yet attempted or ever saw, is not perhaps so good as might be done upon a 2d essay; yet I find it performs well enough, the unforeseen defects in it I might probably remedy in another.

That God would preserv and continue your health and grant such success in all your designs and the great affair you have still upon your hands, that you may have such encouragement for the carrying on and compleating it, as may abundantly answer your desires is the hearty prayer of  
Sir

Your most obliged Friend and humble Servant

Abr Sharp

Horton September<sup>11</sup> 4 1703

This comes by a Friend and Kinsman Mr Robert Stansfield who lodges at the White Horse near Cripplegate or at Mr Knaps a Salter in Basing Hall street who will stay about 14 days in London He has some thoughts of delivering this himself in company with his wife my Niece and perhaps her brother<sup>12</sup> who was some time a Student of Physick in Leyden being my nearest relations who are desirous as other strangers to gratify their curiosity with the view such rarities as may be seen in or near the City

ADDRESS

To Mr Flamsteed MR at the Observatory in Greenwich Park near London

Annotations to Letter 909

SHARP TO FLAMSTEED

4 September 1703

Endorsed by Flamsteed: 'Mr Sharps 19. Sept 4. 1703'.

1. Letter 908.
2. That of Robert Stansfield, according to the postscript.
3. Sharp was trying to obtain Cheyne's book, for which see n. 4.
4. George Cheyne, *Fluxionem methodus inversa* (London, 1703).
5. Humphrey Ditton, 'De Curvarum Tangentibus e Maximorum ac Minimorum Theoria immediate deductis: Una cum Theorem ...', appeared in *Phil. Trans.* 23 (No. 284, for Mar.-Apr. 1703), pp. 1333-45.
6. *An institution of fluxions: containing the first principles, the operations, with some of the uses and applications of that admirable method ...* (London, 1706 [1705]).
7. In fact he did not do so again until 1707: see Letter 908, n. 11.
8. Unidentified.
9. Probably Louis Carré, *Méthode pour la mesure des surfaces, la dimension des solides, leurs centres de pesanteur, de percussion et d'oscillation, par l'application du calcul intégral* (Paris, 1700); it is not clear, however, why Sharp believed there were two separate works.
10. This 'but' is faint, and may have been intended as a deletion.
11. Written '7r'.
12. Elizabeth, and John Sharp.

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FLAMSTEED TO DERHAM

11 SEPTEMBER 1703

Mentioned in Letter 913, 29 September 1703.

Promised to supply information about sunspots.

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## FLAMSTEED TO JEUELL

18 SEPTEMBER 1703

From a draft in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/36, f. 68<sup>v</sup>).

The Observatory Sept[ember] 18. 1703

Sir

Tho yours of October 10 past<sup>1</sup> with an Originall picture of your famous countryman the Noble Tycho Brahe and the copy<sup>2</sup> of one in his Danish Majesties<sup>3</sup> your Masters Court were left at Ham-borow with Mr Stratford<sup>4</sup> in the same Moneth. yet the Copy arrived here last spring but the Ori-ginall not till within a fortnight of Midsummer<sup>5</sup>. it was sullied with Age and ill keeping and moreover crackt very much and injured by the conveyance: it was two moneths afterwards ere I could get it cleand and repayred by a skillfull workeman<sup>6</sup>, and this was no sooner done, but I was obliged to take a jorney into the Country, which kept me from this place five Weeks and makes me returne my thanks for your acceptable present so much later then you might justly expect them.

I was desirous of his picture, both for the agreement of our studies, and of severall accidents of my life that answer to his<sup>7</sup> at 100 yeares distance; As that I was borne 100 yeares after him, The English Observatory was built 100 yeares after his, my father was averse to my studying Mathe-maticks as his was I was designeing to settle in another place when the providence of God fixed me in his then Majesties service here; and some others I told you when you obliged me here with your company. The Parallell can not now be carried on for I am now two yeares older then he was when he died<sup>8</sup> I have had no fit of the stone (his mortall distemper if I mistake not) this eight yeares. I enjoy my health indifferently well, I prayse God for all. and whereas he was forced (through the envy of some disingenuous spitefull persons, and the designes of avaritious favorites) to quit his Country and Observatory, before he had perfected any parte of his labors; I continue in this, have brought my labors to greater perfection, and doubt not through the blessing of God (With her Majesties and his Royall Highnesses favor, and the encoragement of some of our eminent and learned Nobility) to see a large and compleat catalogue of about 3000 fixed stars, with chartes of all the Constellations here visible (and perhaps of the southern too, if God bless the labors of a freind<sup>9</sup> now in the East Indies with success) together with New both Solar and Lunar Tables, and some other Tracts, published dureing my life and in convenient time. whereas what Tycho left fell into the hands of his executors and was not published till some yeares after his death<sup>10</sup>.

My New Catalogue will shew not only the Longitudes and Latitudes of all the stars, but also their Right Ascentions and distances from the North Pole, and the Variations of the two last answering to one degree of Longitude. in every star. which will make the Tables serve for many future ages, and allwayes easy to be used by our Saylours: Tycho gave these variations onely in 100 principall stars, so that all the rest were of little use to any but to those that were versed in Astronomy, and knew how to calculate them.

The figures of the Constellations in Bayers Chartes<sup>11</sup> (from which all since him have copied and by which those on our globes are formed) are notoriously false, and No ways agree with Ptolemys Descriptions which Tycho and all betwixt him and Ptolemy follow: I have in my new Charts restored the Antient figures and made them so large that  $\frac{4}{10}$  of an Inch answer to one<sup>12</sup> degree of the Meridan and Equator, or 4 inches to every ten degrees; so that the declination of any star may be seen or found on the Chart, to the tenth parte of a degree, and its Right Ascention to about half a minute of time, by bare inspection; and that to any time either past or to come

If God of his goodness shall spare me life to see these publisht, I intend to make you a present of a copy or two, as an acknowledgment of the great obligation you have layd upon me: but least he should not, I doe earnestly entreat you to let me know what I can send you hence that may be acceptable to you I will procure and send it you as a present testimony of the esteeme I have of your guift which I cannot but thinke much more worth then any favor or kindness I shewd you when you honord me with your company here. together with Mr Hoadly<sup>13</sup>.

Your originall has on it an Inscription<sup>14</sup> and devise that shew the piety, firmness of mind, and love to his Country of Your Nobleman, at a time when he was forced from it by designeing Courtiers, that swayd a young King, and had not knowledge enough to understand how usefull his labors and expenses would be to posterity. They could not then Apprehend how far reall knowledge would be advanced by them, nor of what use they would be to our Navigators in the next Age; nor how much posterity would own themselves obliged to Denmarke, for the encouragement and supports King Frederick the 2d had afforded him; and therefore Tycho Never complains of his Country, and but modestly intimates the Injury they had done themselves, more then to him, in his Inscription; and professes his dependance upon providence which carried him to the Emperors Court where he lived died and was buried with greater honor then Denmark could afford him: some small writers<sup>15</sup> (or rather collectors of other mens Workes) have of late endeavored to lessen his Character, but to their own disadvantage; for they have onely made it evident to all the World, that they understand him now, as little as his detractors in the Danish Court did formerly: That sort of Authors are never easy but when they can say something that may depreciate the merit and reputation of those who have deserved the best of Mankind; The Noble Tychos Workes are like a Piramid (represented in the devise on his Picture) that will stand firm against the rage of winds and waves, and bring honor to his Country Denmark as long as their are Navigators on the seas, travellers on land, or Men of Reall Learneing and Science in the World. and as long as I live his picture shall owne that it was your gift and favor to Sir

Your thankfull obliged freind and humble servant

ADDRESS [from copy]

John Flamsteed M R

To Captaine Jueell at Copenhagen. Denmark

Annotations to Letter 911

FLAMSTEED TO JUELL

18 September 1703

Endorsed: 'Letter of Thanks to Capt Jueell for an Originall Picture of Tycho Brahe Sept 8. 1703.'

