XLV. *A ſecond Letter to the Right Hon. the Earl of* Macclesfield, *Preſident of the Royal Society, concerning the Tranſit of* Venus *over the Sun, on the 6th of* June 1761; *by the Rev.* Nathanael Bliſs, *M. A.* Savilian *Profeſſor of Geometry in the Univerſity of* Oxford, *and F. R. S.*

My Lord,

Read Jan 7, 1762.

THE interior conjunctions of the planets Mercury and Venus, that happen near the ecliptic limits, have always engaged the attention of aſtronomers, as they furniſh the beſt means of determining ſome of the moſt important elements in the theory of thoſe Planets. The tranſits of the former have been often and carefully obſerved by the moſt eminent aſtronomers, ever ſince the invention of the teleſcope; and, it may be preſumed, that the elements of Mercury's theory are eſtabliſhed as accurately as can be expected. The opportunities of obſerving Venus upon the ſun's diſk occur ſo ſeldom, that the aſtronomers of theſe days have reaſon to think themſelves peculiarly happy, in being eye-witneſſes of ſo rare a phænomenon; more particularly too, as the advantages reſulting from the obſervations of this tranſit, are, in all probability, of the greateſt moment. The firſt, and only obſervation of this kind, was made by our ingenious countryman, the Rev. Mr. Jeremiah Horrox, a young gentleman of very diſtinguiſhed abilities, who, by his own obſervations, with inſtruments

ments conſtructed under his own inſpection, and finiſhed by his own hands, was enabled to correct the ſo much boaſted tables of Lanſbergius, and to predict, with a degree of preciſion unknown to thoſe times, a phænomenon, which he himſelf thought to be of great conſequence. He immediately communicated this important diſcovery to his friend, and companion in his aſtronomical ſtudies, Mr. William Crabtree, and earneſtly exhorted him to prepare for the obſervation. The ſtate of the heavens, on that day, was not very favourable: however, both Mr. Horrox and his friend were lucky enough to obſerve it; the former, at a time when the limbs of the ſun and Venus were in the point of contact, viz. on the 24th of November 1639, O. S. And theſe two were the firſt, and only perſons, that ever ſaw Venus in the ſun, before the preſent year.

By the Rudolphine tables, conſtructed from the obſervations of Tycho Brahe, Kepler was enabled to predict, in the year 1629, that Venus would paſs over the ſun's diſk in the year 1761: and my worthy predeceſſor, that eminent aſtronomer and mathematician, Dr. Halley, in a memoir publiſhed in the Philoſophical Tranſactions, N° 348. exhorted the aſtronomers of all countries to attend to this rare phænomenon, with all poſſible diligence; as it would furniſh them with the beſt means of determining the parallax and diſtance of the ſun, and, conſequently, the dimenſions of the whole ſolar ſyſtem. How far the method propoſed by him, will enable us to ſolve this difficult problem, muſt be left to time to diſcover, when the obſervations, made in places properly ſituated, can be compared with thoſe made here, and in other famous obſervatories. The attention paid to the opinion of an Engliſh aſtronomer, by the moſt renowned Princes, more particularly by his late Majeſty, at the requeſt of your Lordſhip, and the Royal Society, will reflect the greateſt honour upon their names, to the lateſt poſterity. But as the tables, which Dr. Halley made uſe of, were very imperfect, his own not being then conſtructed, and did not repreſent the place of Venus on the ſun with that accuracy, which the method, in this caſe, required: and as that eminent philoſopher committed a ſmall miſtake in his calculations, by placing the axis of Venus's path, and the axis of the equator, on the ſame ſide of the axis of the ecliptic; a miſtake which the moſt accurate calculator might eaſily fall into: from theſe conſiderations, I ſay, the honour of determining the ſun's true parallax is, probably, reſerved for the reign of his preſent Majeſty; from whom, as a patron of ſcience, and every uſeful art, we have the greateſt reaſon to promiſe ourſelves every poſſible encouragement and aſſiſtance.

