R. H. A. Bennet 1817
Sept. Eleven

TABLES

OF THE

APPARENT PLACES

OF THE COMET OF 1661.

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APPARENT PLACES

OF THE COMET OF 1661,

WHOSE RETURN IS EXPECTED IN 1789.

To which is added,

A new Method of uſing the RETICULE RHOMBOIDE.

BY

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P R E F A C E.

THE following Tables, with the few pages of explanation annexed, were in great meaſure computed, and the large plate of the comet's orbit was engraved, before I had heard that Monſ. Pingrè had computed Tables of the ſame ſort, which were to be publiſhed in the Connoiſſance des Temps for 1789. Theſe would certainly have hindered my undertaking the preſent work; but as it was ſo far advanced, and as my Tables are much more copious than thoſe of Mr. Pingrè, and the elements I have uſed ſomewhat different, I thought it might not be deemed uſeleſs to publiſh this work.

In a buſineſs of this ſort, where a ſmall change in the elements of the comet, or its arrival at the perihelion in the intervals of the ſuppoſed tabular times, muſt make a conſiderable change in the apparent places, much accuracy in computing them would have been an uſeleſs waſte of labour: they therefore were found by conſtruction only, in the way given at large in the ſubſequent pages.

 Thoſe

Thofe who wifh for a particular account and hiftory of the Comet in queftion, will find it in Mr. Pingré's Treatife above referred to, or in the Comêtographie of that excellent author: There is alfo a moft ingenious Memoire on this fubject publifhed by Monf. Mechain, in the Hiftoire de L'Academie des Sciences.

To the Tables of the Comet I have fubjoined a method of obferving with the Reticule Rhomboide, which I have long practifed with much fuccefs, and indeed have reafon to think as accurate as the ufual method of ufing it. This may be of peculiar ufe to perfons who may fee the comet in the fouthern hemifphere, in the courfe of a voyage, and who, with a telefcope and tolerable watch, may at once make moft valuable obfervations, if they are but for a day or two at land.

TABLES

OF THE

APPARENT PLACES

OF THE

COMET OF 1661.

WHEN Dr. Halley, in consequence of the discoveries of his illustrious friend and master, Sir Isaac Newton, applied himself to calculate the parabolic orbits of all the comets, of which sufficient observations had been made; he found such a similarity in the elements of several of them, as to render it almost certain that they were returns of the same comets, moving in extremely extended ellipses, and visible only in the inferior part of their orbits. The first of these, whose period is about 75 years, and which had been observed in 1456, 1531, 1607, and 1682, he announced for the year 1759, as the perturbations of the planets, he thought,

thought, might lengthen its period, and retard its return to the ſun about a year.

What Halley had predicted on a general view of the ſyſtem; the celebrated Monſ. Clairault, with equal genius and labour, reduced to an accurate calculation; and gave the laſt deciſive proof of the truth of the Newtonian ſyſtem of univerſal attraction, by aſcertaining the period of the comet's revolution within a month; though the perturbations had amounted to no leſs than 588 days.

An equal ſimilarity in the elements of the comets of 1532 and 1661, induced Dr. Halley to predict its return for the year 1789; but as the time of its arrival at the perihelion muſt be, from the perturbations of the planets, uncertain within a few months, and its firſt appearance will be in the ſouthern part of the heavens; I have thought that it might not be uſeleſs to conſtruct Ephemerides for its apparent place to every eight days, ſuppoſing its arrival at the perihelion to be every ſixteen days for a year; in order to guide perſons reſident in the ſouthern hemiſphere, or near the equator, in their ſearch for it. And as all the places were laid down from the large drawing of the orbit, which accompanies this book, and its places for any other given time on any ſuppoſition of its arrival at the perihelion, may be with great eaſe found by the ſame method; it will be proper to give a ſhort account both of the drawing and method of computation from it.

The

The outer double lined circle reprefents the ecliptic, having the fun in its centre, and is divided into figns and degrees.

The orbit of the earth is reprefented by an eccentric circle, whofe radius is fix inches, which is taken as the mean diftance of the earth from the fun; and it is divided to every fourth day from July 1788 to July 1789.

The orbit of the comet is reprefented by the parabola, divided and numbered to every fourth day, in its true dimenfions; the ends of the lines which are perpendicular to the line of nodes, with the fame numbers by them, are the places of the comet projected on the plane of the ecliptic.

Thefe points are thus found: Let fall a perpendicular from the place of the comet in its orbit, on the line of nodes, and find its value in parts of the fun's mean diftance from the earth, taken as unity; then with that perpendicular for radius, find the cofine of the inclination of the comet's orbit in parts of the fun's mean diftance from the earth, and fet that off on the perpendicular before mentioned, from the line of nodes towards the comet's place.

The numbers given in Table I. are the perpendicular diftances of the comet from the plane of the ecliptic, in parts of the fun's mean diftance from the earth, which is taken as unity.

Thefe diftances are alfo fet off on the correfponding lines of projected place, from the line of nodes towards the comet's place; as having them given faves much time in finding the comet's place by conftruction.

Thefe diftances are found by making the cofine of the inclination found as above, radius, and taking the tangent of the inclination = to the diftance from the plane of the ecliptic in parts of the fun's mean diftance from the earth.

With thefe data the comet's geocentric place is quickly found, in the following manner:

For the longitude, draw a line from the place of the earth to the projected place of the comet, and a parallel line paffing through the fun, will cut the ecliptic in the comet's geocentric longitude fought.

For the latitude: With the diftance of the earth from the projected place of the comet for radius, make the perpendicular diftance of the comet from the plane of the ecliptic, found in Table I. Tangent; the angle given will be the geocentric latitude fought.

Should any one be defirous of knowing the real geocentric diftance of the comet, it is readily found by the drawing and Table I. it being ever the hypothenufe of a right angled triangle, one of whofe fides is the diftance of the earth from the comet's projected place; the other is the

per-

perpendicular diſtance of the comet from the plane of the ecliptic.

All theſe operations are readily performed with a good ſector, and to a much greater degree of accuracy than is requiſite for operations of this nature.

The projected points and table of perpendicular diſtances were found by this means, which otherwiſe would have conſumed much time in computing.

The elements of the comet's orbit, which I have uſed for the drawing, and apparent places given in the enſuing Tables, are thoſe given by Dr. Maſkelyne in his Announce of the Comet, and are as follow:

Perihelion diſtance - - - -	0.44851
Place of aſcending node - - - -	2ˢ. 24°. 18′
Inclination of the orbit to the ecliptic -	32 . 36
Perihelion forwarder in the orbit than the aſcending node - - - - -	33 . 28
Motion direct.	

The Tables give the apparent longitudes and latitudes of the comet on fifteen different ſuppoſitions of its arrival at the perihelion, viz. from Auguſt 25, 1788, every ſixteen days, to Auguſt 12, 1789. Theſe places will, without much error, ſerve for the ſame days in the following years, ſhould the return of the comet be ſo long delayed.