At RGO 1/33, f. 119<sup>v</sup>, is a copy in the hand of a rather incompetent amanuensis. The letter has been quoted and its context discussed in Frances Willmoth 'Models for the practice of astronomy: Flamsteed, Horrocks and Tycho', in *id.* ed., *Flamsteed's stars*, pp. 49-75, esp. 72-74.

1. Letter 878 (in vol. 2), not extant.

2. These two portraits of Tycho are now at the Bodleian Library, Oxford, and the Royal Society, respectively, as a result of a bequest by Margaret Flamsteed. The Bodleian complained that it had received the copy in place of the original, but Flamsteed's remarks below indicate that the portrait he took to be the original was the one with an inscription – which is now in the Bodleian.

3. Frederick IV, who ruled Denmark from 1699 to 1730.

4. 'A Hamburg merchant', according to a note by Flamsteed: RGO 1/56, f. 9<sup>r</sup>. Probably Francis Stratford, who transmitted goods and large sums of money to Sweden and Denmark on the Crown's behalf, and had links with Hamburg: *Calendar of treasury books* vols 17 (for 1702), pp. 39, 246, 275, and 18 (for 1703), p. 65.

5. The same note records its arrival on 8 June 1703.

6. A note of Flamsteed's (at RGO 1/56, f. 9<sup>r</sup>) says he handed the original painting to Mr Chamberlaine (probably one of Mrs Flamsteed's relatives) to be repaired by 'Walton and Clarett'. Peter Walton had succeeded his father as Keeper of the King's Pictures in 1700 and evidently carried on his father's business as a restorer; Wolfgang William Claret was a portrait-painter and copyist: Ellis Waterhouse, *The dictionary of 16th and 17th century British painters* (Woodbridge, 1988), pp. 290, 46.

7. Flamsteed probably drew this information from his copy of Pierre Gassendi, *Tychonis Brahei, equitis Dani, astronomorum coryphaei vita ...* (Paris, 1654): Forbes, 'Library ...', p. 127.

8. Tycho died on 24 Oct. 1601, at the age of 55.

9. James Pound.

10. The definitive version of Tycho's star catalogue appeared in Johannes Kepler, *Tabulae Rudolphinae* (Ulm, 1627); his observations were only published in Lucius Barretius *alias* Albert Curtz, ed., *Historia coelestis* (Augsburg, 1666).

11. Johann Bayer, *Uranometria, omnium asterisumorum continens schemata, nova methodo delineata, aereis laminis expressa* (Augsburg, 1603).

12. This word was substituted for 'every'.

13. Perhaps cleric John Hoadly or his brother Benjamin, mentioned in Letter 1320, 12 Aug. 1712.

14. Flamsteed's note at RGO 1/56, f. 9<sup>r</sup>, gives the inscription as: 'Effigies Tychonis Brahe Ottonis Dani Ætatis suae Anno 50 completo Quo post diutium in patria Exilium Libertati desideratae Divino provisue restitutus est'. That is, 'Portrait of the Danish [Otto], Tycho Brahe, at the end of the fiftieth year of his age. In which by divine providence he was restored to his much-desired freedom after a lengthy exile from his native land.'

15. Unidentified. Perhaps Flamsteed was thinking of French authors such as Eustache le Noble, whose *Uranie: ou les tables des philosophes* (Paris, 1698) found the Tychonic system more ingenious than probable. 'Part of a letter from the Reverend Mr Gourdon F.R.S. ... concerning ... the remains of the observatory of the famous Tycho Brahe' appeared in *Phil. Trans.*, 22 (No. ..., 1703), pp. 691-93, and said 'that the island Ween [Hven] ... was none of the fittest for Astronomical Observations'. But this seems too insubstantial to justify Flamsteed's comment.

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## FLAMSTEED TO SHARP

21 SEPTEMBER 1703

From the original in the Library of the Royal Society, London (MS. 798.13).

The Observatory Sept[ember] 21. 1703

Sir

Mr Stanfeild<sup>1</sup> brought me your kind letter on Saturday last<sup>2</sup> Your new married neice his wife<sup>3</sup> was with him but her brother<sup>4</sup> was not in their company. being retired as they told me into the country because he found himselfe not well in London. they had a couple of Londoners<sup>5</sup> in their company. and were at the dore as I was going to prayers had they come before dinner I could have shewed them much better then I did what respects I bear to you but at that time you know the Mayd governs with her brush mop and bucket if they were not enterteind as they expected I hope you will pardon me. for I was in some manner surprised by them.

You tell me you have put a diagonall scale on your Micrometer tis well done of what sort soever it be. for should the screw wear as it certainly will it cannot affect the Measures Numberd on your Scale. if you take them allwayes the same way I use allwayes to doe it closeing you may doe it opening if you please so you hold allwayes to the same method.

I have L'Hospitals book of fluxions<sup>6</sup> and have seen Carrè<sup>7</sup> who is no more then a continuator of him and not much esteemed nor are the fluxions much valued here since what is done by them may be done otherwayes by proper methods and the old geometry of which a many are wholly ignorant that are often boasteing and talkeing of fluxions They have their use and are not to be despised but the old geometry is not to be layd by for their sakes

Mr Hudson delivered your letter to Mr Ralphson who has promised to send you Dr Cheyny's book<sup>8</sup> I had sent you the Transaction<sup>9</sup> with it but that yours tells me you have it allready.

Mr Lowthorp is abridging or rather reduceing the matter of the Transactions under proper heads<sup>10</sup>. his Work is in the presse but he cannot get above a sheet finished per week. All the Mathematicks will be put together. he is an able man. has a good pen. a clear head and I hope will performe to expectation. sometime since Mr Ditton promised to doe as much for the Acta Curiosa<sup>11</sup> and Leipsick Acta<sup>12</sup> he is the better Mathematician. but I feare the Worke is too heavy for him<sup>13</sup>

Jupiter is now observable in the evenings I shall take care of his satellits. if you will look after them sometimes we may perhaps change some notes that may tell us how far little Horton is removed from the Meridian of the Observatory.

I am busy copying some Meane Motions of the luminarys from Tables Made by Mr Jacobs<sup>14</sup> of Lisbon I corresponded with him when you lived with me<sup>15</sup>. he is now dead. he makes use of the Caroline Lunar Hypothesis<sup>16</sup> and does no more then apply some Corrections to Streets Numbers you may expect a further account of him If I meet with any thing worth Imparteing from Sir

Your reall freind and humble servant  
John Flamsteed M R

I enjoy my health pretty well I bless God for it and wish you yours.