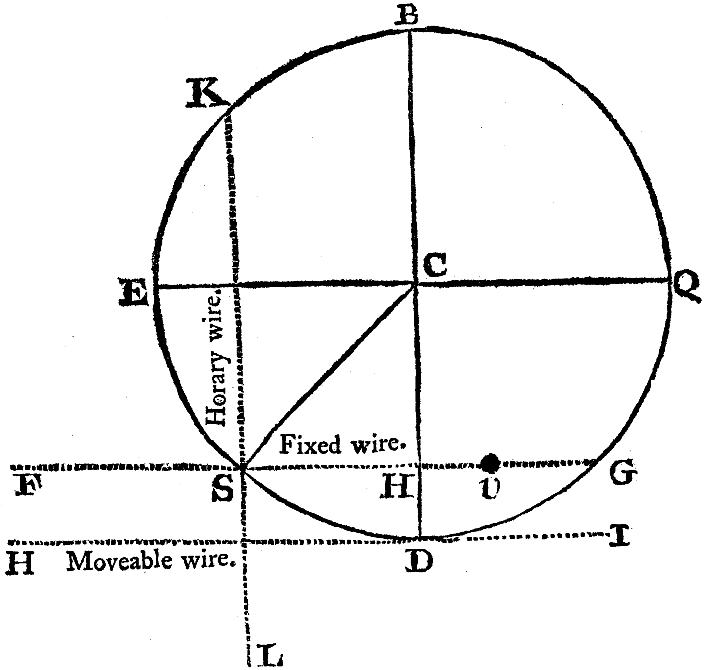
I have already had the honour of preſenting to your Lordſhip, and the Royal Society, an account of the obſervations of the contacts of the ſun's and Venus's limbs, made at Greenwich, and at your Lordſhip's own obſervatory. As the time would not then permit me to examine the obſervations made with the micrometer, I could only ſelect a few particulars, relating to the diameters of the ſun and Venus, as meaſured by different obſervers. I have ſince had leiſure to examine all the obſervations made upon the day of the tranſit, both at Shirburn caſtle, and at the Royal Obſervatory at Greenwich; and ſhall now beg

leave

leave to lay before you, both the obſervations themſelves, and the ſeveral reſults deducible from them by calculation.

The method of determining the right aſcenſion and declination of the center of Venus from that of the ſun, was the ſame which Dr. Bradley uſed, in obſerving a former tranſit of Mercury. The planet was made to run down the fixed wire of the micrometer, and the difference of the time of paſſage was obſerved between it, and that part of the ſun's limb, which was cut by that wire; and the moveable wire was brought to touch the ſun's lower limb. If the ſun's lower limb had been made to run down the fixed wire, and the moveable wire brought to the planet, and the difference of the time of paſſage had been obſerved between it and the ſun's conſequent limb, on the ſuppoſition, that the wire was not exactly parallel to the diurnal motion, it would have cauſed a conſiderable error in the difference of right aſcenſion, obſerved at the diſtance of the ſun's ſemidiameter. But the method we made uſe of requires ſome calculation, to determine the poſition of Venus on the ſun's diſk.

FIG. 1.



Let, therefore, in Fig. 1. the circle EDQB represent the sun's disk, in which let EQ be parallel to the equator, and BD an hour-circle; let the pricked line FG represent the fixed wire of the micrometer, HI the moveable wire, and KL the perpendicular or horary wire. The difference of right ascension Hv, and of declination CH, will be determined in the following manner: SC, or CD, the semidiameter of the sun is given, and CD — DH = CH, the difference of declination; and SC and CH being given, SH may be found; and then the observed difference of right ascension Sv being diminished minifhed in the ratio of radius to the fine of the polar diftance of Venus, will give HU, the difference of right afcenfion.