 In

In each ſuppoſition, its place is given every eighth day, from 96 days before the perihelion, to the ſame time after it, unleſs the comet's projected diſtance from the earth exceeds double the diſtance of the earth from the ſun; in which caſe it can be ſcarcely viſible, even to the beſt teleſcope, particularly in its deſcent to the ſun.

The inſpection of the drawing will ſhew, that its appearance will be very inconſpicuous to us, if its return ſhould happen during the ſummer months. Indeed in the northern hemiſphere, we have in that caſe ſcarce a chance of ſeeing it at all. Thoſe perſons, therefore, who inhabit the ſouthern climates, ſhould redouble their ſearch, leſt it ſhould paſs entirely unobſerved.

During the winter and ſpring months, it will probably force itſelf on our notice, unleſs its ſtate be much altered ſince its laſt appearance, a thing by no means improbable, as it ſeems that, in the very ſame circumſtances, the colour and ſize of the ſame comet varies much.

As the orbit of this comet is much inclined to the ecliptic, and the line of nodes is not near the point of interſection of its orbit with that of the earth, it can never approach very near us. The ſmalleſt diſtance poſſible is when it paſſes the earth's orbit after the perihelion, which happens at forty-four days after, when its diſtance from the plane of the ecliptic is .4250, or about $\frac{4}{10}$ths of the diſtance from the ſun to the earth. Should the earth then be in that point of its orbit, the comet will paſs through the north pole of the ecliptic with a rapid apparent motion.

Its diſtance from the earth's orbit, when it paſſes it in deſcending to the ſun, is much greater, being .5960, or $\frac{6}{10}$ths of the ſun's diſtance. This happens forty-ſeven days before the perihelion.

The places of the comet are given for every eighth day throughout each period, though in many inſtances it will not be viſible from its proximity to the ſun, particularly in ſummer, when it will be almoſt in ſuperior conjunction for a month on each ſide the perihelion.

Should the earth be in the line of nodes, and on the ſame ſide when the comet paſſes its aſcending node, it may viſibly tranſit the ſun's diſk. This, however curious, is a ſight we have not much reaſon to expect, as ſo nice a coincidence of circumſtances is very improbable.

The deſcending node cuts the comet's orbit far beyond the earth.

From the poſition of the aſcending node, the comet cannot make any very near approach to Venus; and the orbit of Mercury is included in that of the comet, and conſiderably nearer the ſun than the perihelion diſtance of the comet.

These

Thefe are the principal circumftances relative to the next return of the expected comet, which, however, is ftill a doubtful event. Nor fhould its non-appearance lead any one to think, that the foundations of aftronomy are erroneous or doubtful. When we confider the very fmall probable quantity of matter contained in comets, when compared with planets, the larger ones particularly, and the flownefs of their motion when in the neighbourhood of Jupiter and Saturn, which expofes them the longer to the action of their attractive power: above all, when the difcovery of the Georgium Sidus, a body of confiderable magnitude, and placed at double the diftance from the fun of the furtheft planet known before, points out another difturbing caufe, more potent, as further removed from the great center of attraction; and may even lead us to a belief, that the limits of the planetary fyftem may not even be placed at that vaft diftance, but the attraction of the fun may guide other regularly revolving bodies, perhaps for ever invifible to our moft powerful telefcopes: we may perhaps wonder rather, that any comet preferves the figure of its orbit, fo as to prove its identity in its different returns to the fun, than that fuch a phenomenon happens fo feldom.

The real fize of different comets certainly varies moft aftonifhingly; and the attention of the prefent race of aftronomers has difcovered many, which even in the laft century would have paffed unobferved, and before the invention of

tele-

telefcopes could not have been feen; fo that perhaps as yet we have not had the return of thofe vaft comets which forced themfelves into the notice of our anceftors. Yet ftill it is rather fingular, that among twenty-fix calculated by Halley, three fhould have borne very ftrong marks of identity, and that the fifty comets obferved fince his time fhould not have added one to that number.

I cannot help therefore fufpecting, that, befides thofe comets whofe orbits may have been fo far altered, as totally to quit the fun, and wander through the immeafurable voids of fpace, till they fall within the fphere of attraction of fome other ftar (an hypothefis by no means improbable), many may have returned fo much altered in the figure and pofition of their orbits, as to be totally unknown to us for the fame. Indeed of this we have one moft ftriking inftance in the comet of 1770, whofe period, as deduced from its appearance at that time, was only five years and an half, as feparately computed by Meffrs. Lexell and Pingrè; and yet this comet has appeared no more, at leaft fo as to be recognizable by us.

This then has proved beyond a doubt the vaft changes incident to thefe fingular bodies; and as the proof of their returning refts as yet on a fingle inftance, we are fo far at leaft authorifed to fay, that poffibly as many may be altered as not.

T A B L E I.

Perpendicular Diſtances of the COMET from the Plane of the Ecliptic.

South of the Ecliptic.				North of the Ecliptic.			
Days before the Perihelion	Diſtance.	Days before the Perihelion	Diſtance.	Days before the Perihelion	Diſtance.	Days after the Perihelion	Diſtance.
100	1 · 0850	40	0 · 5000	4	0 · 0650	44	0 · 4250
96	1 · 0610	36	0 · 4500	Perihel.	0 · 1370	48	0 · 4290
92	1 . 0300	32	0 · 4000	Days after the Perihelion		52	0 · 4310
88	0 . 9900	28	0 · 3400			56	0 · 4400
84	0 · 9550	24	0 · 2800			60	0 · 4410
80	0 · 9200	20	0 · 2150	4	0 · 1920	64	0 · 4420
76	0 · 8800	16	0 · 1500	8	0 · 2470	68	0 · 4420
72	0 · 8420	12	0 · 0850	12	0 · 2900	72	0 · 4420
68	0 · 8050	8	0 · 090	16	0 · 3250	76	0 · 4410
64	0 · 7620			20	0 · 3530	80	0 · 4400
60	0 · 7210			24	0 · 3740	84	0 · 4340
56	0 · 6840			28	0 · 3920	88	0 · 4300
52	0 · 6450			32	0 · 4050	92	0 · 4290
48	0 · 5960			36	0 · 4175	96	0 · 4270
44	0 · 5500			40	0 · 4225	100	0 · 4250

Pe-

Perihelion, Aug. 25, 1788.