#### ADDRESS

None [cover lost]

#### Annotations to Letter 912

#### FLAMSTEED TO SHARP

21 September 1703

1. Robert Stansfield: see postscript to Letter 909, 4 Sept. 1703.
2. 18 September.
3. Elizabeth Stansfield.
4. John Sharp.
5. Unidentified.
6. Guillaume François de l'Hospital [later written as l'Hôpital], *Analyse des infiniment petits pour l'intelligence des lignes courbes* (Paris, 1696).
7. Louis Carré, *Méthode pour la mesure des surfaces, la dimension des solides, leurs centres de pesanteur, de percussion et d'oscillation, par l'application du calcul intégral* (Paris, 1700).
8. George Cheyne, *Fluxionem methodus inversa* (London, 1703).
9. That is, 'the Transaction wherin is Mr Ditton's discourse of Tangents': No. 284, for Mar.-Apr. 1703, containing Humphrey Ditton's 'De Curvarum Tangentibus e Maximorum ac Minimorum Theoria immediate deductis...' at pp. 1333-45.
10. John Lowthorp, *The philosophical transactions and collections, to the end of the year 1700. Abridg'd and dispos'd under general heads*, 3 vols (London, 1705).
11. *Miscellanea curiosa, sive ephemeridum medico-physicarum Germanicarum Academiae* covered 1670-1705 in numerous volumes published at Frankfurt 1684-1706, then continued as *Academiae Caesareae Leopoldinae naturae curiosorum ephemerides*.

12. That is, *Acta eruditorum Lipsiae*, published from 1682 onwards.
13. No such publication appeared.
14. Henry Jacob(s) (fl. 1673-1688) is listed as resident at Lisbon in 1673 and 1686: S. George West, 'Members of the Lisbon "Factory" in the late seventeenth century', *Annual report ... of the Historical Association, Lisbon Branch* (1954), pp. 706, 707.
15. See Letters 598a, 5 July 1688, and 600, 7/17 Sept. 1688 (both in vol. 2).
16. That is, Thomas Streete's, as embodied in his *Astronomia Carolina, or a new theory of the coelestial motions ...* (London, 1661).

913

## DERHAM TO FLAMSTEED

29 SEPTEMBER 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/36, ff. 130<sup>r</sup>-131<sup>r</sup>).

Upminster ∅ [Wednesday] Sep[tember] 29. 1703.

Sir

Yours of Sept. 11<sup>1</sup> (which was not come to my hands when I saw you in London) I found at Rumford<sup>2</sup> that evening in my return, with one from Mr Towneley. Mr Towneley's was chiefly about some errors in some Rain-Tables he formerly sent me. But there was one thing worth your knowing, if you have not already heard it, viz That Mr Adams<sup>3</sup> told him, 'Twas his opinion; "that Saxton's Mapps<sup>4</sup> (from whence Mr Towneley thinks Speed's<sup>5</sup> were drawn) "have not misplaced any place in England above a Mile either in Longitude or Latitude<sup>6</sup>.

As to your Letter, I give you many thanks for it. But because you promised me the Declina[tion], etc of the Solar Spots, when you should hear of my receipt of your Letter, and now despairing to see you here by reason of the foul weather, I therefore give you this trouble to beg the favour of the performance of your promise: and also that you will send me the Proportions of the distances of the Planets, which I desired of you in my last: to enable me to make my self a good Scheme, or rather Instrument, of the Solar Systeme.

I have since I last wrote to you<sup>7</sup> been diligent in my Observations of the Circumjovial-Eclipses. But by reason of ill weather, have not been able to make but one good Observation, which was the Emersion of the 3d Satel. Sep: 22. It emerged at 8<sup>h</sup>. 9'. 53" A.T. The Latitude of the Satel. is greater than you make it in Phil: Trans: Nr 178<sup>8</sup>. I had no Instr[umen]t to measure it, but I traced the Satel. from the Shadow to the very body of ♃: and it seemed to but just pass under the northern Limb of ♃. as in this Figure

That evening I observed also the time of Lucida Aquilae transiting my Meridian-Instrument: but I have mislaid it, and cannot with all my search find my note of it. Which I am sorry for, because you might thereby have



been able to judge the truth or error of my Instrument, and of my Observations determined thereby. I remember I calculated the time of it's Transit, which agreed with my Observation within a few seconds of Time. I intend this Night to sit up to see the Immers. and Emers. of the 3d Satellite, if it be fair, and will take notice of some Fixt Star's transiting the Meridian by my Instr[umen]t. I wish I had for this purpose the Declina[ti]on, and R. Asc. of a few more of the brightest Fixt Stars between the Tropicks, with their Variations. I shall take it as a great encrease of your favours, if you will give Mr Weston<sup>9</sup> your leave and order to copy me some, as Regel, that in Orion's left Shoulder, Procyon, Cor Hydrae, Spica  $\mathfrak{M}$ , the brightest in  $\Omega$ , the northern in  $\mathfrak{M}$ , forehead, Fomalhaut (altho' out of the Tropicks) and the Northern in the Whale's<sup>10</sup> Tail, and that in his Jaw. But if you think I ask too many, or too much trouble, moderate me as you please.

You were pleased to promise to lend me Horox's works<sup>11</sup>, to copy the Cuts by, as also Huygens Systema Saturnium<sup>12</sup>. I desire you will order them to be left for me at Mr Knapton's Bookseller at the Crown in S. Pauls Church-yard<sup>13</sup>, who will with most safety send them to me. I will take [...] use them with all safety, and send them to you by my servant in no long time afterwards. My humble service to your Lady. I am

Sir Your very affectionate Br[other] and humble servant  
Wm Derham

#### ADDRESS

To the Reverend Mr Flamsteed at the Royal Observatory near Greenwich.

#### Annotations to Letter 913

#### DERHAM TO FLAMSTEED

29 September 1703

Near the address Flamsteed wrote: 'Mr Derham Sept 29 1703'. On the blank verso of the letter itself are '1703 Sept 22.09.' and a few lines of mathematical calculation, also in Flamsteed's hand.

1. Letter 910, not extant.
2. Romford, Essex, on Derham's route back to Upminster.
3. The surveyor John Adams.
4. Christopher Saxton compiled 35 maps of the English and Welsh counties during 1574-79 and published a national map in 1585. His county maps were reissued several times during the seventeenth century, with the collective title *The shires of England and Wales*.
5. The 67 plates for John Speed's *The theatre of the empire of Great Britaine* (1611 and many later editions) were compiled and engraved during c.1603-11.
6. Derham placed quotation marks before 'have' and in the margin before 'in', rather than supplying any at the end of the quotation.
7. No earlier letter survives.

8. 15, No. 178 (for Dec. 1685), pp. 1262-65, contains Flamsteed's 'description and uses' of his instrument for finding the positions of Jupiter's satellites: see Letters 548 and 549 (in vol. 2).

9. Thomas Weston, Flamsteed's assistant.

10. Here 'Jaw, and th' is deleted.

11. John Wallis, ed., *Jeremiae Horroccii ... opera posthuma* (London, 1673).

12. Christiaan Huygens, *Systema Saturnium* (The Hague, 1659).

13. James Knapton, a well-known bookseller-publisher, traded at this address 1687-1738.

914

## EIMMART TO FLAMSTEED

24 OCTOBER 1703

From the original in the Russian National Library (Rossiiskaia Natsional'naiia Biblioteka), St Petersburg (N.998, Tome 2, p. 72).