As the clouds began to difperfe, and the fky to become favourable, at Shirburn caftle, above two hours before we had any opportunity of obferving at Greenwich, I fhall firft give the obfervations there made by Mr. Hornfby, and afterwards my own at Greenwich. But here I would beg leave to premife, that, though the numbers are given to parts of a fecond, the obfervers do not pretend to an imaginary exactnefs, (for they did not eftimate the times of paffage nearer than a quarter of a fecond of time) but the numbers are fuch as refult from the turning minutes and feconds of time into motion, and the revolutions and parts of the fcrew of the micrometer into minutes and feconds.

The fun's horizontal diameter, as meafured by the micrometer, was 31′ 33″, and that of Venus, by feveral obfervers, 58″; the following obfervations were therefore deduced, by affuming the femidiameter of the fun = 15′ 46″.5, and that of Venus = 29′.

1. At 17^h 33′ 50″, apparent time, at Shirburn, the center of Venus preceded the part of the fun's limb, cut by the fixed wire, 12′ $3\frac{3}{4}$″ in motion; and the north, or upper limb of Venus, was north of the fouthern, or lower limb of the fun, 6′ 29″.6: therefore, the center of the fun preceded the center of Venus in right afcenfion 1′ 36″.9; and the center of Venus was fouth of that of the fun in declination 9′ 45″.8. The fame, to avoid repetition, in all the following obfervations.

2. At

2. At $17^h\ 35'\ 41''$, the center of Venus preceded the ſun's limb $12'\ 13''$; and the upper limb of Venus was north of the ſun's lower limb $6'\ 19''.7$: ſun's center, therefore, before that of Venus in right aſcenſion, $1'\ 21''$; and the center of Venus was ſouth of the ſun's center in declination $9'\ 55.7''$.

3. At $17^h\ 40'\ 1''$, Venus before ſun's limb $12'\ 37\frac{1}{2}''$, and was north of ſun's lower limb $6'\ 18.2''$: therefore, ſun's center, before that of Venus in right aſcenſion, $57''.2$; and Venus ſouth of ſun's center in declination $9'\ 57''.3$.

N. B. In theſe obſervations, the ſun's limb undulated.

4. At $17^h\ 43'\ 59''$, Venus before ſun's limb $12'\ 47''$; and was north of ſun's lower limb $6'\ 16''.3$: therefore, ſun's center before Venus in right aſcenſion $47''$; and Venus ſouth of ſun's center in declination $9'\ 59''.2$.

5. At $17^h\ 50'\ 31''$, Venus before ſun's limb $13'\ 9\frac{1}{4}''$; and was north of ſun's lower limb $6'\ 10''.4$: therefore, ſun's center before Venus in right aſcenſion $22''$; and Venus ſouth of ſun's center in declination $10'\ 5''.1$.

6. At $18^h\ 3'\ 41''$, Venus before ſun's limb $13'\ 48\frac{3}{4}''$; and was north of ſun's lower limb $5'\ 59''.2$: therefore, the center of Venus was before the ſun's center in right aſcenſion $23''.2$; and was ſouth of ſun's center in declination $10'\ 16''.3$.

7. At $18^h\ 8'\ 54''$, Venus before ſun's limb $14'\ 13''$; and was north of ſun's lower limb $5'\ 53''.8$: therefore, Venus before ſun's center in right aſcenſion $49''.9$; and was ſouth of ſun's center in declination $10'\ 21''.7$.

8. At

8. At 18^{h} 15′ 50″, Venus before ſun's limb 14′ 33″; and was north of ſun's lower limb 5′ 48″: therefore, Venus before ſun's center in right aſcenſion 1′ 13″.2; and was ſouth of ſun's center 10′ 27″.5 in declination.

9. At 18^{h} 28′ 6″, Jenus before ſun's limb 15′ $9\frac{1}{4}$″; and was north of ſun's lower limb 5′ 35″.4: therefore, Venus before ſun's center in right aſcenſion 1′ 57″.2; and was ſouth of ſun's center in declination 10′ 40″.1.

10. At 19^{h} 18′ 49″, Venus before ſun's limb 18′ $5\frac{1}{2}$″; and was north of ſun's lower limb 4′ 45″.5: therefore, Venus before ſun's center in right aſcenſion 5′ 25″.3; and was ſouth of ſun's center 11′ 30″.

