LIII. *The Quantity of the Sun's Parallax, as deduced from the Obſervations of the Tranſit of* Venus, *on* June 3, 1769: *By* Thomas Hornſby, *M. A.* Savilian *Profeſſor of Aſtronomy in the Univerſity of* Oxford, *and F. R. S.*

Read Dec. 19, 1771.

THE uncertainty as to the quantity of the Sun's parallax, deduced from the obſervations of the tranſit of Venus in 1761 (whether it aroſe from the unfavourable poſition of the planet, ſo that a ſufficient difference of time in the total duration of the tranſit was not, and indeed could not be, obtained from obſervations made at different places; or from the diſagreement of the obſervations of different aſtronomers, which were to ſerve as terms of compariſon) ſeems now to be entirely removed: and from the obſervations made in diſtant parts by the aſtronomers of different nations, and eſpecially from thoſe made under the patronage and direction of this Society, the learned of the preſent time may congratulate themſelves on obtaining as accurate a determination of the Sun's diſtance, as perhaps the nature of the ſubject will admit.

The two following Tables give not only the obſervations themſelves, but alſo the computed differences of time from which the parallax was deduced.

TABLE I.

Places.	Latitude.	Obſervers names.	Int. Cont. at Ingreſs	Int. Cont. at Egreſs	Obſ. Dur.
	° ′ ″		H. ′ ″	H. ′ ″	H. ′ ″
Wardhus.	70 22 36 N.	F. Hell.	9 34 10,6	15 27 24,6	5 33 14
Kola.	68 52 56 N.	M. Rumonſky.	9 42 4	15 35 23	5 53 19
Hudſon's Bay.	58 47 32 N.	M. Wales.	1 15 21,3	7 0 45,5	5 45 24,2
		M. Dymond.	1 15 25,3	7 0 48,5	5 45 23,2
California.	23 3 37 N.	Abbè Chappe.	0 17 27,9	5 54 50,3	5 37 32,4
K. George's Iſland.	17 28 55 S.	Capt. Cook.	21 44 15,5	3 14 13	5 29 57,5
		Mr. Green.	21 43 55,5	3 14 3	5 30 7,5
		Dr. Solander.	21 44 2,5		

TABLE II.

	Obſerved durations.	Difference of comp. durat.	Difference of obſerv. durat.	Sun's parallax.
	H. ′ ″	′ ″	′ ″	″
King George's Iſland.	5 29 52,5			
Wardhus.	5 53 14	23 31,36	23 21,5	8,639
Kola.	5 53 19	23 41,09	23 26,5	8,611
Hudſon's Bay.	5 45 23,7	15 51,90	15 31,2	8,511
California.	5 37 32,4	7 42,43	7 29,9	8,464
California.	5 37 32,4			
Wardhus.	5 53 14	15 48,93	15 51,6	8,724
Kola.	5 53 19	16 4,41	15 56,6	8,629
Hudſon's Bay.	5 45 23,7	8 9,47	8 1,3	8,555
Hudſon's Bay.	5 45 23,7			
Wardhus.	5 53 14	7 39,46	7 50,3	8,905
Kola.	5 53 19	7 49,19	7 55,3	8,813
Mean of all				8,650

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The ſecond column of the ſecond Table contains the obſerved duration, or interval of time, between the two internal contacts; the third contains the difference of each duration, deduced by computation upon a ſuppoſition that the Sun's parallax was $= 8'',7$ on the day of the tranſit; the fourth, the difference of that duration, as determined by actual obſervation: In the laſt column is given the horizontal parallax on the day of the tranſit, reſulting from a compariſon of the third and fourth columns.

In the above compariſon, I have uſed Captain Cook's obſervation at the ingreſs, and a mean of his and Mr. Green's obſervations at the egreſs; becauſe, upon a compariſon of the obſerved times at the ingreſs and egreſs, made at the ſeveral places, when reduced to the center of the Earth, upon a ſuppoſition that the Sun's parallax on the day of the tranſit was $= 8'',65$, the difference of meridians, as deduced from Captain Cook's obſervation at the ingreſs, agrees much better with the ſame differences deduced from a mean of the two obſervations at the egreſs, than thoſe derived either from the obſervation of Mr. Green, Dr. Solander, or even from a mean of all the three obſervations, as appears from the following compariſon.

	Wardhus.		California.	
	Ingreſs.	Egreſs.	Ingreſs.	Egreſs.
	H. ′ ″	H. ′ ″	H. ′ ″	H. ′ ″
Obſerved times.	9 34 10,6	15 27 24,6	0 17 27,9	5 54 50,3
Effect of parallax.	+ 6 35,6	— 4 35,9	+ 24,9	+ 4 52
Reduced times.	9 40 46,2	15 22 48,7	0 17 52,8	5 59 42,3

	Kola.		Hudſon's Bay.	
	Ingreſs.	Egreſs.	Ingreſs.	Egreſs.
Obſerved times.	9 42 4	15 35 23	1 15 23,3	7 0 47
Effect of parallax.	+ 6 37,4	— 4 45,1	+ 4 15,9	+ 0 38,7
Reduced times.	9 48 41,4	15 30 37,9	1 19 39,2	7 1 25,7

King George's Iſland.