- Illustriss. etc.

Paucis hisce lineolis gravissimas occupationes tuas interpellanti ausum dedit Nobiliss. D. Doppelmayr<sup>1</sup>, arcta affinitate ut et suavissima conversatione singulariter mihi junctus: Tanti autem faciliorem intempestivitate abs te veniam mihi promitto, quanto prolixius et confidentius eximia humanitas tua, ab eodem haud ita pridem ex Anglijs reduce<sup>2</sup>, erga me celebrata fuit; Hac etiam fretus specimen Astronomicum in translatione operis Conterranei vestri Thome Stretij, cuius Astron: Carol:<sup>3</sup> latinitate docuerit<sup>4</sup> censurae vestrae submittit, quo labore, scil[icet], haud vulgarem gratiam apud nostros (uti auguror) ita haud locum applausum apud nostros optime ni fallor increvitur. Caeterum memini me ante plurantes annos literas<sup>5</sup> ad te submississe, observationem phaenomeni annui coelestis<sup>6</sup> continentes, an autem ad manus perlatae fuerit, valde dubito, cum nihil hactenus de iis rescire potuerim. Opportunum jam esset hisce nonnihil de rebus sideralibus annectere, praecipue de transitu elapsa aestate maculae per discum solarem, quam etiam mihi cum aliis haec loci videre contigit, verum ob infirmitatem meam et inclementiam caeli circa hoc phaenomenon nihil solidi observatae licuit. Projectio mea corporis solaris, quam ante triennium sub titulo Ichnographia<sup>7</sup> peredidi ex actis Eruditorum Lipsiensibus<sup>8</sup> fortasse innotuit, super qua exactissimi vestri iudicij censuram cognoscere<sup>9</sup>, aveo; interea, quicquid a me ad aestimationem famae tuae proficisci poterit, omni studio in id intendet

Celebritati Nominis Tui addictissime cultor

Die 24. Oct. 1703

**Translation of Letter 914**

EIMMART TO FLAMSTEED

24 October 1703

Most illustrious, etc.

The most noble Doppelmayr<sup>1</sup>, an associate with whom I share a particularly close affinity and most pleasant discourse, has given me the courage to interrupt your weighty pursuits with these few lines. Moreover, I promise myself a readier pardon from you for [such] untimeliness, since your great kindness was praised to me at length and confidently by the same [friend], on his return from England not very long ago<sup>2</sup>. Relying on this, he is submitting to your scrutiny an astronomical specimen in the form of a translation of the work of your fellow-countryman Thomas Streete, whose *Astronomia Carolina*<sup>3</sup> he has exhibited in Latin<sup>4</sup>. For this work (as I predict) he will receive no mean thanks from our people, so greatly has interest in this celebrated subject increased amongst them, if I am not mistaken. For the rest, I remember that several years ago I sent you a letter<sup>5</sup> containing an observation of a celestial phenomenon of that year<sup>6</sup>, but I very much doubt whether it ever reached your hands, since I have as yet been unable to find out anything about it. It would have been opportune to have appended something about sidereal matters to this, in particular about the passage of a spot across the solar disc last summer, which I happened to see along with others here; but because of my illness and an unfavourable sky I was not able to make any reliable observation of this phenomenon. My projection of the solar body, which I published three years ago under the title 'Ichnographia'<sup>7</sup>, has perhaps come to your notice through the learned transactions of Leipzig<sup>8</sup>. I long to know the result of your most precise judgment upon it<sup>9</sup>: but in the meantime whatever I can do to enhance the valuation of your fame, to that I shall direct all my efforts.

A most devoted worshipper of your celebrated name

24 October 1703

## Annotations to Letter 914

EIMMART TO FLAMSTEED

24 October 1703

1. Johann Gabriel Doppelmayr, mathematician and astronomer, played a leading role in providing his German compatriots with information about developments in England, France and Holland during the first half of the eighteenth century.

2. He had left Germany in Sept. 1700, travelling to Leyden, Oxford, London and elsewhere over the following two years. The exact dates of these visits are not recorded, but it is possible that was the unnamed 'Gentleman from Prussia' admitted to a Royal Society meeting on 26 Mar. 1701 (Journal Book 1702-14, JBC X).

3. Published in London in 1661 with an apparently identical second issue in 1663; originally in English with the exception of its title.

4. *Astronomia Carolina; ... quam transtulit J. G. Dopplelmayr ... et ... addidit Tabulas Rudolphinas a J. B. Morino ... in facile compendium redactas* (Nuremberg, 1705).

5. See Letter 631, 14/24 Jan. 1690/1 (in vol. 2).

6. A transit of Mercury.

7. *Ichnographia nova contemplationum de sole, in defolatis antiquorum philosophorum ruderibus concepta a Georgio Christophoro Eimmarto* (Nuremberg, 1701); Poggendorf and the *Allgemeine Deutsche Biographie* attribute it to his daughter, Maria Clara Eimmart.

8. It is reviewed in *Acta eruditorum Lipsiae* [vol. 20] (1701), pp. 387-93.

9. Flamsteed kept no record of any reply.

915

## FLAMSTEED TO LISTER

28 OCTOBER 1703

From the original in the Bodleian Library, Oxford (MS. Lister 37, f. 75<sup>r</sup>).

The Observatory Octob[er] 28. 1703

Sir

I beg the favor of you to acquaint me when you shall be in London next. that I may waite upon you as soon as you arrive and have one half hours discourse with you<sup>1</sup> For having drawn large mapps of the Constellations I would shew you some of them and have your advise both how to procure a few of them curiously copied and likewise your estimate of the Charge of the plates and work for engraveing them. which will be no difficult thinge for you to give when you have seen them.

I have endeavord to procure a good draughts man from London to copy a Couple of figures on the Mapps I have prepared, One<sup>2</sup> promised me to come down hither but our Globe makers in London being told by him that I desired such a thing. have dissuaded him, to force me to send my Charts to London *where they might copy them* and I doubt not but they would *in spite of any engagement of the draughts man*. You are very well acquainted with that sort of Workmen and I hope on the account of our former acquaintance you will not refuse me the favor I request. Onely I desire that you would let me know of your next coming to town and where I may meet you and at what hour God spareing your health.

I have hopes to gaine the places also of the southern Fixed stars by the help of Mr Pownd<sup>3</sup> who has good Instruments of my Contrivance<sup>4</sup> with him and is like to settle on an Island much more convenient then St Helena<sup>5</sup> for this business. he is a sober man an Excellent scholar<sup>6</sup> skillfull in Physick and the abstrusest parts of mathematick[s] and Moreover works well in Brass or Iron. he is chapla[in] to a factory<sup>7</sup> and I thinke 2d in their Councill so that having both a temper skill

and authority and being m[ore]over a very sincere and honest man I have hopes his endeavors will meet with all the successes that others of a different character wanted. this news is all the satisfac[tion] I can make you at present for the trouble given you by this from

Your affectionate and humble servant  
John Flamsteed

My service to Madam Lister. if my wife had been at home I must have presented hers to you both.

I desire you not to let it be known that You have this letter from me You may burne it I shall give you my reason for this request when I have the happiness to see you

#### ADDRESS

To Dr Martin Lister Physitian to her Majesties at his house in Ebsham these present. Epsam in Surry.