Days of the Month.	Distance from Perihelion in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
June 14	72	1 . 7 . 15	25 . 0 S
22	64	1 . 15 . 0	24 . 45
30	56	1 . 23 . 15	24 . 0
July 8	48	2 . 2 . 30	22 . 40
16	40	2 . 13 . 15	20 . 30
24	32	2 . 24 . 40	17 . 15
Aug. 1	24	3 . 7 . 45	12 . 15
9	16	3 . 21 . 40	6 . 40
17	8	4 . 6 . 10	0 . 10
25	Perihel.	4 . 22 . 0	5 . 45 N
Sept. 2	8	5 . 7 . 30	9 . 45
10	16	5 . 22 . 30	12 . 0
18	24	6 . 5 . 20	13 . 0
26	32	6 . 16 . 30	13 . 10

Perihelion, Sept. 10, 1788.

Days of the Month.	Distance from Perihelion in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
June 22	80	1 . 5 . 50	28 . 0 S
30	72	1 . 12 . 45	27 . 55
July 8	64	1 . 21 . 0	27 . 45
16	56	2 . 0 . 0	27 . 20
24	48	2 . 10 . 15	25 . 50
Aug. 1	40	2 . 21 . 45	23 . 30
9	32	3 . 4 . 30	19 . 45
17	24	3 . 18 . 10	13 . 50
25	16	4 . 2 . 45	7 . 30
Sept. 2	8	4 . 17 . 30	0 . 15
10	Perihel.	5 . 3 . 40	6 . 15 N
18	8	5 . 18 . 20	10 . 0
26	16	6 . 2 . 45	12 . 15
Oct. 4	24	6 . 15 . 0	12 . 50
2	32	6 . 25 . 20	13 . 0

Perihelion, Sept. 26, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
June 22	96	0 . 28 . 0	30 . 15 S
30	88	1 . 4 . 0	31 . 0
July 8	80	1 . 10 . 20	31 . 40
16	72	1 . 17 . 45	32 . 0
24	64	1 . 26 . 30	32 . 30
Aug. 1	56	2 . 6 . 30	32 . 10
9	48	2 . 18 . 0	31 . 15
17	40	3 . 1 . 0	28 . 30
25	32	3 . 15 . 0	24 . 0
Sept. 2	24	4 . 0 . 0	16 . 45
10	16	4 . 15 . 0	8 . 30
18	8	5 . 0 . 0	0 . 25
26	Perihel.	5 . 15 . 0	6 . 40 N
Oct. 4	8	5 . 29 . 40	10 . 30
12	16	6 . 13 . 0	12 . 30
20	24	6 . 24 . 35	13 . 0
28	32	7 . 4 . 15	13 . 0

Perihelion, Oct. 12, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
July 8	96	1 . 1 . 15	34 . 0 S
16	88	1 . 7 . 0	35 . 20
24	80	1 . 13 . 30	36 . 30
Aug. 1	72	1 . 21 . 30	37 . 50
9	64	2 . 1 . 20	38 . 50
17	56	2 . 12 . 15	39 . 30
25	48	2 . 25 . 30	38 . 30
Sept. 2	40	3 . 11 . 0	35 . 40
10	32	3 . 26 . 50	30 . 0
18	24	4 . 13 . 30	20 . 30
26	16	4 . 29 . 0	10 . 15
Oct. 4	8	5 . 13 . 0	0 . 30
12	Perihel.	5 . 27 . 30	7 . 15 N
20	8	6 . 11 . 30	11 . 0
28	16	6 . 24 . 0	12 . 50
Nov. 5	24	7 . 4 . 30	13 . 15
13	32	7 . 13 . 20	13 . 15

Perihelion, Oct. 28, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
July 24	96	1 . 2 . 25	39 . 15 S
Aug. 1	88	1 . 7 . 40	41 . 25
9	80	1 . 14 . 0	43 . 30
17	72	1 . 22 . 15	45 . 40
25	64	2 . 2 . 40	48 . 10
Sept. 2	56	2 . 15 . 40	50 . 15
10	48	3 . 2 . 30	50 . 45
18	40	3 . 23 . 0	47 . 30
26	32	4 . 12 . 50	40 . 0
Oct. 4	24	5 . 1 . 0	26 . 30
12	16	5 . 15 . 50	12 . 40
20	8	5 . 28 . 30	0 . 45
28	Perihel.	6 . 11 . 25	8 . 0 N
Nov. 5	8	6 . 23 . 35	12 . 0
13	16	7 . 4 . 45	13 . 45
21	24	7 . 14 . 15	13 . 50
29	32	7 . 22 . 0	13 . 45
Dec. 7	40	7 . 28 . 25	13 . 10

Perihelion, Nov. 13, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Aug. 9	96	1 . 0 . 20	45 . 30 S
17	88	1 . 4 . 20	48 . 45
25	80	1 . 9 . 40	52 . 20
Sept. 2	72	1 . 16 . 20	56 . 40
10	64	1 . 26 . 20	61 . 45
18	56	2 . 11 . 30	66 . 15
26	48	3 . 8 . 45	69 . 45
Oct. 4	40	4 . 14 . 25	66 . 40
12	32	5 . 11 . 25	55 . 0
20	24	5 . 28 . 10	35 . 30
28	16	6 . 8 . 40	16 . 0
Nov. 5	8	6 . 17 . 20	1 . 0
13	Perihel.	6 . 27 . 0	9 . 5 N
21	8	7 . 7 . 0	13 . 0
29	16	7 . 16 . 0	14 . 30
Dec. 7	24	7 . 24 . 10	14 . 40
15	32	8 . 1 . 0	14 . 30
23	40	8 . 7 . 0	13 . 50
31	48	8 . 12 . 0	13 . 5

Pe-

Perihelion, Nov. 29, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Aug. 25	96	0 . 21 . 40	52 . 50 S
Sept. 2	88	0 . 22 . 0	57 . 0
10	80	0 . 22 . 30	61 . 30
18	72	0 . 22 . 0	66 . 50
26	64	0 . 18 . 40	73 . 0
Oct. 4	56	0 . 7 . 0	79 . 30
12	48	10 . 4 . 0	86 . 40
20	40	8 . 0 . 35	77 . 45
28	32	7 . 19 . 45	63 . 15
Nov. 5	24	7 . 12 . 45	42 . 45
13	16	7 . 11 . 10	19 . 45
21	8	7 . 11 . 15	1 . 0
29	Perihel.	7 . 14 . 20	10 . 30 N
Dec. 7	8	7 . 20 . 50	14 . 45
15	16	7 . 28 . 0	16 . 0
23	24	8 . 4 . 45	16 . 0
31	32	8 . 10 . 20	15 . 40
Jan. 8	40	8 . 15 . 20	15 . 10
16	48	8 . 19 . 30	14 . 30
24	56	8 . 23 . 0	14 . 0
Feb. 1	64	8 . 25 . 45	13 . 30

