

- I. *The Longitude of Lisbon, and the Fort of New York, from Wansted and London, determin'd by Eclipses of the First Satellite of Jupiter. By the Reverend Mr. James Bradley, M. A. Astron. Prof. Savil. R. S. S.*

SOME curious Astronomical Observations having lately been communicated to this Society from *Lisbon*, among which were several Eclipses of the first Satellite of *Jupiter**; I was willing to examine whether I had made any at *Wansted* which tallied with them, that by comparing such together, the true Difference of Longitude between those Places might be found. But looking over my Observations of the first Satellite, made last Year and the beginning of this, I meet only with Two Emerfions that were observed the same Night both at *Lisbon* and *Wansted*. There are others, indeed, made within a few Days of each other, which may likewise be made use of to determine the Difference of Longitude; but not with the same degree of Certainty, by reason of the irregular Motion of the Satellite; which I presume, chiefly arises from the Gravity of the other Satellites towards it. For altho' the Effect of the Influence that the Satellites have on each other, is most remarkable in the Second, whose Motion will sometimes be accelerated or retarded thereby, as much as amounts to 30 or 40 Minutes in time, in the space of about seven Months, or in half the Period in which the three innermost Satellites return, to have nearly the same Position with respect to themselves, and the Shadow of *Jupiter*; yet the first

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* *Vide* Page 90.

seems also liable to Inequalities that cannot well be accounted for, but from some such Cause as is before-mentioned, the effect of which will not easily be reduced to any Rule, but from a long and exact Series of Observations. And till some better and more certain Rule can be found out, we may suppose, that the Effect produced by this Cause, is, during small Intervals, proportionable to the time. On this Supposition I have compared some Observations with others not made the same Nights; and the result is nearly the same as in those which were observed at the same time in both Places, as will appear by the following Particulars.

The Immersion of the First Satellite was observed at *Wansted* with Mr. *Hadley's* Reflecting Telescope on *August 4*, N. S. 1725, about 45'' after the time of the Immersion, as calculated from my Tables. By another Observation made *August 29*, N. S. the true Immersion preceded the Calculation from the same Tables 1' 10''. So that in 25 Days the Satellite's Motion was accelerated as much as answer'd to 1' 55'' in time. Supposing therefore the Acceleration to have been in the same proportion between *July 28*, and *August 4*, N. S. then the true Immersion *July 28*, N. S. would have happen'd at *Wansted* about 1' 15'' after the time by the Tables, which make the Immersion at 12 h. 48' 45'' App. Time. The true Immersion therefore was at *Wansted July 28*, N. S. 12 h. 50' 0'' App. Time; and at *Lisbon* 'twas observed at 12 h. 12' 26'' App. Time, the Difference being 37' 34''.

September 28, N. S. the First Satellite was seen emerging in the Reflector at *Wansted* 3' 50'' sooner than the Tables make the Emerision; and by the Mean of two more Observations made at the same Place, and with the same Telescope, on the 14th and 16th of *October*, N. S. the true Emerision preceded the Calculation

lation $4' 30''$. We may therefore from hence conclude, that on *Sept. 21*, N.S. the true Emerfion at *Wansted* preceded the Calculation by the Tables about $3' 35''$, and that the true Emerfion there was at $12h. 1' 15''$ *Apr. 1*; but this Emerfion was observed at *Lisbon* at $11h. 24' 55''$, the Difference being $36' 20''$.

The Observations at *Wansted* being made with Mr. *Hadley's* Reflecting Telescope (by which one may see the First Satellite near $\frac{1}{4}$ of a Minute sooner when 'tis Emerging, than in a Refracting Telescope of 15 Feet, and the contrary when 'tis Immerging) there ought to be some Allowance made on account of different Telescopes made use of at *Lisbon* and *Wansted*, by deducting 10 or $15''$ from the Difference of Time collected from the Immerfions, and adding as much to the Difference deduced from the Emerfions. Such Correction being made, the Difference of Meridians by the Immerfion observed *July 28*, will be $37' 20''$, and by the Emerfion *Sept. 21*, $36' 35''$.

The Emerfion observed at *Lisbon*, *Decemb. 8*, N.S. at $8h. 32' 40''$ Apparent Time, was likewise seen at *Wansted* in a 15 Foot Tube at $9h. 10' 5''$ Apparent Time, the Air being a little hazy, which may probably make the Difference $37' 25''$ a little too great.

The Emerfion seen at *Lisbon Jan. 16*, 1726, N. S. at $6h. 51' 10''$, which seems accompanied with Circumstances that argue its Exactness, was likewise very well observed at *Wansted* in a 15 Foot Tube at $7h. 28' 22''$ Apparent Time, the Difference being $37' 12''$.

These are the only Observations among those which were last communicated, that I could compare with any degree of Certainty with my own: But I find others printed in the *Philosoph. Transact.* N^o. 385, which were likewise made by the same curious Persons, who observed an Emerfion of the First Satellite at *Lisbon*

September 2, 1724, N.S. at 9h. $36' 57''$. This was seen also at *Wansted* in the Reflector at 10h. $13' 28''$ Apparent Time. Hence, allowing for the different Telescopes, the Difference of Meridians is $36' 45''$.

