VIII. *A Delineation of the Tranſit of* Venus *expected in the Year* 1769, *by Mr.* James Ferguſon.

To the Right Honourable the Earl of Macclesfield, *Preſident of the Royal Socie'y.*

My Lord,

Read Feb. 10, 1763. I Beg leave to preſent to the Royal Society a delineation of the tranſit of Venus in the year 1769 [TAB. I.] which will be a much better tranſit for diſcovering the Sun's parallax than that in 1761 was.

Although I have only mentioned Wardhuys in Norwegian Lapland, and the Solomon iſles in the great South Sea, as proper places for obſerving that tranſit; yet I am ſenſible, that any other place near the north cape will be juſt as well for the northern obſervers; and Tuberon's Iſle, or St. Bernard's, or the Fly Iſlands, in the great South Sea, will anſwer as well for the Southern.

Although it cannot be expected, that any delineation can be ſo exact as calculation, yet I hope this projection will be found to come very near the truth; and am, with the higheſt reſpect,

My Lord
your Lordſhip's
and the Royal Society's
moſt obliged humble ſervant
James Ferguſon.

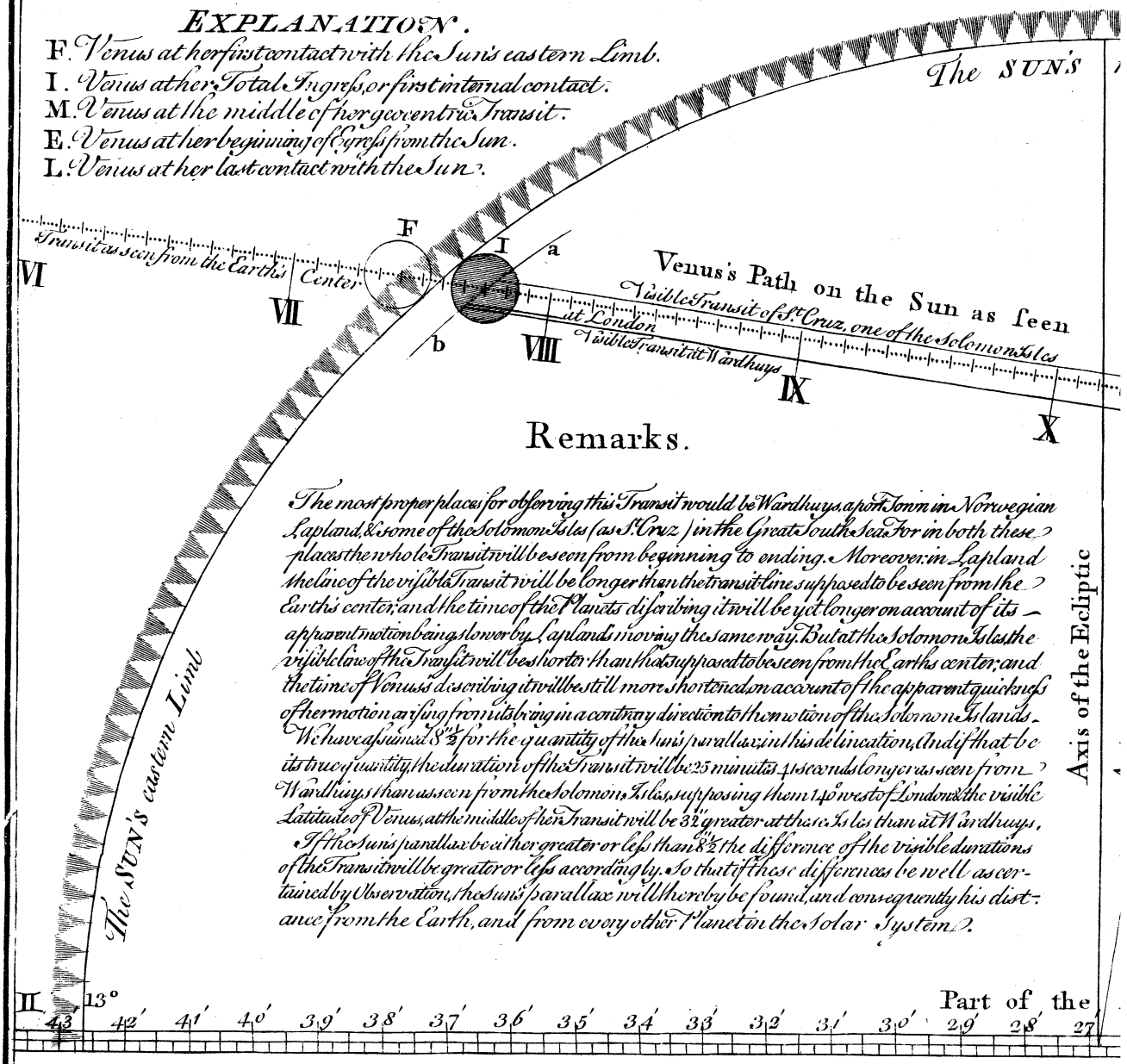
Mortimer-Street,
Feb. 10, 1763.

