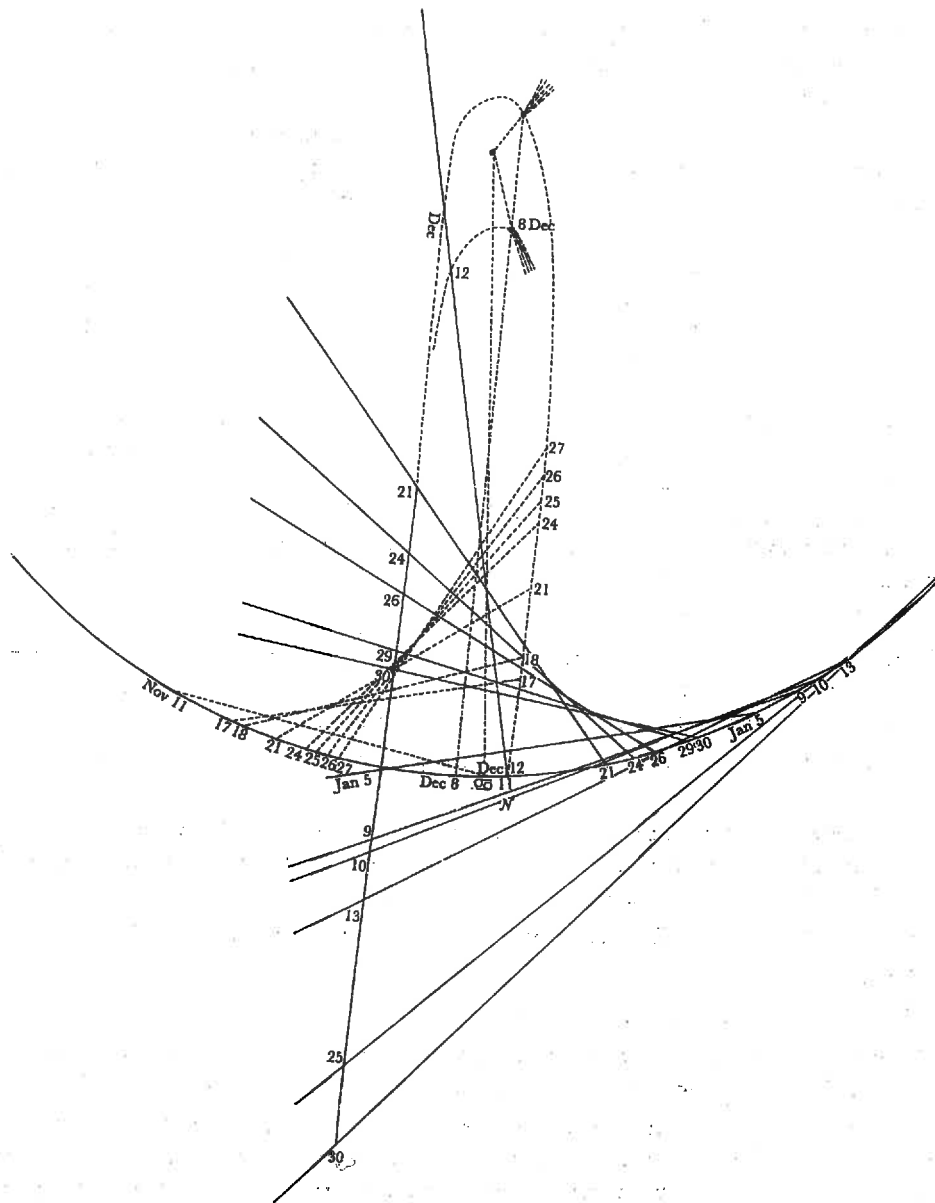


Figure by Flamsteed, enclosed with Letter 252



[In Flamsteed's handwriting:]

hæc figura vestigiij vice Cometicæ descripta fuit ab ipso tempore apparitionis et literis communicata cum Domino Crompton quibus responsa Domini Newtoni respiciant. (This map of the comet's path was described at the very moment of its appearance, and communicated in a letter to Mr Crompton, to which Newton's replies relate.)