11. At 19^{h} 22′ 37″, Venus before ſun's limb 18′ $9\frac{1}{4}$″; and was north of ſun's lower limb 4′ 44″.3: therefore, Venus before ſun's center in right aſcenſion 5′ 29″.9; and was ſouth of ſun's center 11′ 31″.2.

12. At 19^{h} 25′ 50″, Venus before ſun's limb 18′ $23\frac{3}{4}$″; and was north of ſun's lower limb 4′ 42″.5: therefore, Venus before ſun's center in right aſcenſion 5′ 45″; and was ſouth of ſun's center 11′ 32″.9.

13. At 19^{h} 29′ 20″, Venus before ſun's limb 18′ $31\frac{3}{4}$″; and was north of ſun's lower limb 4′ 35″.2: therefore, Venus before ſun's center in right aſcenſion 5′ 59″.8; and was ſouth of ſun's center in declination 11′ 40″.3.

14. At 19^{h} 45′ 58″, Venus before ſun's limb 19′ $20\frac{1}{2}$″; and was north of ſun's lower limb 4′ 19″: therefore, Venus before ſun's center in right aſcenſion 7′ 1″.5; and was ſouth of ſun's center 11′ 56″.5.

15. At 19^{h} 49′, Venus before ſun's limb 19′ 28″; and was north of ſun's lower limb 4′ 16″.6: therefore,

fore, Venus before ſun's center in right aſcenſion 7′ 11″.1; and was ſouth of ſun's center 11′ 58″.9.

16. At 20ʰ 12′ 1′, the center of Venus followed the ſun's preceding limb, cut by the fixed wire, 1′ 58″; and was north of ſun's lower limb 3′ 54″.2: therefore, Venus before ſun's center in right aſcenſion 8′ 34″.2; and was ſouth of ſun's center in declination 12′ 21″.3.

The following obſervations were made by myſelf, at Greenwich, as ſoon as the ſky became favourable.

1. At 19ʰ 38′ 21″, apparent time, at Greenwich, the antecedent, or firſt limb of Venus, preceded that part of the ſun's limb cut by the fixed wire 18′ 48¾″ in motion; and the center of Venus was north of the ſouthern, or lower limb of the ſun, 4′ 4″.5: therefore, the center of Venus preceded the ſun's center in right aſcenſion 6′ 18″.9; and was ſouth of that of the ſun in declination 11′ 42″.1.

2. At 19ʰ 42′ 9″, the limb of Venus before ſun's limb 18′ 52½″; and was north of ſun's lower limb 3′ 56″.8: therefore, Venus before ſun's center in right aſcenſion 6′ 31″; and was ſouth of it in declination 11′ 49″.7. But this is marked as dubious.

3. At 19ʰ 44′ 35″, limb of Venus before ſun's limb 19′; and center was north of ſun's lower limb 3′ 57″.5: therefore, Venus before ſun's center in right aſcenſion 6′ 37″.1; and was ſouth of ſun's center in declination 11′ 49″.

4. At 19ʰ 53′ 14″, limb of Venus before ſun's limb 19′ 22½″; and was north of ſun's lower limb 3′ 51″.3: therefore, Venus before ſun's center in right aſcenſion 7′ 5″; and was ſouth of ſun's center in declination 11′ 55″.2.

5. At

5. At 19^h 58′ 26″, limb of Venus before ſun's limb 19′ 37½″; and was ſouth of ſun's lower limb 3′ 43″: therefore, Venus before ſun's center in right aſcenſion 7′ 28″.6; and was ſouth of ſun's center in declination 12′ 3″.5.

The few obſervations, which were afterwards made by Mr. Green, with Mr. Dollond's micrometer, are omitted; for they diſagree ſo much with themſelves, and alſo with the above, that there muſt be ſome error in reading the numbers of the nonius; or, which is more probable, in placing the micrometer exactly parallel to the equator, occaſioned by the hurry with which they were made.