IX. *An*

The *TRANSIT* of VENUS over the SUN, June 3d. 1769. Delineated by *James Ferguson.*

EXPLANATION.

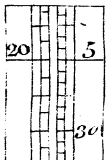
F. *Venus at her first contact with the Sun's eastern Limb.*
I. *Venus at her Total Ingress, or first internal contact.*
M. *Venus at the middle of her geocentric Transit.*
E. *Venus at her beginning of Egress from the Sun.*
L. *Venus at her last contact with the Sun.*

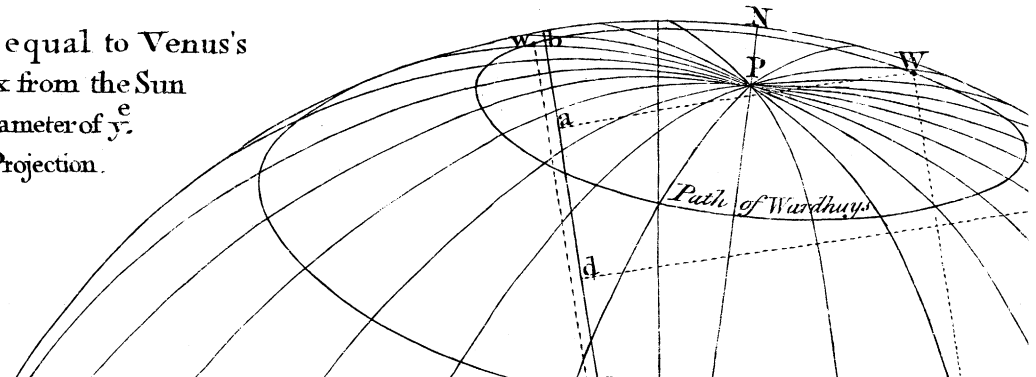


Remarks.

The most proper places for observing this Transit would be Wardhuys, a port Town in Norwegian Lapland, & some of the Solomon Isles (as St. Cruz) in the Great South Sea. For in both these places the whole Transit will be seen from beginning to ending. Moreover in Lapland the line of the visible Transit will be longer than the transit line supposed to be seen from the Earth's center, and the time of the Planets describing it will be yet longer on account of its apparent motion being slower by Lapland's moving the same way. But at the Solomon Isles the visible line of the Transit will be shorter than that supposed to be seen from the Earth's center; and the time of Venus's describing it will be still more shortened on account of the apparent quickness of her motion arising from its being in a contrary direction to the motion of the Solomon Islands. We have assumed 8″½ for the quantity of the Sun's parallax in this delineation, And if that be its true quantity, the duration of the Transit will be 25 minutes 41 seconds longer as seen from Wardhuys than as seen from the Solomon Isles, supposing them 140° west of London. & the visible Latitude of Venus, at the middle of her Transit will be 32″ greater at those Isles than at Wardhuys. If the Sun's parallax be either greater or less than 8″½ the difference of the visible durations of the Transit will be greater or less accordingly. So that if these differences be well ascertained by Observation, the Sun's parallax will thereby be found, and consequently his distance from the Earth, and from every other Planet in the Solar System.

Scale of 21″.3, equal to Venus's horizontal Parallax from the Sun and to the Semidiameter of y.e Earth's Disc in this Projection.





Scale of Minutes and Seconds of a Degree.

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

on.

EXPLANATION.