This Emerision at *Wansted* preceded the Calculation by the Tables $4' 40''$. And another Emerision observed with the same Telescope on Sept. 18, N.S. preceded the Calculation $5' 10''$. We may therefore suppose, that on Sept. 9, N.S. the true Emerision at *Wansted* preceded the computed about $4' 52''$. The Emerision that Day by the Tables was at 12h. $15' 34''$ App. Time; therefore the true Emerision at *Wansted* was at 12h. $10' 42''$. At *Lisbon* twas observed at 11h. $34' 26''$. So that allowing for the Difference of Telescopes, the Difference of Meridians by this Observation is $36' 30''$.

The Mean of all these Differences is about $36' 58''$, from which subtracting $28''$ for the Difference of Meridians between *London* and *Wansted*, the remainder will be the Difference of Meridians between *London* and *Lisbon*, viz. $36' \frac{1}{2} = 9^{\circ} 7' \frac{1}{2}$, *Lisbon* being so much to the Westward of *London*. This Difference of Longitude is about $5' \frac{1}{2}$ greater than what is determined in the forementioned *Transaction*: But as the Gentlemen to whom we are indebted for these Observations, have given us hopes that they will continue to make and communicate more, we need not doubt but their exact Care and Diligence will soon enable us to judge yet more nicely of the true Situation of those Cities with respect to each other.

The same *Transaction* containing some Observations of Eclipses of the same Satellite made in the Fort of *New York*, communicated by his Excellency *William Burnet*, Esq; Governor of *New York*, I shall take this

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Opportunity of determining the Longitude of that Fort more exactly than it can be supposed to be there done, by the bare Comparison of the Observations with the Tables; having two Observations made at *Wansted*, which tally with two made at *New York*, on *Aug. 25*, and *Sept. 10*.

By the Observation made *Aug. 25*, 1723, O. S. which is esteemed the most distinct and best, the Satellite Emerged at 9h. 35' 14" by the Clock, which went about $1' \frac{1}{4}$ too fast for the Apparent Time at the Emerision, as appears by the Altitudes of the Sun's Limb taken the Morning before and after the Observation; so that the Emerision at *New York* was at 9h. 34' Apparent Time; that is, 9h. 32' 20" Mean Time.

August 27, 8h. 57' 40" Mean Time, the Satellite was seen emerging at *Wansted* in the Reflector; and *Sept 12*, 7h. 17' 15" M. T. 'twas seen emerging again in the same Telescope: So that in 15d. 22h. 19' 35" there were 9 Emerisions; and the Interval between each was about 1d. 18h. 28' 50". This substracted from the Time of the Emerision observ'd at *Wansted August 27*, will give the true Emerision at *Wansted* on *August 25*, 14h. 28' 50" M. T. that is, 4h. 56' 30" later than it was observed at *New York*.

September 10, 8h. 0' 10" by the Clock, another Emerision was observed at *New York*. From the Altitudes of the Sun's Limb taken the Morning before, I compute the Error of the Clock at the time of the Emerision to be 1' 10", and that the Emerision happen'd at 7h. 59' App. T. that is, 7h. 51' 52" Mean Time at *New York*. But substracting the forementioned Interval of 1d. 18h. 28' 50" from the Time of the Emerision observed at *Wansted September 12*, 7h. 17' 15" M. T. we shall have the time of the true Emerision at *Wansted* on *Sept. 10*, at 12h. 48' 25" M. T. which

which is 4h. 56' 33" later than 'twas observed at *New York*. The Difference therefore of Meridians between *Wansted* and *New York*, allowing about 15" for the Difference of Telescopes, is about 4h. 56' 45", and between *London* and *New York*, 4h. 56' $\frac{1}{4}$. So that the true Longitude of *New York* from *London* is 74° 4' West.

II: *Observationes Astronomicae habitae Ulyssipone, Anno 1725, & sub init. 1726, à Rev. P. Johanne Baptista Carbone, Soc. Jes. Communicante Isaaco Sequeyra Samuda, M.D. R.S.S. Coll. Med. Lond. Lic.*

R Arò cælum hoc anno nubibus expers ^{Temp. Ver. correct. à Meridie.} contemplari licuit. Tunc verò vel maximè turbatum sensimus, cum aliquid spectatu dignum propiùs immineret; ut meritò crederem, omnes nobis hoc anno observationes Astronomicas fuisse interdictas. Perpaucas tandem habere datum est circa consuetas intimi Jovis Satellitis Eclipses, quas hìc subnecto, Lunari Eclipsi, die 21 Octobris, Martisque transitu per Lunam, die 18 Septembris, omninò inobservatis.

Mens. Dies.

Jul. 28.

Immergi visus est in umbram Jovis veram, 12 12 26
 telescopio consueto Josephi Campani palmorum Rom. 30. Ceperat verò debilitari lumen, 12 11 35

H. M. S.