Perihelion, Dec. 15, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Sept. 10	96	0 . 3 . 15	58 . 0 S
18	88	11 . 27 . 35	60 . 45
26	80	11 . 20 . 0	63 . 20
Oct. 4	72	11 . 9 . 10	65 . 15
12	64	10 . 26 . 0	65 . 50
20	56	10 . 12 . 30	64 . 30
28	48	9 . 29 . 30	61 . 0
Nov. 5	40	9 . 19 . 0	56 . 0
13	32	9 . 11 . 0	48 . 30
21	24	9 . 0 . 0	36 . 30
29	16	8 . 19 . 10	19 . 45
Dec. 7	8	8 . 10 . 10	1 . 15
15	Perihel.	8 . 6 . 0	12 . 10 N
23	8	8 . 7 . 15	16 . 45
31	16	8 . 11 . 15	18 . 0
Jan. 8	24	8 . 16 . 0	17 . 50
16	32	8 . 20 . 0	17 . 20
24	40	8 . 23 . 45	16 . 45
Feb. 1	48	8 . 27 . 20	16 . 0
9	56	8 . 29 . 30	15 . 40
17	64	9 . 1 . 40	15 . 20
25	72	9 . 3 . 0	15 . 0
March 5	80	9 . 4 . 15	14 . 45
13	88	9 . 5 . 0	14 . 20
21	96	9 . 4 . 45	14 . 15

Perihelion, Dec. 31, 1788.

Days of the Month.	Diſtance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Sept. 26	96	11 . 10 . 20	56 . 50 S
Oct. 4	88	11 . 3 . 0	57 . 0
12	80	10 . 26 . 30	56 . 10
20	72	10 . 19 . 25	54 . 15
28	64	10 . 13 . 45	51 . 45
Nov. 5	56	10 . 10 . 20	48 . 30
13	48	10 . 6 . 40	44 . 30
21	40	10 . 4 . 0	40 . 30
29	32	10 . 2 . 10	35 . 20
Dec. 7	24	9 . 28 . 40	27 . 40
15	16	9 . 23 . 0	16 . 45
23	8	9 . 13 . 20	1 . 0
31	Perihel.	9 . 1 . 45	13 . 40 N
Jan. 8	8	8 . 26 . 45	19 . 30
16	16	8 . 25 . 50	20 . 45
24	24	8 . 27 . 30	20 . 30
Feb. 1	32	9 . 0 . 0	19 . 50
9	40	9 . 2 . 0	19 . 15
17	48	9 . 4 . 20	18 . 30
25	56	9 . 5 . 45	18 . 15
March 5	64	9 . 6 . 25	18 . 0
13	72	9 . 6 . 40	17 . 40
21	80	9 . 6 . 30	17 . 30
29	88	9 . 5 . 40	16 . 50
April 6	96	9 . 4 . 0	16 . 45

Perihelion, Jan. 16, 1789.

Days of the Month.	Diſtance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Oct. 12	96	10 . 25 . 30	50 . 40 S
20	88	10 . 20 . 50	48 . 40
28	80	10 . 18 . 0	46 . 30
Nov. 5	72	10 . 15 . 30	43 . 45
13	64	10 . 14 . 20	41 . 5
21	56	10 . 14 . 0	38 . 0
29	48	10 . 14 . 0	34 . 45
Dec. 7	40	10 . 15 . 15	31 . 40
15	32	10 . 16 . 30	26 . 45
23	24	10 . 17 . 0	20 . 45
31	16	10 . 16 . 0	12 . 45
Jan. 8	8	10 . 11 . 10	0 . 50
16	Perihel.	10 . 0 . 0	14 . 0 N
24	8	9 . 19 . 40	22 . 0
Feb. 1	16	9 . 13 . 20	24 . 25
9	24	9 . 11 . 30	24 . 30
17	32	9 . 11 . 20	23 . 45
25	40	9 . 11 . 25	23 . 15
March 5	48	9 . 11 . 35	22 . 30
13	56	9 . 11 . 0	22 . 15
21	64	9 . 9 . 40	21 . 45
29	72	9 . 8 . 0	21 . 30
April 6	80	9 . 6 . 0	21 . 5
14	88	9 . 3 . 20	20 . 15
22	96	8 . 29 . 40	20 . 0

Perihelion, Feb. 1, 1789.

Days of the Month.	Diſtance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Oct. 28	96	10 · 18 · 50	43 · 8 S
Nov. 5	88	10 · 17 · 30	41 · 0
13	80	10 · 17 · 20	38 · 35
21	72	10 · 17 · 25	36 · 0
29	64	10 · 18 · 15	33 · 55
Dec. 7	56	10 · 20 · 0	31 · 20
15	48	10 · 22 · 0	28 · 30
23	40	10 · 24 · 40	25 · 30
31	32	10 · 28 · 0	21 · 50
Jan. 8	24	11 · 1 · 40	16 · 50
16	16	11 · 3 · 15	10 · 30
24	8	11 · 4 · 0	0 · 45
Feb. 1	Perihel.	10 · 27 · 45	12 · 45 N
9	8	10 · 16 · 40	24 · 0
17	16	10 · 5 · 40	29 · 0
25	24	9 · 28 · 10	30 · 0
March 5	32	9 · 24 · 0	30 · 5
13	40	9 · 20 · 50	29 · 30
21	48	9 · 18 · 0	28 · 40
29	56	9 · 14 · 0	28 · 20
April 6	64	9 · 10 · 15	28 · 5
14	72	9 · 5 · 30	27 · 30
22	80	9 · 0 · 30	26 · 30
30	88	8 · 25 · 20	24 · 55
May 8	96	8 · 19 · 0	23 · 30

Perihelion, Feb. 17, 1789.

Days of the Month.	Diſtance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Nov. 13	96	10 · 18 · 10	37 · 15 S
21	88	10 · 18 · 35	35 · 0
29	80	10 · 20 · 0	33 · 10
Dec. 7	72	10 · 21 · 20	30 · 50
15	64	10 · 23 · 30	28 · 45
23	56	10 · 26 · 40	26 · 40
31	48	11 · 0 · 0	24 · 15
Jan. 8	40	11 · 4 · 0	21 · 40
16	32	11 · 8 · 20	18 · 40
24	24	11 · 13 · 0	14 · 10
Feb. 1	16	11 · 18 · 0	8 · 45
9	8	11 · 21 · 45	0 · 45
17	Perihel.	11 · 21 · 30	11 · 30 N
25	8	11 · 15 · 0	23 · 30
March 5	16	11 · 4 · 0	32 · 45
13	24	10 · 21 · 20	37 · 15
21	32	10 · 10 · 15	39 · 30
29	40	10 · 1 · 20	40 · 0
April 6	48	9 · 23 · 0	39 · 30
14	56	9 · 13 · 10	39 · 0
22	64	9 · 3 · 40	38 · 0
30	72	8 · 24 · 0	35 · 30
May 8	80	8 · 16 · 0	32 · 35
16	88	8 · 9 · 20	28 · 30
24	96	8 · 3 · 0	25 · 15