The larger divisions are minutes of a Degree, and the smaller ones are Seconds. The Discs of the Sun & Venus, & the geocentric Latitude of Venus, are laid down from this Scale, according to the tabular Elements. The Parallaxes of Venus's Latitude, as seen from M and Wardhuys and from the Solomon Isles, both at the times of total Ingress and beginning of Egress are taken from this Scale, and set off from the geocentric Transit line by marks: and through these marks the lines of the visible Transits are Drawn. All the parallaxes are delineated on the Earth's Disc, and measured on the Scale on the left hand.

N's northern Limb

en

from M different Parts of the Earth.

X XI XII I II

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Axis of the Ecliptic

Axis of Venus's Orbit

The SUN's western Limb.

The Times and Durations of the TRANSIT.

	1 As they would be if neither the Sun nor Venus had any Parallax.		2 As they will be on Account of the Parallaxes of the Sun and Venus.		
Equal times at	Total Ingress H. M. S.	Beg. of Egress H. M. S.	Total Ingress H. M. S.	Beg. of Egress H. M. S.	Duration H. M. S.
The Earth's center	VII 45 0 A.	I 24 0 M.	No Parallax	No Parallax	5 39 0
Wardhuys.	IX 45 0 A.	III 24 0 M.	IX 37 25 A.	III 29 5 M.	5 51 40
LONDON.	VII 45 0 A.	I 24 0 M.	VII 37 30 A.	Invisible	———
St. Cruz Isle.	X 25 0 M.	III 4 0 A.	X 29 36 M.	III 55 55 A.	5 25 59

the ECLIPTIC

27 26' 25' 24' 23' 22' 21' 20' 19' 18' 17' 16' 15' 14' 13' 12' 11' 13° II

An Orthographical Projection of the Earth's enlightened Disc as seen from the SUN during the time of the TRANSIT.

L

EXPLANATION.

NLB. The Earth's enlightened Disc, on which are delineated the Equator, Tropic

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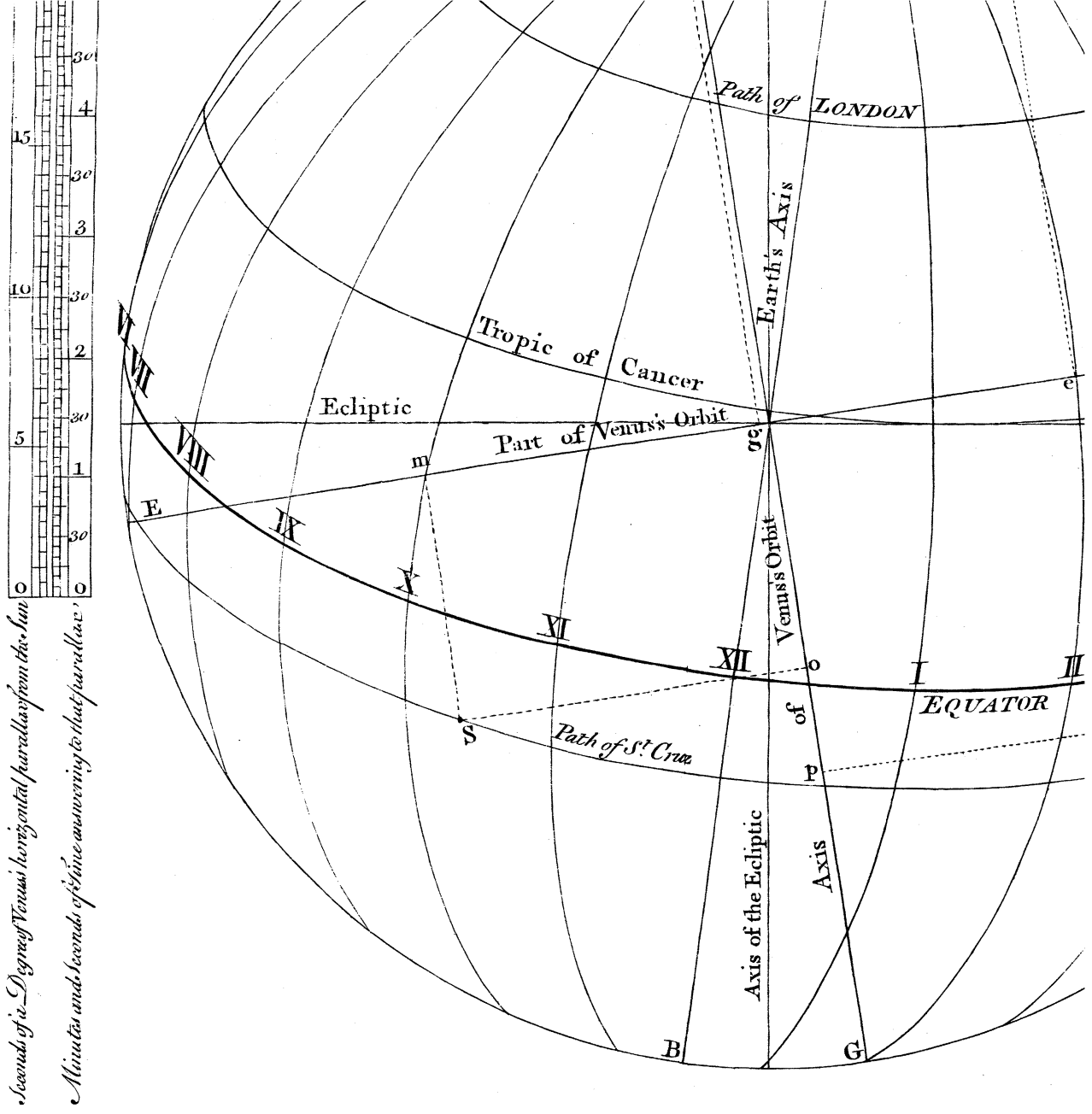
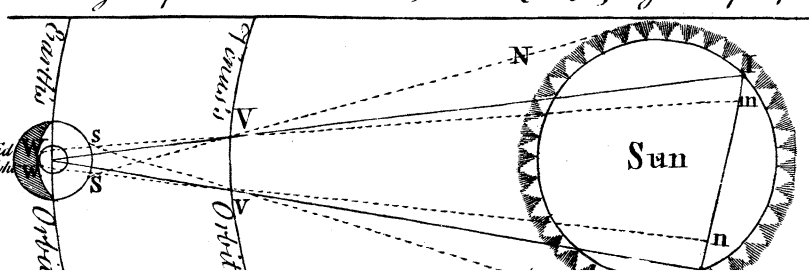
Tropic