255 NEWTON TO FLAMSTEED

16 APRIL 1681

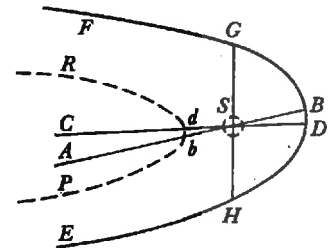
From the original⁽¹⁾ in the Bodleian Library.
In reply to Letter 252

Trin. Coll. Apr. 16. 1681.

Sr

Tis now almost thre weeks since upon my return⁽²⁾ from a journey I received yours. By some indisposition & other impediments I have deferred answering you longer then I intended. For I was desirous to return you quicker thanks for your kind communications. The complements you are pleased out of extream kindness to give me, might better have suited wth your self from me; nor do I think it suits wth me to judg of an Hypothesis after your thoughts upon it. I only propounded objections for you your self (if you had not thought on 'em before) to judge further of it by; wch therefore being designed only for your use I forbear to urge further & shall only speak to ye question of two Comets. The mistake about ye date of Pere Gallet's observations was in ye Copy I received of them. In ye title 'twas writ *Stylo veteri*, & accordingly the observations all but ye two last were altered from ye new style to ye old one & put November 17, 18, 21, 24, 25. Decem: 6, 7. And ye like alteration from ye new to ye old style had ye French Observations under them. I perceive ye Scholar in his observation of ye transit of ye Comet by Spica was mistaken in ye time. He recollected it only by circumstances & it seems told me Novemb 16 for Novemb. 19. In your argument from ye consent of elongations, if you estimate ye motion of ye Comet not in ye Ecliptick but in ye line of its proper motion (as I think should be done) you will find some difference⁽³⁾ between November & December. But that is not material, the apparent celerity depending on ye earth's distance from ye Comet at those times, & so whether equal or unequal being but accidental. You⁽⁴⁾ seem to incline to think the way of ye Comet wider then in your scheme⁽⁵⁾ & so do I for I apprehend ye Comet in Mr Halleys & your first observations Dec 8, 10, 11, 12 to have been remoter from us then ye ☉ & about Jan 2 to have been as far from ye ☉ as ye earth was & its Heliocentrick place yn to have been Π 9 degr wth north latitude 19 or 20 degr or thereabouts. But you are afraid the long tail will not admitt the Comets passing beyond ye ☉. I apprehend nothing from thence, for I am forced to beleive the tail extended beyond ye sphere of δ during ye whole appearance of ye Comet & so was long enough to appear in ye beginning of December as long as it did. Nor was the apparent length of it at that time any way enormous but consonant to ye law it observed all December. For ye tail all that month & (by my observation some days in

January) ended at a great circle wch cut the Ecliptick in $\uparrow 19\frac{1}{2}$ degrees at an angle of about 52 degr.⁽⁶⁾ Now if the December Comet was beyond ye \odot in ye beginning of December, the comets of November & December could hardly be ye same for this reason. Let EDF represent ye line ye Comet moved in, S the Sun, CD the axis of that line passing through ye Sun, D its vertex or Perihelion of ye Comet, and AB the plane of ye Ecliptick crossed by the axis in S . By contemplating ye figure you will perceive the Vertex or Perihelion D was on ye south side ye Ecliptick & consequently since the comet crost ye Ecliptick about ye 3d or at latest ye 4th of December it was in D a little before that time vizt above half a day before, for the angle DSB was about 6 or 8 degrees at least. But in conjunction wth ye Sun it was Decemb 9. So then in passing from D to conjunction there were scarce less



then six days spent. But in the Hypothesis the point D was opposite to ye earth about December 7 & consequently December 9 was so neare to opposition that is to conjunction wth ye \odot that the comet in passing thence to conjunction could not have spent many houres. Again drawing GSH perpendicular to CD , GS being equal to SH , the Comet should have had as much latitude in H as in G . In passing from conjunction to G it must have spent much more time then in passing from D to conjunction & consequently could not be in G before ye 12th day if so soon & so in G had 8 or 9 degrees⁽⁷⁾ north latitude at least, but in H by ye Roman observations as they are adapted to ye Hypothesis could not have above a degree south latitude.