Perihelion, March 5, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.	Geocentric Latitude.
		S ° ′	° ′
Nov. 29	96	10 · 20 . 30	32 · 30 S
Dec. 7	88	10 · 21 · 50	30 · 45
15	80	10 · 24 · 10	28 · 55
23	72	10 · 26 · 40	27 · 0
31	64	11 · 0 · 0	25 · 15
Jan. 8	56	11 · 3 · 40	23 · 15
16	48	11 · 7 · 35	21 · 30
24	40	11 · 12 · 40	19 · 0
Feb. 1	32	11 · 18 · 0	16 · 20
9	24	11 · 24 · 0	12 · 20
17	16	0 · 0 · 30	7 · 35
25	8	0 · 7 · 0	0 · 30
March 5	Perihel.	0 · 11 · 15	9 · 40 N
13	8	0 · 10 · 40	21 · 30
21	16	0 · 5 · 15	33 · 45
29	24	11 · 24 · 0	44 · 15
April 6	32	11 · 8 · 45	53 · 15
14	40	10 · 17 · 45	61 · 5
22	48	9 · 21 · 40	59 · 30
30	56	8 · 26 · 30	56 · 0
May 8	64	8 · 9 · 0	49 · 0
16	72	7 · 28 · 30	41 · 0
24	80	7 · 23 · 0	34 · 15
June 1	88	7 · 19 · 0	28 · 0
9	96	7 · 17 · 0	23 · 35

Perihelion, March 21, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.	Geocentric Latitude.
		S ° ′	° ′
Jan. 16	64	11 · 6 · 30	23 · 0 S
24	56	11 · 11 · 0	21 · 15
Feb. 1	48	11 · 15 · 35	19 · 20
9	40	11 · 21 · 20	17 · 20
17	32	11 · 27 · 30	14 · 45
25	24	0 · 4 · 30	11 · 5
March 5	16	0 · 12 · 15	6 · 40
13	8	0 · 20 · 0	0 · 25
21	Perihel.	0 · 27 · 0	8 · 30 N
29	8	1 · 2 · 0	18 · 45
April 6	16	1 · 4 · 45	30 · 45
14	24	1 · 6 · 25	44 · 50
22	32	1 · 9 · 0	61 · 30
30	40	1 · 21 · 35	79 · 50
May 8	48	6 · 15 · 30	79 · 0
16	56	6 · 27 · 30	60 · 30
24	64	6 · 29 · 35	46 · 45
June 1	72	7 · 1 · 45	36 · 45
9	80	7 · 3 · 15	29 · 30
17	88	7 · 5 · 50	24 · 0
25	96	7 · 7 · 0	20 · 10

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Perihelion, April 6, 1789.

Days of the Month.	Diftance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Feb. 17	48	11 . 23 . 30	17 . 30 S
25	40	0 . 0 . 20	16 . 10
March 5	32	0 . 6 . 45	13 . 45
13	24	0 . 14 . 0	10 . 15
21	16	0 . 22 . 40	6 . 15
29	8	1 . 3 . 0	0 . 15
April 6	Perihel.	1 . 11 . 20	7 . 30 N
14	8	1 . 20 . 0	16 . 15
22	16	1 . 28 . 45	26 . 25
30	24	2 . 10 . 35	37 . 45
May 8	32	3 . 1 . 0	49 . 15
16	40	4 . 2 . 20	55 . 30
24	48	5 . 6 . 45	52 . 0
June 1	56	5 . 29 . 0	43 . 30
9	64	6 . 11 . 0	35 . 0
17	72	6 . 19 . 0	28 . 30
25	80	6 . 24 . 35	23 . 30
July 3	88	6 . 29 . 30	19 . 30

Perihelion, April 22, 1789.

Days of the Month.	Diftance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
March 13	40	0 . 8 . 20	15 . 25 S
21	32	0 . 15 . 15	13 . 0
29	24	0 . 23 . 45	9 . 45
April 6	16	1 . 2 . 50	5 . 45
14	8	1 . 13 . 10	0 . 10
22	Perihel.	1 . 24 . 0	6 . 45 N
30	8	2 . 5 . 45	14 . 15
May 8	16	2 . 18 . 20	22 . 30
16	24	3 . 4 . 0	30 . 15
24	32	3 . 24 . 30	36 . 15
June 1	40	4 . 17 . 35	38 . 0
9	48	5 . 9 . 0	35 . 30
17	56	5 . 25 . 30	31 . 0
25	64	6 . 6 . 40	26 . 15
July 3	72	6 . 15 . 30	22 . 15

Perihelion, May 8, 1789.

Days of the Month.	Diftance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
April 6	32	0 . 24 . 0	12 . 45 S
14	24	1 . 3 . 0	9 . 30
22	16	1 . 12 . 50	5 . 30
30	8	1 . 24 . 0	0 . 10
May 8	Perihel.	2 . 6 . 30	6 . 30 N
16	8	2 . 19 . 30	13 . 0
24	16	3 . 4 . 0	19 . 25
June 1	24	3 . 20 . 40	24 . 45
9	32	4 . 9 . 20	28 . 0
17	40	4 . 28 . 0	28 . 30
25	48	5 . 14 . 30	26 . 30
July 3	56	5 . 28 . 0	24 . 0
11	64	6 . 8 . 10	20 . 50
19	72	6 . 16 . 30	18 . 15
27	80	6 . 23 . 0	16 . 0
Aug. 4	88	6 . 29 . 0	14 . 0

Perihelion, May 24, 1789.

Days of the Month.	Diftance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
April 22	32	1 . 2 . 45	12 . 40 S
30	24	1 . 12 . 10	9 . 20
May 8	16	1 . 22 . 45	5 . 25
16	8	2 . 4 . 30	0 . 8
24	Perihel.	2 . 18 . 0	6 . 20 N
June 1	8	3 . 2 . 30	11 . 45
9	16	3 . 17 . 30	17 . 0
17	24	4 . 4 . 0	20 . 45
25	32	4 . 21 . 20	22 . 45
July 3	40	5 . 7 . 20	22 . 45
11	48	5 . 21 . 10	21 . 15
19	56	6 . 2 . 40	19 . 30
27	64	6 . 12 . 0	17 . 20
Aug. 4	72	6 . 19 . 30	15 . 30
12	80	6 . 26 . 0	13 . 50

Perihelion, June 9, 1789.

Days of the Month.		Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
May	8	32	1 . 11 . 30	12 . 45 S
	16	24	1 . 21 . 40	9 . 15
	24	16	2 . 3 . 0	5 . 20
June	1	8	2 . 15 . 0	0 . 20
	9	Perihel.	2 . 29 . 20	5 . 45 N
	17	8	3 . 14 . 20	10 . 55
	25	16	4 . 0 . 0	15 . 10
July	3	24	4 . 16 . 0	18 . 15
	11	32	5 . 1 . 40	19 . 30
	19	40	5 . 16 . 0	19 . 15
	27	48	5 . 28 . 10	17 . 45
Aug.	4	56	6 . 8 . 20	16 . 30
	12	64	6 . 16 . 40	15 . 0
	20	72	6 . 24 . 0	13 . 30

Perihelion, June 25, 1789.