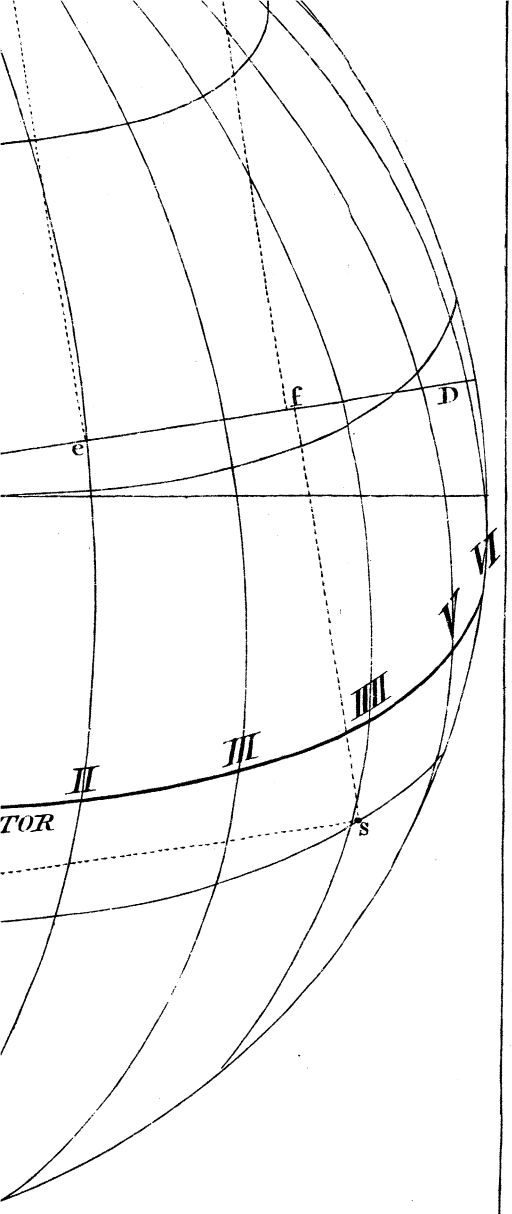
The Elements from which these Projections are dedu