If the comet turned short of ye \odot suppose in ye line PQR ,⁽⁸⁾ the difficulties are thereby something diminished, but I think not taken of. The point d or vertex of ye figure described by ye Comet was in conjunction wth ye \odot Decemb 7. The Comet in conjunction Decemb 9. Therefore, the comets conjunction happened on that side d towards b . The Comet was in b (the point where it crost ye Ecliptick) Decemb 3 or 4. Therefore it spent 5 or six days in passing from b to a point between b & d : wch space by the Hypothesis is yet so little that the comet could not spend many hours in passing it. And I think too the south latitude though it could not be so great as ye north, yet it ought to have been greater then ye Roman observations Novem 26 & 27 make it.

But what ever there be in these difficulties, this sways most with me that to make ye Comets of November & December but one is to make that one paradoxical. Did it go in such a bent line other comets would do ye like & yet no such thing was ever observed in them but rather the contrary. The comets of 1665, 1677 & others which moved towards ye Sun, or some of them at least, had they twisted about ye Sun & not proceeding on forward gone away behind him

they would have been seen again coming from him. The many wch have been seen advancing from the ☉, or some of them at least, would have been seen in the former part of their course advancing towards him, had that former part been performed, not in the line of the latter part shooting on backwards towards the regions beyond ye ☉ but twisting about him towards any hand. Those which were seen both before & after their perihelium's as the comets of 1472, 1556, 1580 & 1664 would not as they did, have begun in one part of the heavens & ended in ye opposite part, going through almost a semicircle wth motion first slow then swift then slow again as if done in a right line, had it been done in such a line as ye Hypothesis puts. Let but ye Comet of 1664 be considered⁽⁹⁾ where the observations were made by accurate men. This was seen long before its Perihelion & long after & all the while moved (by the consent of the best Astronomers) in a line almost straight. So neare was ye line to a straight one that Monsieur Auzout⁽¹⁰⁾ on supposition that 'twas an arch of a great circle about ye dog starr (as Cassini guessed and Auzout was afterward willing should be believed) or rather a straight one (as ye obviousness of ye Hypothesis, easiness of ye calculation, & number of observations on wch 'twas founded makes me suspect) did from thre observations predict the motion to ye end without very considerable error.

But you ask why the Comet of November staid so long in the same southern latitude if it turned not back? I am not satisfied that it did so. I fear twould be hard to warrant any of ye observations of that Comet to less then a degree & why then might it not have in the time of the Canterbury observation between one & two degrees north latitude, & afterwards crossing ye Ecliptick about ye beginning of ye Roman observations, as Gallet makes it, & from thence advancing continually southward, arrive to between one & two degrees of south latitude at ye end of the Roman.

Your observation of Decemb 12 by your last correction is become much more agreeable to ye phænomenon of ye tail then before & yet I fear is not altogether right. I suspect (if you are sure there was no error committed in taking its distance from Venus) that Venus had some minutes more longitude then in your reconning. In your observations last sent⁽¹¹⁾ ye comet Jan 10 is put in γ 20^d $42'$, in a former copy in γ 20^d $49'\frac{1}{2}$. That of γ 20^d $49'\frac{1}{2}$ seems to correspond best wth your other observations. The Parisian observations compared wth yours seem to have too much longitude.⁽¹²⁾ Namely December 29 by about $6'$, Jan 4 & 6 by about 3 or $4'$, Jan 8 by $7'$ or $8'$, Jan 13 by $12'$. The greatest difference being in Jan 13, it may perhaps be worth your while to examin your own observation of that day before you publish it. I made an observation about that time wch though inferior in accurateness to either of yours yet may possibly give some light into ye difference between you. Namely Jan. 11 I observed at