#### Annotations to Letter 915

#### FLAMSTEED TO LISTER

28 October 1703

1. Flamsteed had evidently received no reply from Lister to his letter of 8 July 1703 (Letter 906).
2. Unidentified. In November 1703 and April 1704, Flamsteed 'got some of the maps of the constellations to be anew delineated by P[aul] Vansomer, an excellent draughtsman, but in years: the charts being prepared by Mr Weston' (Baily, *Flamsteed*, p. 65, from RGO 1/35, f. 79).
3. James Pound, who was then in China.
4. The making of a quadrant for Pound is described in Letter 805, 23 Jan. 1699/1700; its receipt appears to have been acknowledged in Letter 941, 7 June 1704 [not extant].
5. Where Halley had made the observations for his *Catalogum stellarum australium sive supplementum catalogi Tychonici* (London, 1679), the first systematic printed catalogue of the southern stars.
6. He had studied at Hart Hall in Oxford, proceeding BA and MA in 1694, MB in 1697.
7. That is, to a trading settlement of the East India Company.

916

## FLAMSTEED TO WILLIAM LLOYD

1703 [BEFORE 18 NOVEMBER]

From the original in the National Library of Wales, Aberystwyth (MS 11547D).

My Lord

I receaved your sonnes<sup>1</sup> [...] horse to wait upon the Archbishop<sup>2</sup> at Lambeth. there I v[iewed] the Note in Calvisius<sup>3</sup> but had not time to enquire by wh[at] Tables he calculated his Eclipses nor what differenc[e of] Meridians he makes betwixt us and Jerusalem

The three following dayes I was obliged to spend in [...] about some affaires of my owne so that I had no leasure [to] calculate the proposed Eclipse till this morneing. when I fo[und] by my own correct Tables under the Meridian of Gree[nwich] (the sinus Viridis of the Romans.) Anno Christi 33 April 3

Lunar Eclipse began at	0 <sup>h</sup> . 50' pm.	
	2 . 16 <sup>6</sup> / <sub>10</sub>	digits then VII <sup>1</sup> / <sub>5</sub> on the [...] side of
	3 . 43	the Moon.

By observations of a lunar Eclipse taken at Aleppo in Syria Aug. 17/27. 1635 which you may see in Ricciolis Astronomia Reformata<sup>4</sup> pag. 102. the difference of Meridians between Aleppo and Paris is about 2<sup>h</sup>.22' therefore betwixt London and Aleppo near 2<sup>h</sup>.30'

Jerusalem lies to the West of the Meridian of Alepo at least 10' so that tis at most but 2<sup>h</sup>.20' betwixt our Meridian and that of Jerusalem where therefore

The begining of the Eclipse was at	3 <sup>h</sup> . 10'
The end at	6 . 03

The sun set that day at Jerusalem at 6<sup>h</sup>.11' so that the Ecli[pse] was wholly over before the Moon rose.

I am apt to thinke Calvisius made the difference of Meridians about an hour more then it really is for some of our old Mapps represent it so; and if it really were so, the end might have been seen at Jerusalem.

I hope this account is full to what your Lordship desires if not You may please to let me know your further commands, if God spare me health I shall endeavor to answer them with the first opportunity hoping you will excuse the unavoydable delay of this and pardon him for it who is with all due respect.

Your Lordships most humble servant  
John Flamsteed M R

ADDRESS

To The Reverend Mr. Lloyd.



Pray excuse my putting you to all this Trouble and believ it will be well placed on the Churches account, besides that you very much oblige

Your assured Friend and Servant  
W Worcester

By your account the Eclips was quite over 8 minuts before the Sun went down But by my reckoning it ought to be Visible at Jerusalem some minutes after sun-set. I hope you will finde it so upon farther Consideration. And you will think of more for it your self then what I offer in the enclosed There is none I know but your self whom I can consult on this Occasion

### Enclosure in Letter 917

WILLIAM LLOYD TO FLAMSTEED

18 November 1703

Calvisij Chronolog: Isag:<sup>7</sup> c. 49. p. 167. lin. 4 a f.

die tertio Apr. hora sexta vespertina, Luna oriente, et Christo jam e cruce deposito, et sepulto, praeter illam Eclipsin praeternaturalem etiam Eclipsis Lunae naturalis accidit.

Id. Chronolog. A.M. 3982 Post +um 33. p. 438.

Eclipsis etiam Lunaris accidit eodem die, cum Luna vesperi oriretur. Latitudo vera australis 36.21. semidiameter Lunae 16.16. summa semidiametrorum 59.20. scrupula residua 23.0. digiti Ecliptici 8.29. facta est Hierosolymis horis 5.49. post meridiem, cum paulo post Luna oriretur.

Lamy in Apparatu Chronologico ad Harmon. Evang.<sup>8</sup> (a Mathematico Parisiensis Joh. le Febvre, ut ipse agnoscit p. 54) ait p. 117. Plenilunium contigit hâc sextâ feriâ, horâ quintâ vespertinâ cum quinquaginta minutis<sup>9</sup>. Tunc temporis Luna Eclipsium digitorum sex cum tertiâ parte digiti passa est.

Ib. p. 124. Lunarem vero defectionem laudatus saepius Astronom., cum alijs compluribus Astronomis, deprehendit suis exquisitis calculis.

Hardouin de supremo Christi Paschate<sup>10</sup>.

p. 22. anno 33. Plenilunium expletum fuisse decimâ quintâ a jugo die<sup>11</sup>, quâ die Pascha ex lege peractum est, defectus Lunae patefecit, sub horam quartam pomeridianam iniens, desiniens post septimam, ut Grandamicus<sup>12</sup> noster observunt, pag. 189. ita ut Luna emergens ex umbrâ terrae, Hierosolymis conspiceretur post solis Occasum, feriâ sextâ, quâ Christus obiit.

p. 61 lin. 9. obscuratus est Sol Luc. 23.45. Luna quoque defectionem passa est, ab hora quarta usque ad septimam. Plenilunium horâ post meridiem quartâ 24'.29". ese Grandamico.

p. 70. lin. 7. a fine. Nunc annus 32 proponendus est, ex veris motibus, verisque conjunctionibus Lunae cum Sole: quas accepimus a P. Gouye<sup>13</sup>, in hoc Ludovici Magni Collegio<sup>14</sup> Mathematicarum artium Professore ad Meridianum Parisiensem aptatas. Has autem ut meridiano Hierosolymitano accomodaremus, singulis adjecimus horas 2. 3[8<sup>15</sup>]. min. Horas a media nocte computamus.