Days of the Month.		Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
May	16	40	1 . 11 . 0	15 . 20 S
	24	32	1 . 20 . 0	12 . 55
June	1	24	2 . 1 . 10	9 . 30
	9	16	2 . 12 . 30	5 . 20
	17	8	2 . 25 . 30	0 . 15
	25	Perihel.	3 . 10 . 0	5 . 30 N
July	3	8	3 . 25 . 20	10 . 15
	11	16	4 . 11 . 10	14 . 0
	19	24	4 . 27 . 0	16 . 10
	27	32	5 . 11 . 30	17 . 15
Aug.	4	40	5 . 24 . 30	16 . 50
	12	48	6 . 5 . 20	15 . 40
	20	56	6 . 15 . 0	14 . 30

Perihelion, July 11, 1789.

Days of the Month.		Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
May	24	48	1 . 10 . 45	17 . 45 S
June	1	40	1 . 19 . 15	16 . 10
	9	32	1 . 29 . 20	13 . 30
	17	24	2 . 10 . 0	9 . 45
	25	16	2 . 22 . 20	5 . 30
July	3	8	3 . 6 . 0	0 . 10
	11	Perihel.	3 . 21 . 0	5 . 30 N
	19	8	4 . 6 . 10	9 . 45
	27	16	4 . 22 . 30	13 . 0
Aug.	4	24	5 . 7 . 20	14 . 50
	12	32	5 . 21 . 0	15 . 30
	20	40	6 . 2 . 40	15 . 0
	28	48	6 . 12 . 20	14 . 0

Perihelion, July 27, 1789.

Days of the Month.		Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
June	1	56	1 . 10 . 0	20 . 15 S
	9	48	1 . 18 . 20	19 . 0
	17	40	1 . 27 . 40	17 . 5
	25	32	2 . 8 . 0	14 . 15
July	3	24	2 . 19 . 30	10 . 20
	11	16	3 . 2 . 10	5 . 45
	19	8	3 . 16 . 0	0 . 10
	27	Perihel.	4 . 1 . 30	5 . 30 N
Aug.	4	8	4 . 17 . 20	9 . 45
	12	16	5 . 2 . 45	12 . 30
	20	24	5 . 17 . 0	14 . 0
	28	32	5 . 29 . 40	14 . 20
Sept.	5	40	6 . 10 . 40	13 . 45
	13	48	6 . 20 . 0	13 . 0

Perihelion, Aug. 12, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
June 9	64	1 . 9 . 15	22 . 45 S
17	56	1 . 17 . 0	22 . 0
25	48	1 . 26 . 0	20 . 35
July 3	40	2 . 6 . 15	18 . 45
11	32	2 . 17 . 0	15 . 30
19	24	2 . 29 . 10	11 . 15
27	16	3 . 12 . 30	6 . 15

Perihelion, Aug. 12, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° ′	Geocentric Latitude. ° ′
Aug. 4	8	3 . 26 . 30	0 . 10 S
12	Perihel.	4 . 12 . 20	5 . 40 N
20	8	4 . 28 . 30	9 . 45
28	16	5 . 13 . 20	12 . 15
Sept. 5	24	5 . 27 . 10	13 . 15
13	32	6 . 9 . 0	13 . 45
21	40	6 . 19 . 0	13 . 0

P O S T S C R I P T.

I HAD omitted mentioning in its proper place, another uſe to which the annexed drawing of the Comet's Orbit may be applied; viz. to the ſeeing at once whether any obſerved Comet is the one we are ſeeking. Suppoſe, for example, that a comet is obſerved on January 20th, 1789, with a longitude of 7^s 20°, and 10° ſouth latitude, draw a line through the ſun, cutting the ecliptic in the obſerved longitude, and a parallel line paſſing through the place of the earth in its orbit, does not cut the orbit of the comet at all; and therefore, the comet obſerved cannot be the one of 1661.

Suppoſe the obſerved longitude had been 9^s 10°, and its latitude 10° ſouth; in this caſe, a line drawn as above will cut the comet's orbit; but in a part where it muſt have an high northern latitude; and therefore, this likewiſe cannot be the expected comet.

Suppoſe the longitude of the comet obſerved as above to be 9^s 12° 30′, and its latitude north to be 21° 30′; by the operation above ſtated it will appear, that the comet we ſeek will have that longitude eight days after its perihelion with a northern latitude. The method given in the former part of the work will at once find the latitude for theſe points, which is juſt what was obſerved. This comet may therefore be the one ſought; but it will require two obſervations more to bring it to a certainty, as many parabolas may paſs through two given points, but only one can paſs through three ſuch points.

Deſcription of a Method of taking the differences of Right Aſcenſion and Declination; with the Reticule Rhomboide of Dr. Bradley, without placing the Inſtrument in the Plane of the Equator.

THE very ingenious ſyſtem of Wires, invented by Dr. BRADLEY, for taking differences of Right Aſcenſion and Declination, and called ſince *the Reticule Rhomboide*, has this inconvenience in common with all others, that it requires being placed in an equatorial poſition.

As this is ſcarcely poſſible without an equatorial motion in the ſtand of the teleſcope, and even then is not accompliſhed either with eaſe or expedition, a method of applying the Rhomboid, by which a conſiderable degree of accuracy may be obtained, without the leaſt regard to the poſition of the inſtrument, provided it be but ſteady, muſt be often extremely convenient, and may ſometimes be very uſeful, particularly with reſpect to comets, which are ſeen at times when the obſerver may not have accurate inſtruments at hand, or time to remove and replace thoſe which he has; whereas this method requires no preparation but pointing the telefcope to the object intended to be obferved.

It is fcarce neceffary to fay, that the conftruction of the Rhomboid is by forming a triangle, whofe bafe (vid. fig. 1.) B C is equal to the perpendicular A D. Then by the properties of fimilar triangles, the differences of every line drawn parallel to the bafe will be equal to the parts of the perpendicular intercepted between thofe lines. Thus let. 1. 1. and 2. 2. (fig. 1.) be the paths of two ftars through the Rhomboid; the difference of α β and γ δ, the tranfits of the ftars through the field of the Rhomboid, will be equal to ϵ ζ, their difference in Declination. Their difference of Right Afcenfion is found by halving the obferved lines of the tranfits, which of courfe gives their paffage over the centre of the inftrument, no other wires being ufed but A. B. and A. C.

In practice, the Rhomboid is completed by joining two of thefe triangles by the bafe, in order that the whole extent of the field of the telefcope may be applied to difference of Declination (vid. fig. 3.); but the theory of the inftrument exifts in either of the triangles.