	Ingreſs.				Egreſs.
	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Mean.
Obſerved times.	21 44 15,5	21 44 4,5	21 44 2,5	21 43 55,5	3 14 8
Effect of parallax.	5 40,4	5 40,4	5 40,4	5 40,4	+ 6 23,8
Reduced times.	21 38 35,1	21 38 24,1	21 38 22,1	21 38 15,1	3 20 31,8
Ditto at Wardhus.	9 40 46,2	9 40 46,2	9 40 46,2	9 40 46,2	15 22 48,7
Difference of meridians.	12 2 11,1	12 2 22,1	12 2 24,1	12 2 31,1	12 2 16,9

	Ingreſs.				Egreſs.
	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Mean.
Reduced times at K. G. Iſl.	21 38 35,1	21 38 24,1	21 38 22,1	21 38 15,1	3 20 31,8
Ditto at California.	0 17 52,8	0 17 52,8	0 17 52,8	0 17 52,8	5 59 42,3
Difference of meridians.	2 39 17,7	2 39 28,7	2 39 30,7	2 39 37,7	2 39 10,5

	Ingreſs.				Egreſs.
	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Mean.
Reduced times at K. G. Iſl.	21 38 35,1	21 38 24,1	21 38 22,1	22 38 15,1	3 20 31,8
Ditto at Kola.	9 48 41,4	9 48 41,4	9 48 41,4	9 48 41,4	15 30 37,9
Difference of meridians.	12 10 6,3	12 10 17,3	12 10 19,3	10 10 26,3	12 10 6,1

	Ingreſs.				Egreſs.
	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Mean.
Reduced times at K. G. Iſl.	21 38 35,1	21 38 24,1	21 38 22,1	21 38 15,1	3 20 31,8
Ditto at Hudſon's Bay.	1 19 39,2	1 19 32,9	1 19 39,2	1 19 39,2	7 1 25,7
Difference of meridians.	3 41 4,1	3 41 15,1	3 41 17,1	3 41 24,1	3 40 53,9

The near agreement of the difference of meridians between King George's Iſland and the four other places, as deduced from Captain Cook's obſervation at the ingreſs, and from a mean of his and Mr. Green's obſervations at the egreſs, ſufficiently, I think, ſhew that the obſerved duration at King George's Iſland is at leaſt $5^h\ 29'\ 52'',5$: And, from a compariſon made in the ſame manner with the obſervations at Hudſon's Bay, it might be ſhewn that the time of the egreſs is uncertain to a few ſeconds, owing, perhaps, to the hazineſs of the air peculiar to that climate, even at the altitude of 10 or 12 degrees.

By the end of the Sun's eclipſe on the morning after the tranſit, the longitude of Wardhus from Paris, according to Father Hell, is $1^h\ 55'\ 6''$ E. of Paris, or $2^h\ 4'\ 22''$ E. of Greenwich: and, according to the obſervation of Mr. Rumouſky, Kola is $2^h\ 2'\ 55''$ E. of Paris, or $2^h\ 12'\ 11''$ E. of Greenwich. The point therefore at King George's Iſland, where the tranſit was obſerved, is $9^h\ 57'\ 53'',6 = 149°\ 28'\ 24''$ W. of Greenwich; Vill St. Joſeph in California is $7^h\ 18'\ 42\frac{1}{2}'' = 109°\ 40'\ 37''$ W. of Greenwich; and Prince of Wales's Fort in Hudſon's Bay $6^h\ 16'\ 49\frac{1}{2}'' = 94°\ 12'\ 22''$ W. of Greenwich.

From the near agreement of the ſeveral reſults before found, which are independent of the knowledge of the longitude of each place, and affected only by the neceſſary error in obſerving, the accuracy of the obſervation made at the Cape of Good Hope in 1761, by Meſſieurs Maſon and Dixon, is abundantly confirmed; by comparing which with the

the beſt obſervations made in the places whoſe longitudes were very nearly aſcertained, the Sun's parallax on the 5th of June was found = 8″,692 *. And Mr. Pingré, notwithſtanding the ſeveral arguments very ſpeciouſly produced in favour of his own obſervation at the Iſland of Rodrigues, as repreſented in his learned Memoire on the Sun's Parallax, will probably be of opinion, that an error of one minute was committed in writing down the time of his obſervation, as was conjectured by many perſons, as well as myſelf; a miſtake to which the moſt experienced obſerver is ſometimes liable, when at the time of obſervation the minute is nearly compleated.

The parallax on the 3d of June being 8″,65, the mean parallax will be found to be = 8″,78; and if the ſemidiameter of the Earth be ſuppoſed = 3985 Engliſh miles, the mean diſtance of the Earth from the Sun will be 93,726,900 Engliſh miles. And, as the relative diſtances of the planets are well known, their abſolute diſtances, and conſequently the dimenſions of the Solar Syſtem, will be as follows.

	Relative diſtance.	Abſolute diſtance.
Mercury,	387,10	36,281,700
Venus,	723,33	67,795,500
Earth,	1000,00	93,726,900
Mars,	1523,69	142,818,000
Jupiter,	5200,98	487,472,000
Saturn,	9540,07	894,162,000

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* See Phil. Tranſ. Vol. LIII. for the Year 1763. p. 491.