Ptolemy in his Geography <sup>16</sup> has the Longitudes	gr
of Jerusalem - - - -	66. 0
of London - - - - -	20. 0
	The Difference
	<u>46. 0</u>
The Horary distance between them is	<u>3<sup>h</sup>. 4'</u>
Adde these to the Numbers in your Calculation	
and so the Beginning of this Eclips will be	3 <sup>h</sup> . 54'
the Middle - - - - -	5 <sup>h</sup> . 20 <sup>6</sup> / <sub>10</sub> [..]36"
the End	6 <sup>h</sup> . 47'.
	gr ' "
Ricciolus <sup>17</sup> places his first Meridian at Palma	63. 37 <sup>18</sup>
	<u>22. 30</u>
from thence he accounts the Longitudes of Jerusalem	<u>41. 7</u>
of London	<u>2<sup>h</sup>. 44'. 28"</u>
the Difference between them	
the Horary Distance	3 <sup>h</sup> . 34'. 28"
Adde these to your Numbers	5 <sup>h</sup> . 1'. 4"
the Beginning will be	6 <sup>h</sup> . 27'. 28"
the middle	
the End	2 <sup>h</sup> . 22'
You make the Differences to be as follows	<u>0. 8'</u>
between Aleppo and Paris	2. 30
betw Paris and London	10' at least
therefore betwe. Alep and London	2 <sup>h</sup> . 20'
Again betw Jerus and Aleppo	
subduct these from 2 <sup>h</sup> .30'. - rem	
Hence you conclude that this	2 <sup>h</sup> . 12' which is 26' short
2h.20' is the distance between Jerus. and L.	of Harduin
Then deducting 10' the distance between Jerus and Paris will be	1.380 compared with
that betw. Paris and London is 14' appears	1.743.
by 2 Observations in Ricciol. Almag.	
Ptol. has Beroea in	77 <sup>gr</sup>
and Jerusalem in	<u>66</u>
so the distance is	5 which requires 20 minutes

Ricciol. Alm.<sup>19</sup> VIII.30 saies the Long. of Aleppo in his account cannot be minor quam<sup>20</sup> 67<sup>gr</sup>.6' his Astron. Ref.<sup>21</sup> p. 102 has but that one single Eclips upon which the Judgement is made by 2 Observations 1 at Aleppo and the other at Paris

**Translation of first part of enclosure in Letter 917**

WILLIAM LLOYD TO FLAMSTEED

18 November 1703

In the *Chronologica Isagoge* of Calvisius<sup>7</sup>, ch. 49, p. 167, line 4 from the end.

on the third day of April at the sixth evening hour, with the moon rising, and Christ having been taken down from the cross and buried, besides that supernatural eclipse a natural eclipse of the moon happened.

The same, *Chronolog.* A.M. 3982 A.D. 33, p. 438.

A lunar eclipse also happened on the same day, when the moon was rising in the evening. The true latitude 36.21 south, semidiameter of the moon 16.16, total of semidiameters 59.20, residual seconds 23.0, digits of the eclipse 8.29. It was experienced at Jerusalem at the hour of 5.49. p.m., shortly after the moon rose.

Lamy in *Apparatu Chronologico ad Harmon. Evang.*<sup>8</sup> (taken from the Parisian mathematician Joh. le Febvre, as he himself acknowledges on p. 54) says on p. 117: The full moon happened on that sixth rest-day, at the fifth hour in the evening plus fifty minutes<sup>9</sup>. At that time the moon suffered an eclipse of six digits plus a third part of a digit.

*Ibid.* p. 124. An often-praised astronomer, in company with many other astronomers, has established, through his accurate calculations, that there was a lunar eclipse.

Hardouin *De supremo Christi Paschate*<sup>10</sup>.

p. 22. In the year 33. the moon having reached the full on the fifteenth day from the start of the month<sup>11</sup>, on which day by law the Passover was kept, an eclipse of the moon was apparent, beginning during the fourth hour after noon, ending after the seventh, as our Grandamicus<sup>12</sup> observed, pag. 189, so that the moon emerging from the earth's shadow, it was visible at Jerusalem after the sun's setting, on the sixth day, on which Christ died.

p. 61 line 9. The sun was obscured. Luke. 23.45. The moon also suffered an eclipse, from the fourth hour until the seventh. The full moon was at the fourth hour p.m. at 24'.29", according to Grandamicus.

p. 70, line 7 from the end. The year 32 is now to be related, with respect to the true motions and true conjunctions of the moon with the sun, which we have been given adjusted to the meridian of Paris by P. Gouye<sup>13</sup>, Professor of the mathematical arts in this College of Louis the Great<sup>14</sup>. However, in order to adapt these to the meridian of Jerusalem, we add on each occasion 2 hours 3[8] minutes. We compute the hours from midnight.

## ADDRESS

For my worthy Friend Mr Flamstead at her Majesties Observatory at Greenwich

Annotations to Letter 917  
 WILLIAM LLOYD TO FLAMSTEED  
 18 November 1703

The underlining of phrases in the enclosure was added by Flamsteed, so has been reproduced here as underlining rather than italics.

1. The results were sent in Letter 916, 1703 [before 18 November].
2. '+<sup>i</sup>' is the writer's abbreviation for 'Christi', using 'Anno Christi' as equivalent to 'Anno Domini'.
3. Probably his *Chronologia universalis*, which was printed in part but never published. A. Tindal Hart, *William Lloyd, 1627-1717* (London, 1952), pp. 232-38, discusses the Bishop's writings at this period.
4. See the enclosure, transcribed below, for identifications of these works.
5. Letter 916, which survives but lacks a date.
6. The younger William Lloyd was at this period Rector of Sunningwell, Berkshire, but evidently did not reside there.
7. Sethus Calvisius, *Opus chronologicum ex autoritate s. scripturae ... contextum ... Cui prae-missa est Isagoge chronologica* (several editions; Poggendorf gives the first as at Leipzig, 1605).
8. Bernard Lamy, *Apparatus chronologicus et geographicus, ad commentarium in Harmoniam sive concordiam quatuor evangelistarum* (Paris, 1699).
9. Here Lloyd has added in the margin: '+<sup>i</sup> 33. Apr. 3 ♀'.
10. Jean Hardouin, *De supremo Christi Domini Paschate* (Paris, 1693).
11. In the ancient Jewish calendar, the Passover was observed on the 14th day of the month of Nisan, which began with the first appearance of the new moon after the vernal equinox.
12. Jacques Grandami (1588-1672) taught mathematics at various Jesuit colleges. The reference is probably to his *Chronologia christiana*, 3 vols (Paris, 1668): *Biographie universelle*.
13. Thomas Gouye (1650-1725) taught mathematics at various Jesuit colleges and was a member of the Académie des Sciences from 1699; Poggendorf. The reference may be to his *Observations physiques et mathématiques pour servir à l'histoire naturelle et à la perfection de l'astronomie et de la géographie, envoyées de Siam ... par les P.P. Jésuites missionnaires*, 2 vols (Paris, 1688).
14. Here 'Clermont College.' is written in the margin.
15. The document is damaged here, but this digit appears to have been an 8 or a 9.
16. It is not clear which of the several editions of this work Lloyd used; Flamsteed apparently had a copy of Sebastian Munster's (Basel, 1540): Forbes, 'Library ...' p. 134.

17. See the last paragraph of the enclosure for identifications of two of his works.
18. Above this '67.31.30' was written and crossed through, with the note 'this is Brief'.
19. Giovanni Battista Riccioli, *Almagestum novum* (Bologna, 1651).
20. Translation: 'less than'.
21. Giovanni Battista Riccioli, *Astronomia reformata* (Bologna, 1665).

918

FLAMSTEED TO WILLIAM LLOYD

27 NOVEMBER 1703

From the original in private hands.