In order to make obfervations with the inftrument out of an equatorial pofition, it is neceffary to have a third wire bifecting the Rhomboid, as in fig. 2. and the appulfes of the bodies to be compared, muft be obferved to each of the three wires. A drawing muft be prepared of the Rhomboid,

boid, of ſuch a ſize, that a ſecond of time may be equal to about a tenth of an inch, or about twice the ſize of fig. 2. Then with a ſcale of equal parts, cut on a chamfered edge, apply the obſerved times of the tranſits of each ſtar to the figure, ſo that they may exactly correſpond to the obſervations, and draw pencil lines, which, if the obſervations are well made, will be parallel. The diſtance between theſe lines will be equal to the difference of Declination of the two ſtars, meaſured on the ſame ſcale of equal parts; which muſt be reduced to degrees and minutes of a great circle, at the rate of a degree to four minutes, as uſual: and a line let fall from the point of tranſit of one ſtar, through the middle wire perpendicularly on the path of the other, will give the correction of the differences of Rt. Aſc. obſerved by the middle wire; that correction being meaſured from the point where the above-mentioned perpendicular cuts the path of the ſtar, to that ſtar's tranſit over the middle wire; which correction will, when the Rhomboid declines weſtward, as in fig. 2. be additive when the northern ſtar precedes in Right Aſcenſion, and ſubtractive when the ſouthern one precedes; and the contrary when the Rhomboid declines eaſtward.

Thus in fig. 2. let 1. 1. and 2. 2. be the paths of two ſtars obſerved through the Rhomboid, and let the diſtance $\alpha\ \beta$ be twenty-one ſeconds in time; $\beta\ \gamma$ ten ſeconds; $\delta\ \varepsilon$ thirty-five ſeconds; and $\varepsilon\ \zeta$ be ſixteen ſeconds and a half; then, if a ſcale of one-twentieth of an inch to a ſecond be uſed,

they

they will appear as in the Drawing, and the difference of Declination will be the perpendicular $o\,\varepsilon$, or $\beta\,o$, equal to twelve ſeconds in time, or $3'$ of a degree; and the correction to be applied as above directed to the differences of Right Aſcenſion found by the tranſits of the ſtars over the central wire A. D. will be the ſpace $o\,\beta$, or $\varepsilon\,o$, equal to $8\frac{1}{2}$ ſeconds in time.

If one of the ſtars at 3. 3. paſſes over the lower half of the Rhomboid, the operation is exactly the ſame, as is evident by inſpection of the figure where $\eta\,\theta$ is $29\frac{1}{2}$ ſeconds, $\theta\,\iota$ 26 ſeconds. The difference of Declination between 2. 2. and 3. 3. is $\varepsilon\,\varphi = 17$ ſeconds, or $4'\,15''$ of a degree, and $\theta\,\varphi$ the correction for the Right Aſcenſion $12\frac{1}{2}$ ſeconds.

I have hitherto, for the ſake of ſimplicity, conſidered the ſtars to be obſerved as being in the equator; when they are not, previous to every other operation, the obſerved times muſt be reduced to equatorial, by multiplying them by the coſine of the Declination; but this is neceſſary in the uſual method of obſerving with the Rhomboid. It is alſo to be obſerved, that the lines of the two ſtars' paths through the inſtrument, when laid down on the drawing, will ſeldom be exactly parallel, as a very little error in the obſervations will ſenſibly affect their paralleliſm; but if the inclination be ſmall, it will cauſe but a very ſlight error in the meaſure of the Declination, which I generally take in the centre of the inſtrument.

For

For obſervations of comets, whoſe light is often ſo feeble as not to bear any illumination to the wires, it is neceſſary to have them large; or, perhaps, it is ſtill better to have the inclined parts of the Reticule made of narrow plates, feather edged, as the emerſion and immerſion of a faint comet from their interior edges, is a more accurate obſervation than any that can be made with wires. In ſuch a caſe, if the teleſcope be ſet ſteady, it is not neceſſary to obſerve the biſection of the comet by the central wire, but only that of the ſtar with which it is compared; and having laid down the path of the ſtar as before directed on the drawing, with a parallel ruler draw a line parallel to the path of the ſtar, and containing in the figure of the Reticule, the obſerved number of ſeconds employed by the comet to traverſe the Reticule, and then proceed as before directed: but, if poſſible, it is always beſt to obſerve both ſtar and comet at the central wire, as then the obſervations, when laid down, are a check on each other.

I have reaſon to think, by a compariſon of ſeveral obſervations made in the above-deſcribed method on the comet of 1786, when very faint, and compared by Dr. Maſkelyne with his own at Greenwich; that in the moſt unfavourable circumſtances, this way will not be ſubject to an error of more than a ſecond and an half in time in Right Aſcenſion: and 20″ in Declination, even at conſiderable diſtances from the equator.

F I N I S.

The Orbit of the COMET of 1661, (whose Return is expected about January 1789) projected on the Plane of the Ecliptic, and divided to every Fourth Day.