In order to determine more exactly the time of the ecliptic conjunction, with the latitude of Venus then; together with the time of the middle of the tranſit, and the neareſt approach of the centers; and from thence the true place of her node; I have carefully computed the following numbers from theory: becauſe, as Dr. Halley has obſerved, in the Philoſophical Tranſactions, N° 386, "there is always an unavoid- "able, though ſmall uncertainty in what we obſerve, "yet greater than there can be in the theory, eſpe- "cially now it is ſo very near the truth." The ſolar numbers were computed from new tables, not yet publiſhed, corrected by the ſmall equations, occaſioned by the influence of the moon and planet Jupiter, and alſo the nutation of the earth's axis. The ſun's place was very well obſerved on the meridian, both at Greenwich and Shirburn, the day of the tranſit; which, allowing for the difference of longitude of thoſe places, agreed to a ſurprizing exactneſs, within two ſeconds; and did not differ more than five

 ſeconds

seconds in excess from the computed place. The place of Venus was computed from Dr. Halley's tables, only adding 31″ to the mean motion, and 1′ 45″ to the place of the node; by which corrections, they had been found to agree better with observations made near the inferior conjunction in 1753.

According to these numbers, the ecliptic conjunction of the sun and Venus was June 5, 1761, N. S. at 17^h 51′ 20″, mean time, at Greenwich; and the place of the sun and Venus 2^s 15° 36′ 33″; and the geocentric latitude of Venus south 9′ 44″.9. The places of the sun and Venus being computed for three hours before, and three hours after the ecliptic conjunction, the horary motion of the sun is 2′ 23″.45; of Venus retrograde 1′ 33″.68: the horary motion of Venus from the sun, therefore, 3′ 57″.13, retrograde. The horary motion of Venus in latitude is south 35″.46. The angle of the visible way with the ecliptic 8° 30′ 10″; the horary motion in that way 3′ 59″.77. The right ascension of the sun, supposing the apparent obliquity of the ecliptic 23° 28′ 18″, was then 74° 22′ 19″.2; and the horary motion of the sun in right ascension was 2′ 34″.55. The declination of the sun was then 22° 41′ 35″.9; the horary motion in declination was 15″.33 northwards. The angle formed by the axis of the ecliptic, and the axis of the equator, was 6° 9′ 34″, decreasing hourly one minute.

The right ascension of Venus, at the ecliptic conjunction, was 74° 23′ 27″.2; and the horary motion of Venus in right ascension 1′ 36″.75 retrograde. The horary motion of Venus from the sun in right ascension,

aſcenſion was, therefore, 4′ 11″.3 retrograde. The declination of Venus was then 22° 31′ 54″.2; and the horary motion in declination was 45″.29, ſouthwards: the horary motion of Venus from the ſun in declination was, therefore, 1′ 0″.62, ſouthwards.

The logarithm of the earth from the ſun was then 5.006642; the logarithm of Venus from the ſun was 4.861192; and the logarithm of Venus from the earth was 4.460874. If we ſuppoſe the horizontal parallax of the ſun to be $10\frac{1}{3}$″, then the horizontal parallax of Venus, as ſeen from the earth, will be 36″.31; which, diminiſhed by that of the ſun, is 25″.97. If the parallax in longitude and latitude is computed from theſe data, the viſible horary motion of Venus from the ſun in longitude will be 3′ 58″.35 retrograde, and in latitude 33″.75 ſouth. The longitude and latitude of the center of Venus from the ſun's center, anſwering to the ſeveral right aſcenſions and declinations obſerved, may be determined in the following manner.

FIG. 2.