The Observatory Nov[ember] 27. 1703 5[Saturday]

My Lord

I received your Lordships of the 18th instant<sup>1</sup> on Mo[nday] as I was going to London and where I was obliged to spe[nd the] first days of the Week I had wrote an Answer to it to be sent by the Thursdays post but thro the hast of the peny post it could not be sent at that time. haveing gained leasure yest[er]day I calculated the Eclipse Xi 33 both by the Caroline<sup>2</sup> and Wings tables<sup>3</sup>.

by the Caroline it began at London	1 <sup>h</sup> . 22'. 29".	at Aleppo	3 <sup>h</sup> . 42'. 29"
its middle was	2 . 46 . 49		5 . 06 . 49
End	4 . 11 . 09	digits VII.13	6 . 31 . 09
But by Wings Brittanick Table began	0 . 44 . 56	at Aleppo	3 . 04 . 50
its middle	2 . 20 . 29	dig VIII <sup>1</sup> / <sub>6</sub>	4 . 40 . 29
end —	3 . 56 . 02		6 . 16 . 02

Mr Street fitted his Tables so as to represent the Ancient Babilonian and Egiptian Eclipses within one hour. he had assumed the place of the ☉ Apoge forwarder then he ought by at least 8 degrees which was the reason he could not present<sup>4</sup> some of the nearer. Wing. considered the same with the truer place of the ☉ Apoge which is the reason that the middle of the Eclipse by his Tables differs but 4 minutes of time from mine, yet tho his durations are much too big you see by his Numbers the eclipse ended imediately after the Moon rose. or perhaps before she was well up considering the effects of her parallaxes and therefore were I worthy to lay my advice before your Lordship it should be that you would not build much on the visibility of this eclipse.

The year of our saviors passion is also contested I hope your Lordship in your present worke<sup>5</sup> will give us more light then we have hitherto had

The difference of Meridians betweixt London and Paris is certainly more then 8 and not fully 9 minutes of time as I find by compareing many observations both of the Eclipses of the ☽ and Jupiters satellits

If you examine Mr Gellibrands observations of the Lunar Eclipse<sup>6</sup> that makes it 14' over againe you will see a great fault committed in them, which he has given us nothing whereby to rectifie it.

All the Observations of Eclipses brought from the Mediterranean make it shorter by Much then it has been hitherto made in our Mapps. Geography was in its Infancy in Ptolemys Time. and therefore I wonder he errs no more then he does. The Naturall motion of the Waters as Vossius<sup>7</sup> well observes is after the sun from East to West. which thereby retards the Motion of the ships that sayle easterly and makes them account more leagues Easterly then they have really run. thus the Mediterranean probably came to be layd of longer then it really is and thus the Coast of the East Indies 8. 10. 12. or 14<sup>d</sup>. further of from us then by late observations I find they really are. I hope in a little time to get More light concerning Aleppo which being once well stated. the Longitude of Jerusalem may be pretty well deduced from it by the help of our Mapps. at present I suspect I have rather. made it more then less then it ought to be:

One Mr Newman<sup>8</sup> a very learned man of my neighbourhood dead 15 yeares agoe gave me some Notes he had Collected in Reading (I think the Roman Itinerarys) wherein he found Greenwich to be the *Sinus viridis* Deptford the *Cliva* of the Romans I know not where to find them at Present but when I meet with these Notes againe I shall take care to give your Lordship a further account

I am obliged to your Lordship for giving me this opportunity of serveing you on so excellent an occasion. if your Lordship have any further occasion to make use of my paines please to doe it freely I shall be glad to let you see that I am ever

Your Lordships most dutifull and humble servant  
John Flamsteed M R

#### ADDRESS

To the Right Reverend The Lord Bishop of Worcester at his house in Oxford these humbly present. Oxford.

#### Annotations to Letter 918

#### FLAMSTEED TO WILLIAM LLOYD

27 November 1703

1. Letter 917.

2. Thomas Streete, *Astronomia Carolina, or a new theory of the coelestial motions, with exact and most easy tables and rules for the calculation of eclipses* (London, 1661).

3. Vincent Wing's, presumably as found in his *Astronomia Britannica* (London 1669).

4. These two words are an interlineation over 'represent'.

5. Probably his *Chronologia universalis*, which was printed in part but never published.

6. Source unidentified; Henry Gellibrand wrote a number of books on maths and navigation.

7. Isaac Vossius, *De motu marium et ventorum liber* (The Hague, 1663).

8. Unidentified. Possibly John Newman, Head Master of Colfe's Grammar School, Lewisham, from 1677 to his death in 1687 (Venn, *Alum. Cant.*).

919

## SHARP TO FLAMSTEED

7 DECEMBER 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/34, f. 28').

Sir

I am very sensible of your excessive tho unmerited civility to my Relations<sup>1</sup> when with you, upon which, instead of making any compensation, am still likely further to trespasse, yea<sup>2</sup> find my self (to my no little regrett) exceedingly deficient in what may have any tendency to gratify you, I have not been negligent in attending and observing the Satellit Ecclipses<sup>3</sup> as often as there appeared any probability, but have been extreamply unfortunate chiefly by the badness of the weather, there scarce having been one clear day<sup>4</sup> here since I rec[eive]d your last, but for most part close dark rainy or stormy; so that have but obtaind two tolerable observations, amongst many attempts Vizt November<sup>5</sup> 3<sup>d</sup> 11<sup>h</sup> 1' 20" and November 12<sup>d</sup> 7<sup>h</sup> 24' 10" the first Sat: emerged; though I have waited and hoped for more ere I was willing to transmitt these, yet am forc'd to sitt down under a dissappointment, and which is worse the fears of your displeasure and your denyall (as not worth your labour) of another Catalogue of their Ecclipses for the ensuing year, since I have made so sorry an improvement of this, but if I could render you sensible of the many inconveniences I labour under and the pains I have taken allready, and still must, ere I can remove them, my excuse would more easily be admitted; the last year 4 run not so high but I could without much difficulty observe him within doors at a Casement, but this year he is got quite above my reach, so that I have been constrained to attend him without, for some time had the convenience of resting my Telescope on some old apple trees in an adjoining Orchard, by help of which I made a tolerable shift, but since, my Nephew after his return from Leyden<sup>6</sup>, designing to bring the Garden into better order, has cutt all down, so that I have been forc'd to contrive and make a large tripod or 3 leggd Staffe about 8 or 9 foot high, of strength sufficient to support the Tube I use, which is 16 Ftt, by which I can raise and turn it with little trouble, but have not yett a screw frame wheron to rest the other end which cannot procure here, but must be forced to make, other conveniencys I could propose to my self and shall not grudge the labour and charge, provided I may still retain your favour and you be pleased to impart another Table for next year, without which all will be to no purpose.