		D. H. M. S.
1.	True time at Greenwich of Conjunction of the Sun & Venus June 2	3.10.11.0 P.M.
2.	Their true places in the Ecliptic then as seen from the Earth's center	☌ 2.13.26.51
3.	The Sun's Declination North	22.27.20
4.	The Place of Venus's Ascending Node	☊ 2.14.36.14
5.	Her Geocentric Latitude at that time North Descending	10.22
6.	The Angle of her visible path with the Ecliptic	8.30.10
7.	Her Geocentric horary motion on (or from) the Sun	3.59½
8.	The Sun's distance from the Earth	101523 The Sun's mean distance
9.	Venus's distance from the Sun	72627 from the Earth's center
10.	Her distance from the Earth	28896 being 100000 of such parts.

11.	The Sun's horizontal parallax, as sume	
12.	And consequently, Venus's horizonta	
13.	Their difference = Venus's horizontal	
14.	The Sun's Semidiameter	
15.	Venus's Semidiameter	
16.	Latitude of Wardhus North	
17.	Its Longitude East from Lon	
18.	Latitude of London North	
19.	Latitude of St Cruz one of the Solomon	
20.	Its Longitude West from London, suppo	



EXPLANATION. In this Diagram, S
turns on its Axis according to the orde
in her Orbit at V, she will appear upon t
as seen from the Earth's center, but at Th
Isle at S, she will be in the line S V N,
as then seen from Wardhuys at W, she
The Sun at m, so that her total Ingress
huys, & later as seen from St Cruz, than as seen



deduced.

., assumed to be ?	° 0.00.8".5
horizontal parallax ?	0.00.29.8
rizontal parallax from the Sun ?	0.00.21.3
	0.15.45.5
	0.00.29.5
orth ?	71.00.0
m London (in Time 2 hours)	30.00.0
rth ?	51.30.0
Solomon Islas South supposed to be	11.00.0
don, supposed to be (in time 9h.20m)	140.00.0

EXPLANATION.

N L B. The Earth's enlightened Disc, on which are delineated the Equator, Tropic of Cancer, diurnal Paths of Wardhuys, London, Island of St. Cruz as seen from the Sun; and the parallaxes of Venus's longitude and latitude as seen from those Places, at the times of Venus's two internal contacts with the Sun.

E g D. A small part of Venus's Orbit; and b g G its Axis.

N g B. The Earth's Axis and Universal Meridian. P its North Pole.

W..... The situation of Wardhuys on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's Center: & w the situation of Wardhuys when Venus's Egress from the Sun begins.

W a.... Venus's Parallax in Longitude = 16".¼ westward, as seen from Wardhuys at the time of her total Ingress on the Sun as seen from the Earth's center, and W e her Parallax in Latitude = 18".⅔ southward at that time.

w b.... Venus's Parallax in Longitude = ½" eastward, as seen from Wardhuys at the time when her Egress from the Sun begins, as seen from the Earth's center, and w g, her parallax in Latitude = 21¾ southward, at that time.

L..... The situation of London on the Earth's Disc, as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center.

L d.... Venus's Parallax in Longitude = 16" Westward, as seen from London at the time of her total Ingress as seen from the Earth's center; and L f her Parallax in Latitude, = 14".½ at that time. Her Egress is invisible at London.

S..... The situation of St. Cruz Isle on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center; and s, the situation of St. Cruz when Venus's Egress from the Sun begins.

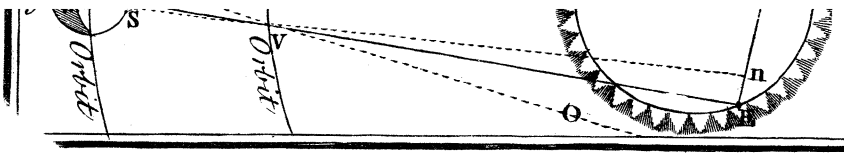
S o.... Venus's Parallax in Longitude = 11".½ Eastward, as seen from St. Cruz at the time of Venus's total Ingress as seen from the Earth's center, & S m her Parallax in Latitude, = 8".½ at that time, North.

s p.... Venus's Parallax in Longitude, = 16".¼ Westward, as seen from St. Cruz at the time when her Egress begins as seen from the Earth's Center, and s f. her Parallax in Latitude = 12" Northward at that time.