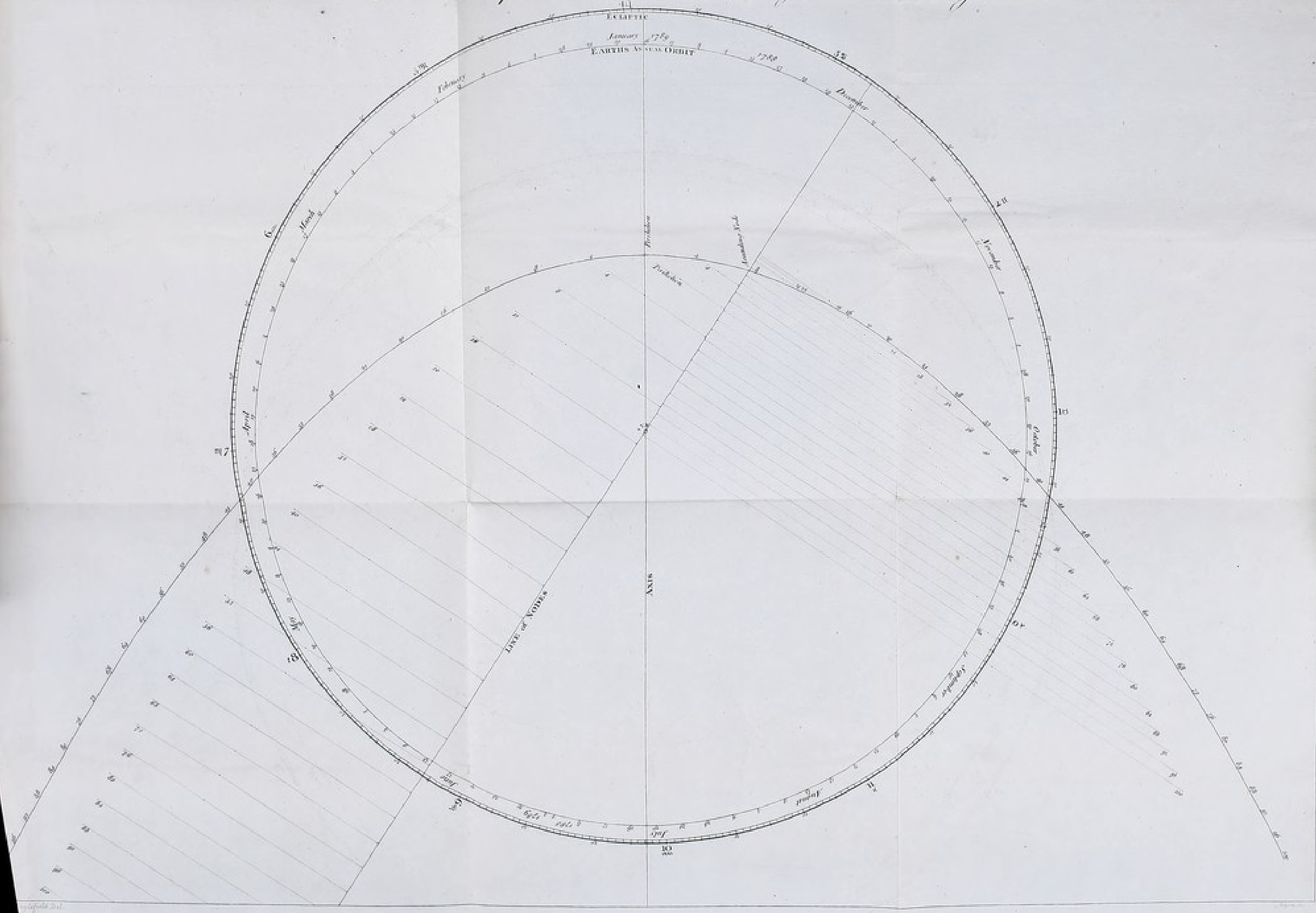

Fig: 1

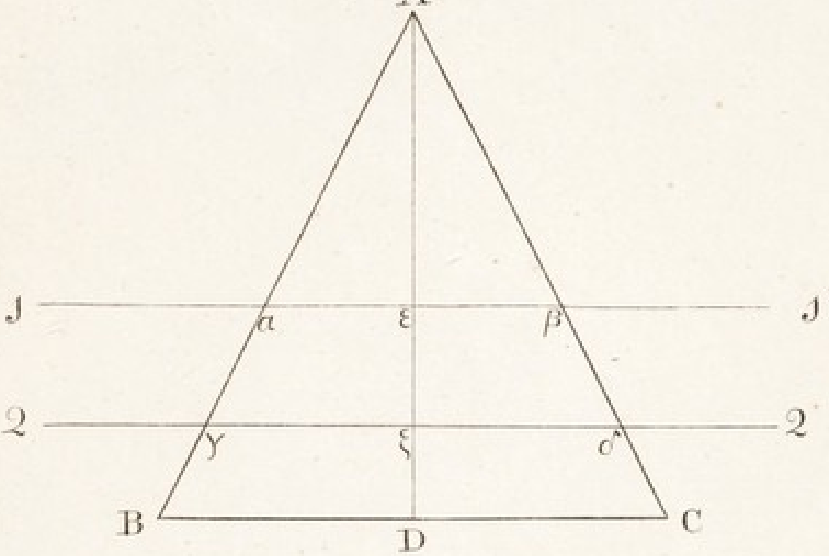

Fig: 2

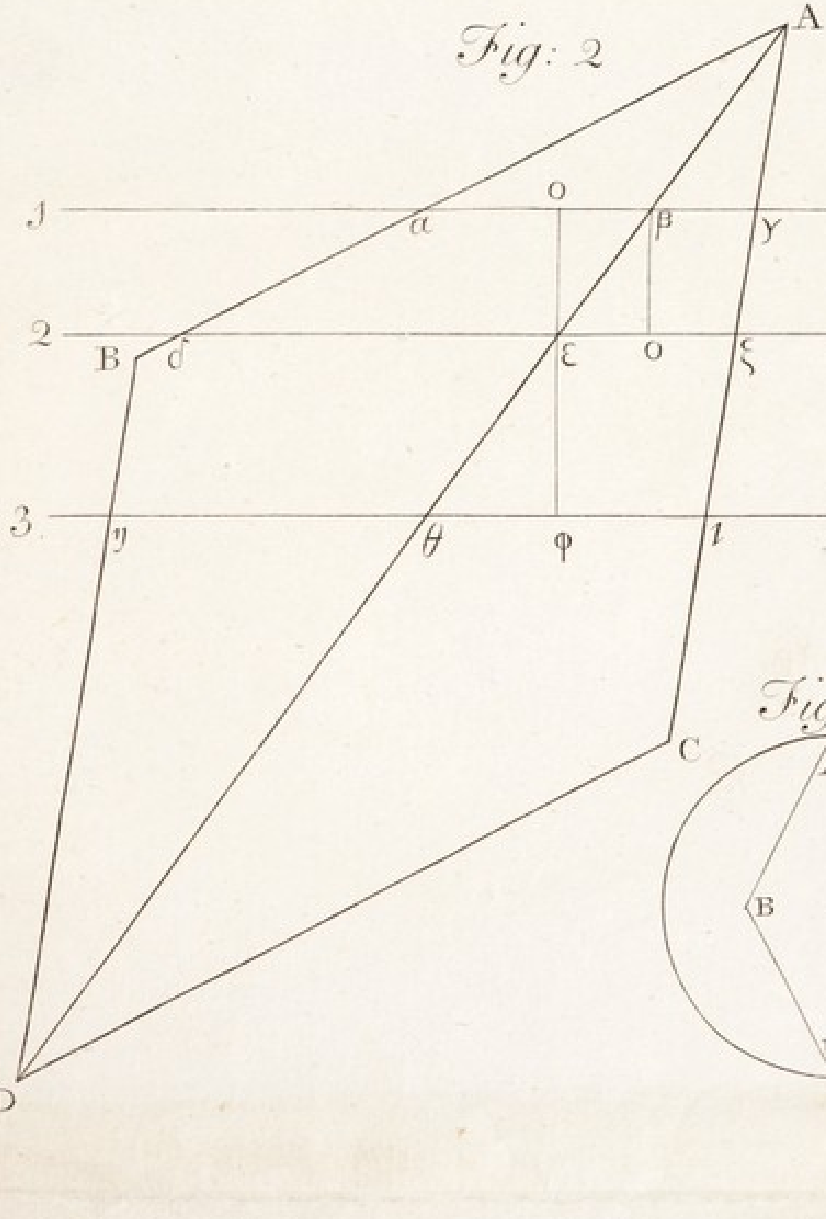

Fig: 3