I am very glad so ingenious a Person has undertaken to abreviate or new methodize the Transactions<sup>7</sup> a work I have long desird and hope may sometime possess to supply my want. Mr Dittons undertaking<sup>8</sup> will be no lesse acceptable; yea rather more, since those tracts are in fewer hands and some in forreign languages; If he accomplish it, twill be very valuable. These Mr

Hodgson has given me account of, and with all (for which I am sorry) that Mr Dittons treatise of Fluxions<sup>9</sup> is laid aside, to compensate which he writes Mr D Moivre designs to publish a piece of that nature<sup>10</sup>, which I question will be preferable to any thing of that kind yet extant. Nothing further at present occurs<sup>11</sup> worth your notice, but that your health may be confirm'd and continued and your affairs succeeded is the hearty desire of

Sir Your most obliged humble Servant

Horton December<sup>12</sup> 7<sup>o</sup> 1703

Abr. Sharp

Though yow may not have Observd the same emersions with these 2 above as is much to be feard since I retrievd them from the circumambient Clouds which in a short time after clos'd and obscurd 4 yet since I find their differences from your Table are nearly equall any of the Observations made since the opposition of 4 and 5 may suffice to give the difference of Meridians to a single minute or perhaps lesse

A S

#### ADDRESS

To the Reverend Mr Flamsteed M: R: at the Observatory in Greenwich-Park near London

Annotations to Letter 919

SHARP TO FLAMSTEED

7 December 1703

Published, without the postscript, in Cudworth, *Sharp*, pp. 74-75. Endorsed by Flamsteed: 'Mr Sharp. Dec 7. 1703 20.'

1. Sharp's niece Elizabeth and her husband Robert Stansfield; their visit is described by Flamsteed at the start of Letter 912, 21 Sept. 1703.
2. Here 'still' has been deleted.
3. That is, of the satellites of Jupiter.
4. Here 'and ni' has been deleted.
5. Written '9r', as is the next November also.
6. John Sharp was a student at Leyden from 1699; the exact date of his return is not known.
7. John Lowthorp, *The philosophical transactions and collections, to the end of the year 1700. Abridg'd and dispos'd under general heads*, 3 vols (London, 1705).
8. Letter 912, 21 Sept. 1703, mentioned that Ditton proposed to abridge the *Miscellanea curiosa, sive ephemeridum medico-physicarum Germanicarum Academiae* (Frankfurt, 1684-) and the *Acta eruditorum Lipsiae* (Leipzig, 1682-). The proposal was not carried out.
9. Humphrey Ditton, *An institution of fluxions: containing the first principles, the operations, with some of the uses and applications of that admirable method ...* (London, 1706 [1705]).

10. Abraham de Moivre, *Animadversiones in D. Cheyneri tractatum de fluxionum methodo inversa* (1704).

11. Here 'further' has been deleted.

12. Written 'Xr'.

920

## FLAMSTEED TO WOOLLEY

9 DECEMBER 1703

Mentioned in Letter 930, 3 January 1703/4, as having reached the hands of the writer of that letter, John Gisborne.

921

## BRATTLE TO FLAMSTEED

15 DECEMBER 1703

From the original in the papers of the Royal Greenwich Observatory, at Cambridge University Library (RGO 1/36, ff. 106<sup>r</sup>-107<sup>v</sup>).

Boston in New England 15. December 1703.

Sir

In the year 1692 I did my self the honour to write to you twice. in my first which was of the 20th of July<sup>1</sup> I sent you some Observations I had made here of the Eclipse of the Moon which hapned the 17th of that month. and in my second which was of the 16th of February following<sup>2</sup> I gave you an Acco[un]t of the provision that both Mr Newman<sup>3</sup> (who was then at New Bristoll) and my self had made for a more accurate Observation of the Eclipse of the Moon which was on the 11th of January preceding, and what difficulties I underwent for that very end, and how we were both of us frustrated by not having so much as one clear sight of the Moon all that night. I also therein acquainted you with my intentions to Observe very diligently the Eclipse of the Sun the 23th of june next following, which according to my Calculation of it should be obscured 37 min[u]ts, tho our Almanacks said there would be none at all; but as I find by looking over my Journall, the Horizon was so over-clouded, that I could make no Observation, or tell whither there was any Eclipse here or not. Concerning the success of either of said letters I was not so happy as to have the least Account, till my dear and worthy friend Mr Henry Newman informed me by letter of the 18th of January 1695/6, that, as you told him you had rec[eive]d but one of my letters, to which you had made me a particul[e]r Answer, and put it into the hands of a N England man for Surer Conveyance, but I never rec[eive]d it. It is to the same kind and evermore Obliging Soul, that I am beholding for my information very lately concerning your good health, which I am very glad to heare of and pray God long to continue, and that you were pleas'd to

enquire after my welfare and would be glad of a correspondence with me, which has Reviv'd my drooping spirits, and is the true reason and occasion of my writing to you at this time, and presenting you with what Observations I have made here since the abovesaid As I remember I gave Mr Newman an Account of some of them heretofore, which were unfortunately lost by shipwreck. — Sir ever since my return from England Anno 1689 as well as for Sundry yeares before I went thither, I have made it my practice to Calculate all the Eclipses that have hapned here, and to transcribe them fair and at large in a book for that purpose, with the projections of all the Solar Eclipses and whereof afterwards, and either under or over against the said Calculations, to write down fairly my Observations when I was favoured with an oportunity, or what hindred when I did not. and looking over said Journal I find that clouds and foul weather have prevented my Observing of any of them (and particularly those notable ones which were in May and October 1696) Save those which I now transmit you, and two of the Moon, namely that on January the 1st 1694. and the 30th of Aug[ust] 1699, which hapning neare your Noon, must there fore be to you in England invisible. Yet although the Heavens have frown'd upon me formerly at so many times, they have been wondrous kind and smil'd upon me the 2 last Eclipses, to wit that of the Sun 29th<sup>4</sup> of last month and that of the Moon the 12th of this<sup>5</sup>. My Observations whereof namely that of the ☽, (for I question whither the ☾ one was visible with you) and of that of the Sun, in 1694 I think were so accurate, as that if they were observed either by your self or any of the Curious in Europe, they might almost Supersede all former or other Observations. I have together with my Observations of the 2 Solar Eclipses sent you also my projection of them according to your most Ingenious treatise of the Doctrine of the Sphere<sup>6</sup> (with the times and places of the principall appearances of the former) and a Synopsis of the Calculation of them from Wings tables<sup>7</sup>, whereby the harmony of the Severalle Methods might be seen at one View. I have, as I hinted before projected all the Solar Eclipses that ever I calculated, in said Journal, and the most difficult examples I could meet with of the Occultation (by the<sup>8</sup> moon) of the fixt stars, only for my pleasure, and to see their Agreement with Observations or Tabular Calculations, which I could easily have copied out and sent you for your examination, but these 2 having so near a reference to the Eclipses which I had Observed, I thought were not improper and might Suffice. Although I may not dissemble another main end I had in sending them, and that is as a tributary Acknowledgment, or an Offering of some part of that fruit which has Sprung from your Stock. I heartily Congratulate your happy discovery, and charitable publication of the abovesaid treatise, than which as I think I never understood any thing more perfectly, I am sure I never valued or was pleas'd with any thing more highly. It seems to me to have the same Advantages over the common Calculatory way, as the Specious Algebra of the Modern has over the Numeral of the Antients with respect both to its brevity, (facility) and perspecuity. for as in the Specious Algebra not only the whole process of the Operation is apparent, which is confounded in the Numeral; but an universall method is thereby shown whereby not only the present difficulty may be resolved, but innumerable other quaestions, by the speciall application of the Generall Solution as the nature of each quaestion requires: So by your way of projecting Eclipses not only every thing is livelily represented and to be seen as in a glass, but every thing else remaining the Same, the drawing only of New Paths will make it serve for any other places. but to return from whence