All these parallaxes are measured on the Scale at the left hand; and the times by which the total Ingress of Venus, & her beginning of Egress, are accelerated or retarded by her Parallax in Longitude, are found in the Scale, right against that Parallax. An eastern Parallax in Longitude retards the Ingress or Egress as seen from any given place, with respect to the time thereof as seen from the Earth's center, and a western parallax in Longitude accelerates it. A northern Parallax in Latitude retards the time of Ingress, as seen from any given place, & accelerates the time of Egress, by the number of Minutes that the half-transit Line on the Sun's Disc is shorter as seen from the given place than as seen from the Earth's center, when Venus passeth above the Sun's center, as in this Transit; & a Southern Parallax in Latitude accelerates the Ingress, and retards the Egress, as seen from any given place, with respect to the time thereof as seen from the Earth's center, by the number of Minutes that the half-transit line on the Sun is longer as seen from the given place than as seen from the Earth's center. And these differences are found by measuring with Compasses in the above Figure of the Sun's Disc, from the Axis of Venus's Orbit to the Arc a b where Venus's center is at the instant of total Ingress; and to the Arc c d where her center is when her Egress begins. And thus, the times of total Ingress, and beginning of Egress as seen from the above mentioned places, were found, as expressed in the Table of the Times and Durations of the Transit.

Diagram. S s W w represents the Earth which the order of the Letters. When Venus is r upon the Sun at I, at her total Ingress, but at the same time, as seen from St. Cruz e S V N, not entered upon the Sun; and t W, she will appear to be advanced upon e Ingress will be sooner, as soon from Wardan as seen from the Earth's center.

As Venus moves from V to v in her Orbit, St. Cruz moves the contrary way, from S to s, and Wardhuys the same way, from W to w. When Venus is at v in her Orbit, she will appear on the Sun at E, at her beginning of Egress, as seen from the Earth's center: but at that time, she will be quite clear of the Sun, in the line s v O, as seen from St. Cruz then at S; and as seen from Wardhuys, then at w, she will appear on the Sun at n, short of her beginning of Egress, which will be later at Wardhuys and sooner at St. Cruz, than as seen from the Earth's center.

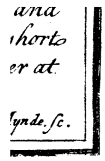


as then seen from Wardhuys at W, she
The Sun at m, so that her total Ingress
huys, & later, as seen from St Cruz, than as seen

t W, she will appear to be advanced upon
e Ingress will be sooner, as soon from Ward-
han as seen from the Earth's center.

clear of the Sun, in the line S V O, as seen from St. Cruz then at S; and
as seen from Wardhuys, then at w, she will appear on the Sun at n, short
of her beginning of Egress, which will be later at Wardhuys and sooner at
St. Cruz, than as seen from the Earth's center.

J. Mynde. sc.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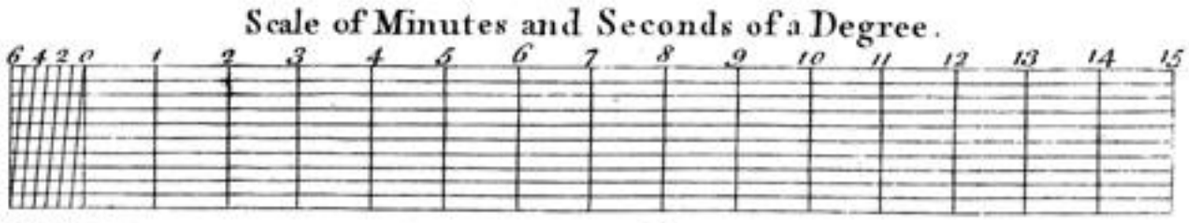
Philos. Trans. Vol. LIII. TAB. I. p. 30.

The *TRANSIT* of VENUS over the SUN, June 3d. 1769. Delineated by *James Ferguson.*

Scale of Minutes and Seconds of a Degree.



EXPLANATION.

F. Venus at her first contact with the Sun's eastern Limb.
I. Venus at her Total Ingress or first internal contact.
M. Venus at the middle of her geocentric Transit.
E. Venus at her beginning of Egress from the Sun.
L. Venus at her last contact with the Sun.