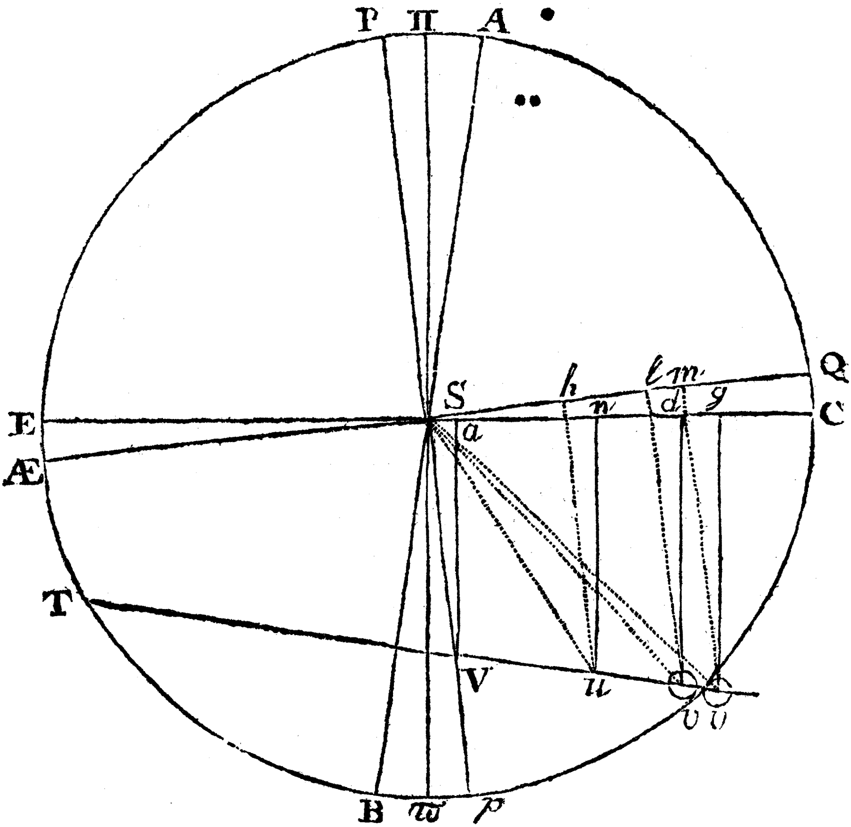


Fig. 2. Let the circle Π E, ϖ C represent the sun's disk; in which let E C be a portion of the ecliptic, Π ϖ its axis, Æ Q a parallel to the equator, P *p* its axis, T V *v* the visible path of Venus on the sun, and A B the perpendicular to that path. The angle Q S C = P S Π = the inclination of the axis of the equator to the axis of the ecliptic, is given by calculation;

culation; then, at the internal contact, the side S v, being the semidiameter of the sun, lessened by the semidiameter of Venus, is given, and also $v\,l$, the observed difference of declination; from whence may be found, by plain trigonometry, the angle v S l; from which, if the angle QSC be subtracted, there will remain the angle v S d; from whence, with S v, may be found S a, the difference of longitude, and $v\,d$, the difference of latitude from the sun's center. in any other position, as at u, there will be given S b, the difference of right ascension, and $u\,b$, the difference of declination; from whence may be found the angle u S b, and the side S u: if from the angle u S b, the angle QSC be subtracted, there will remain the angle u S n; which, with the side S u, before found, will give S n, the difference of longitude, and $u\,n$, the difference of latitude from the sun's center. At the conjunction in right ascension, SV is the observed difference of declination, and the compliment of the angle QSC is = the angle VS a; from whence will be found the difference of longitude S a, and the difference of latitude V a, from the sun's center.

1. If a mean be taken of the 4th, 5th, 6th, and 7th of Mr. Hornsby's observations, and also of the times at $17^h\ 56'\ 46''$, the right ascension of the center of Venus will be $1''.2$ before the sun's center, and the declination of it $10'\ 10''.6$; from whence the visible conjunction in right ascension was at $17^h\ 56'\ 31''$, and the visible declination south of the sun's center $10'\ 10''.4$: the visible longitude was, therefore, $1'\ 5''.5$ before the sun's center, and the visible latitude south of it $10'\ 6''.9$. From the computed