The SUN's northern Limb

The SUN's eastern Limb

Transit as seen from the Earth's Center

Venus's Path on the Sun as seen from different Parts of the Earth.

Visible Transit of St. Croz one of the Solomon Isles at London

Visible Transit at Wardhuys

Axis of Venus's Orbit

Axis of the Ecliptic

The SUN's western Limb.

EXPLANATION.

The larger divisions are minutes of a Degree, and the smaller ones are Seconds. The Discs of the Sun & Venus & the geocentric Latitude of Venus are laid down from this Scale, according to the tabular Elements. The Parallaxes of Venus's Latitude as seen from Wardhuys and from the Solomon Isles both at the times of total Ingress and beginning of Egress are taken from this Scale, and set off from the geocentric Transit line by marks and through these marks the Lines of the visible Transits are Drawn. All the parallaxes are delineated on the Earth's Disc and measured on the Scale on the left hand.

Remarks.

The most proper places for observing this Transit would be Wardhuys a port Town in the Norwegian Lapland & some of the Solomon Isles (as St. Croz) in the Great South Sea. For in both these places the whole Transit will be seen from beginning to ending. Moreover in Lapland the Line of the visible Transit will be longer than the transit line supposed to be seen from the Earth's center, and the time of the Planets describing it will be yet longer on account of its apparent motion being slower by Lapland's moving the same way. But at the Solomon Isles the visible Line of the Transit will be shorter than that supposed to be seen from the Earth's center, and the time of Venus's describing it will be still more shortened on account of the apparent quickness of her motion arising from its being in a contrary direction to the motion of the Solomon Islands.

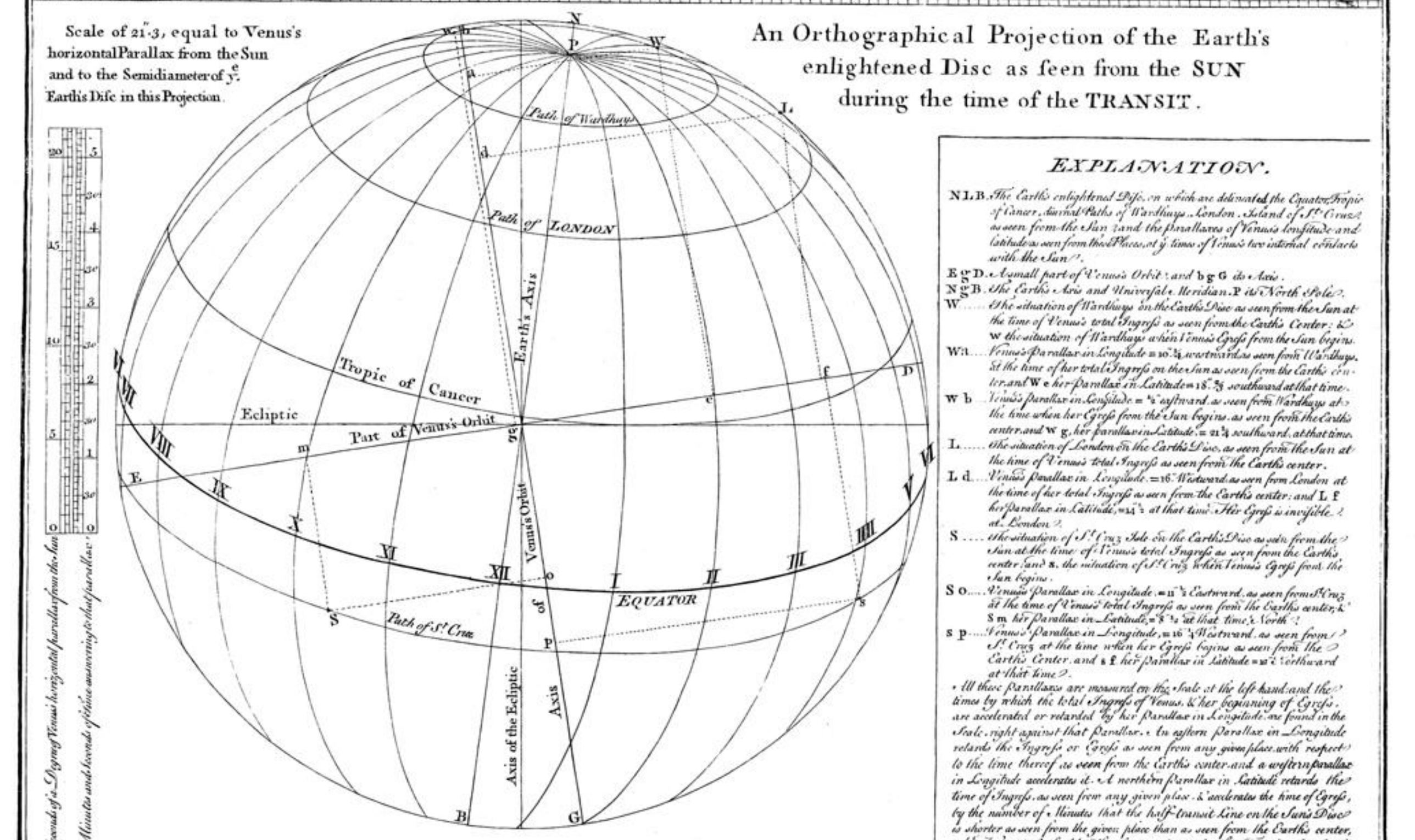
We have assumed 8.5/12 for the quantity of the Sun's parallax in this delineation, and if that be the true quantity the duration of the Transit will be 23 minutes 30 seconds longer as seen from Wardhuys than as seen from the Solomon Isles supposing them 1.5° west of London & the visible Latitude of Venus at the middle of their Transit will be 3.2 greater at these Isles than at Wardhuys.

If the Sun's parallax be either greater or less than 8.5/12 the difference of the visible durations of the Transit will be greater or less according to. So that if these differences be well ascertained by Observation, the Sun's parallax will thereby be found and consequently his distance from the Earth, and from every other Planet in the Solar System.

The Times and Durations of the TRANSIT.

Equal times at	1 • As they would be if neither the Sun nor Venus had any Parallax. Total Ingress H. M. S.	1 Beg. of Egress H. M. S.	2 • As they will be on Account of the Parallaxes of the Sun and Venus. Total Ingress H. M. S.	2 Beg. of Egress H. M. S.	Duration H. M. S.
The Earth's center	VII 45 0 A.	I 24 0 M.	No Parallax	No Parallax	5 39 0
Wardhuys.	IX 45 0 A.	III 24 0 M.	IX 37 23 A.	III 29 3 M.	5 51 40
LONDON.	VII 45 0 A.	I 24 0 M.	VII 37 30 A.	Invisible	———
St. Croz Isle.	X 25 0 M.	III 4 0 A.	X 29 36 M.	III 35 55 A.	5 23 39

Part of the ECLIPTIC



The Elements from which these Projections are deduced.

		D. H. M. S.
1.	True time at Greenwich of Conjunction of the Sun & Venus June 3	3.10.11.0 P.M.
2.	Their true Places in the Ecliptic then as seen from the Earth's center	2.13.26.51
3.	The Sun's Declination North	22.27.20
4.	The Place of Venus's ascending Node	2.14.36.14
5.	Her Geocentric Latitude at that time, North Descending	10.22
6.	The Angle of her visible path with the Ecliptic	8.30.10
7.	Her Geocentric horary motion on her from the Sun	3.59.1/2
8.	The Sun's distance from the Earth } in parts	101523 The Sun's mean distance
9.	Venus's distance from the Sun }	72627 from the Earth's center
10.	Her distance from the Earth }	28896 being 100000 of such parts
11.	The Sun's horizontal parallax assumed to be	0.00.8".5
12.	And consequently, Venus's horizontal parallax	0.00.29.8
13.	Their difference = Venus's horizontal parallax from the Sun	0.00.21.3
14.	The Sun's Semidiameter	0.15.45.5
15.	Venus's Semidiameter	0.00.29.5
16.	Latitude of Wardhuys, North	71.00.0
17.	Its Longitude, East from London (in Time 2 hours)	30.00.0
18.	Latitude of London, North	51.30.0
19.	Latitude of St. Croz one of the Solomon Isles, South supposed to be	11.00.0
20.	Its Longitude West from London supposed to be (in time 9h 20m)	140.00.0

J. Mynde sc.