puted visible motion in longitude and latitude, by making the proper proportion, the visible ecliptic conjunction will be found at $17^h\ 40'\ 3''$ apparent time, at Shirburn, or at $17^h\ 44'\ 4''$ apparent time, at Greenwich, when the visible latitude was $9'\ 57''.6$ south of the sun's center. At $17^h\ 56'\ 46''$, the parallax in longitude (supposing, as above, the horizontal parallax of the sun to be $10\frac{1}{3}''$) will be $14''$, to be added to the visible longitude of Venus, to give her true longitude before the sun's center, and $20''.5$ to be subtracted from the visible latitude, to give the true latitude, as seen from the center of the earth. The true ecliptic conjunction, therefore, was at $17^h\ 36'\ 25''$ apparent time, at Sirburn, or at $17^h\ 40'\ 26''$ apparent time, at Greenwich, by making a proper proportion from the computed true motion of Venus from the sun; and the true latitude was then $9'\ 34.5''$ south.

2. From the mean of 10th, 11th, 12th, and 13th observations, at $19^h\ 24'\ 9'$ apparent time, at Shirburn, the observed right ascension was $5'\ 40''$, and the observed declination was $11'\ 33.6''$; from whence the visible longitude was $6'\ 52.2''$, and the visible latitude $10'\ 53''.3$, from the sun's center; and the visible ecliptic conjunction was at $17^h\ 40'\ 23''$, at Shirburn, or at $17^h\ 44'\ 24''$ apparent time, at Greenwich, with $9'\ 54.9''$ of visible latitude south. The parallax of longitude was $13.2''$, to be added to the visible longitude; and the parallax of latitude $18.1''$, to be subtracted from the visible latitude, to give the true latitude. The true ecliptic conjunction was, therefore, at $17^h\ 36'\ 31''$, at Shirburn, or at

17^h

$17^h\ 40'\ 32''$ apparent time, at Greenwich; the true latitude being then $9'\ 31''.6$ south.

3. From the mean of the 14th and 15th observations, at $19^h\ 47'\ 29''$, the observed right ascension was $7'\ 6''.3$, and the observed declination $11'\ 57''.6$; from whence the visible longitude was $8'\ 20''.5$, and the visible latitude was $11'\ 8''$, from the sun's center; and the visible ecliptic conjunction was at $17^h\ 41'\ 30''$, or at $17^h\ 45'\ 31''$, apparent time, at Greenwich, with visible latitude $9'\ 57''.2$ south. The parallax of longitude was $12''.5$, to be added; and the parallax of latitude $17''.4$, to be subtracted, to give the true longitude and latitude. The true ecliptic conjunction was, therefore, at $17^h\ 37'\ 42''$, at Shirburn, or at $17^h\ 41'\ 43''$, apparent time, at Greenwich; the true latitude being then $9'\ 33''.9$ south.

4. At the internal contact, at Shirburn, at $20^h\ 15'\ 10''$, if the motion in declination, answering to $3'$ of time, be added to the declination observed at the 16th observation, the declination of the center of Venus from the sun's center will be $12'\ 24''.4$; from whence the visible longitude was $10'\ 12''.6$, and the visible latitude $11'\ 23''$, from the sun's center; and the visible ecliptic conjunction was at $17^h\ 40'\ 57''$, at Shirburn, or at $17^h\ 44'\ 58''$, apparent time, at Greenwich, with $9'\ 56''.2$ of visible latitude south. The parallax of longitude, to be added, was $11''.6$; and the parallax of latitude $16''.5$, to be subtracted, to give the true longitude and latitude. The true ecliptic conjunction was, therefore, at $17^h\ 37'\ 13''$, at Shirburn, or at $17^h\ 41'\ 14''$, apparent time, at Greenwich; the true latitude being $9'\ 33''.1$ south.

5. The

5. The 2d obſervation made at Greenwich being dubious, if the mean of the 1ſt, 3d, 4th, and 5th, be taken at $19^h\ 48'\ 39''$, apparent time, at Greenwich, the obſerved right aſcenſion was $6'\ 52''.4$, and the obſerved declination $11'\ 52''.4$; from whence the viſible longitude was $8'\ 6''.1$, and the viſible latitude $11'\ 4''.3$, from the ſun's center. The viſible ecliptic conjunction was, therefore, $17^h\ 46'\ 17''$, apparent time, at Greenwich, with $9'\ 55''.5$ of viſible ſouth latitude. The parallax of longitude, to be added, was $12''.6$; and the parallax of latitude, to be ſubtracted, $17''.3$, to give the true longitude and latitude from the ſun's center. The true ecliptic conjunction, therefore, was at $17^h\ 42'\ 28''$, apparent time, at Greenwich; when the true latitude was $9'\ 32''.4$.

I have omitted the computation of the longitude, latitude, and of the viſible and true conjunction from the internal contact, at Greenwich, and the difference of declination, as given in my laſt letter; becauſe there muſt have been ſome miſtake in reading the numbers of the micrometer, or in ſetting them, or the times, down: for they differ too much from all the above, which correſpond ſo well with each other, (though made at different places, and with different inſtruments) and give the true latitude, at the ecliptic conjunction, about $8''$ leſs, that we cannot ſafely depend upon them.

If, therefore, we ſuppoſe the viſible ecliptic conjunction to have happened at $17^h\ 45'\ 3''$, apparent time, at Greenwich, being the mean of the five foregoing deductions, where the greateſt difference is no more than $2'\ 13''$ of time, or $8''$ of viſible longitude, with 9′ 56″.3 of visible south latitude, from the sun's center; where the greatest difference is no more than 2″.7 in latitude, we cannot much err from the truth: and also, from the mean of the same deductions, the true ecliptic conjunction, as seen from the earth's center, will be at 17ʰ 41′ 17″, with 9′ 33″.1 of south latitude. The middle of the transit was, therefore, at 17ʰ 20′ 5″; and the nearest approach of the centers 9′ 26″.8. The latitude then was 9′ 20″.6 south; but the longitude of Venus being augmented by the aberration of light 3″ 7, equivalent to 56″ of time, by which the true ecliptic conjunction was accelerated, the true equated conjunction was at 17ʰ 42′ 13″. The error in latitude, caused by the aberration of light, was 1″.4, by which it was diminished; the equated latitude, therefore, was 9′ 34″.5.

The equation of time was then 1′ 52″, to be subtracted from the apparent time, to give the mean; consequently, the true equated ecliptic conjunction, as seen from the earth's center, was at 17ʰ 40′ 21″, mean time, at Greenwich. The true place of the sun, corrected by observation, was, at that time, 2ˢ 15° 36′ 12″; and, consequently, the heliocentric place of Venus was 8ˢ 15° 36′ 12″, with the geocentric latitude 9′ 34″.5. Now, in this case, the geocentric latitude is to the heliocentric latitude, as the distance of Venus from the sun is to the distance of Venus from the earth; and therefore, the planet's latitude, as seen from the sun, was 3′ 48″.5. If we suppose the inclination of the orbit of Venus to be 3° 23′ 20″, as determined by Dr. Halley and M. Cassini, the distance of Venus from the node will be 1° 4′ 20″;

$1^s\ 4'\ 20''$; conſequently, its true place $2^s\ 14^\circ\ 31'\ 52''$ on the day of the tranſit. The effect of refraction is not taken into theſe calculations; becauſe, at the firſt obſervations, when its effect would have been greateſt, it amounted only to a very ſmall part of a ſecond.

Theſe, my Lord, are the Concluſions, which I have been able to deduce, from the obſervations made at your Lordſhip's own obſervatory, and at the Royal Obſervatory at Greenwich. They are as faithfully related, as they were ſcrupulouſly calculated; and if they meet with the approbation of your Lordſhip, and of the Royal Society, I ſhall think myſelf ſufficiently rewarded, for the Labour of a long and tedious calculation.

I am,

With the greateſt reſpect,

My Lord,

Your Lordſhip's,

and the Royal Society's,

much obliged,

and moſt obedient,

humble ſervant,

Oxford,
Dec. 15, 1761.

Nathanael Bliſs.

XLVI. *Ob-*