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Theoria motuum planetarum et cometarum

Euler, Leonhard

Berolini, [1744]

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Shelf Mark: Rar 4397

Persistent Link: <https://doi.org/10.3931/e-rara-551>

Investigatio orbitae cometae, qui anno 1744. apparuit.

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Investigatio Orbitæ Cometæ

qui A. 1744. apparuit.

Observationes, ex quibus orbitam hujus cometæ sum determinaturus, mecum Parisiis sunt communicatæ, quæ cum videantur omni cura institutæ, perquam sunt idoneæ, ad quas computus secundum methodum meam accommodetur. Prima quidem observatio facta est Lausannæ jam die 13 Decembr. anni præterlapsi, quæ cum omnium, quas quidem adhuc mihi videre contigit, prima sit, merito in hunc finem adhibetur. Hæc autem cum reliquis, quas accepi, ad meridianum Parisinum revocata sequenti modo se habebat.

Parisiis Temp. appar.	Long. Cometæ	Lat. Com. bor.
1743 Dec. 13 ^d , 8 ^b , 1', 45''	γ 28°, 26', 13''	15°, 11', 0''
1744 Jan. 3, 5, 27, 40	γ 14, 11, 10	17, 32, 50
Jan. 7, 5, 1, 43	γ 12, 3, 10	17, 51, 30
Jan. 18, 7, 2, 0	γ 6, 57, 15	18, 37, 5

Quoniam igitur ad calculum instituendum mihi opus est tribus observationibus, inter quas temporum intervalla non nimis sint inter se inæqualia, ex his elegi primam secundam & quartam, omittendo tertiam utpote secundæ nimis vicinam. Quia enim longitudo hujus cometæ hoc temporis intervallo parum fuit mutata, præstat observationes aliquantum a se invicem remotas adhibere, quam nimis vicinas. Reductis ergo his observationibus ad tempus medium, supputatisque pro earum

momentis terræ solisve locis una cum distantis solis a terra, sequentia prodierunt data:

Ordo Obs.	Berol. temp. medio	Longit. Comet.	Latitudo Com.
I.	1743 Dec. 13 ^d , 8 ^b , 40 [']	0 ^r , 28 ^o , 26 ['] , 13 ^{''}	15 ^o , 11 ['] , 0 ^{''}
II.	1744 Jan. 3, 6, 17	0, 14, 11, 10	17, 32, 50
III.	Jan. 18, 7, 57	0, 6, 57, 15	18, 37, 5

Temp. Obs.	Locus solis	Log. dist. ☉ a Terra
I.	8 ^r , 21 ^o , 30 ['] , 14 ^{''}	4, 9 9 2 9 0 3
II.	9, 12, 48, 18	4, 9 9 2 7 2 1
III.	9, 28, 9, 37	4, 9 9 3 0 3 2

Temporis ergo intervalla inter primam & secundam itemque secundam & tertiam observationem erunt

Inter I & II. 20^d, 21^b, 37[']

II & III. 15, 1, 40

Exprimantur horæ cum minutis in partibus diei decimalibus, ut obtineantur valores pro litteris α & β , quæ in calculum ingrediuntur, erit

$$\alpha = 20,9008 \quad | \quad l \alpha = 1,320136$$

$$\beta = 15,0694 \quad | \quad l \beta = 1,178096$$

Delineetur jam figura his observationibus conveniens, fitque Fig. 9. tabula planum eclipticæ repræsentante, S locus solis, f, g, b , loca terræ in sua orbita momentis trium observationum; sit porro $f\zeta$ longitudo cometæ in observatione prima, $g\eta$ in secunda & $b\theta$ in tertia. Ductisque his lineis, quarum prima & tertia se in k , prima autem & secunda se in m , & secunda cum tertia in q interfecet, erunt cum lineæ tum anguli:

$l S f = 4, 992903$	$S f \zeta = 126^{\circ}, 55', 59''$
$l S g = 4, 992721$	$S g \eta = 91, 22, 52$
$l S b = 4, 993032$	$S b \theta = 68, 47, 38$
$f S g = 21^{\circ}, 18', 4''$	$f k \theta = 21, 28, 58$
$g S b = 15, 21, 19$	$f m g = 14, 15, 3$
$f S b = 36, 39, 28$	$g \eta b = 7, 13, 55$

His præparatis, si nota esset cometæ a terra distantia vera in observatione media, orbita cometæ posset determinari, deficiente autem hac notitia, plures distantia fingi debebunt, ex singulisque orbita cometæ, quam esset habiturus, deduci, ut pateat, quænam hypothesi proxime ad parabolam manuducat, quoniam tuto assumere possumus, veram cometæ orbitam parum a parabola discrepare. Siquis autem de hoc dubitet, poterit cometæ observatio quædam quarta ab assumtis factis remota in subsidium vocari, atque ex orbitis, quas singulæ hypothesi suppeditaverunt, ad hoc tempus locus cometæ supputari, quo pateat, quænam earum proxime cum observatione hac quarta conveniat. In hunc finem adhibui observationem hic in Observatorio Academico factam die 18. Febr. cum cometa stellæ Marchab esset proximus, hinc autem collecta fuit.

Temp. medio Berol.	Longitudo Cometæ	Latitudo Bor.
A. 1744. Febr. 18 ^b , 6 ^b , 43 ^{''}	11 ^s , 19 ^o , 57', 0 ^{''}	19 ^o , 10', 56 ^{''}

Hoc autem tempore erat

Locus Solis 10^s, 29^o, 30', 40^{''}

& log. dist. solis a terra = 4, 995309.

Pluribus igitur factis hypothesibus circa distantiam cometæ a terra

terra in observatione media, eam maxime huic observationi satisfacere deprehendi, quæ simul proxime parabolam exhiberet. Primum quidem suspicatus sum, cum iste cometa tantopere fulgeret, eum a nobis non admodum fuisse remotum, ideoque initio hanc distantiam finxi, 20000 & 30000 posita media terræ a sole distantia 100000, hinc autem orbita prodiit elliptica parum excentrica, non multum a circulo discrepans; unde hæ hypothefes nimium a veritate abhorrebant. Majores igitur valores tribui huic distantiæ, neque prius orbita in hyperbolam abire coeperat, quam istam distantiam = 110000 posuiffem; limites autem, intra quos ea distantia magnitudo, quæ observationi quartæ satisfaceret, inveni 101000 & 106000; sicque præter expectationem distantia cometæ a terra multo major evasit, quam initio putaveram. Cometa igitur a nobis fere æque erat remotus ac sol, & cum ejus diameter apparens æstimaretur unius circiter minuti primi, ejus diameter vera ad diametrum terræ rationem fere habebat triplam.

Sit igitur G verus cometæ locus in observatione secunda, ex quo ad eclipticam demittatur perpendicularum $G\eta$, & quoniam distantia Gg tanquam cognita assumitur, ob angulum $Gg\eta$ latitudini observatæ, $17^\circ 32'$, $50''$ æqualem; prodibit $G\eta = Gg \cdot \sin Gg\eta$ & $g\eta = Gg \cdot \cos Gg\eta$. Factis ergo binis memoratis hypothefibus, calculus sequenti modo instituat:ur:

Hypoth.

	Hypoth. A.	Hypoth. B.
$Gg =$	101000	106000
$l Gg =$	5, 004321	5, 025206
add. $\left\{ \begin{array}{l} l \sin Gg\eta = \\ l \cos Gg\eta = \end{array} \right.$	9, 479275	9, 479275
	9, 979306	9, 979306
$l G\eta =$	4, 483596	4, 504581
$l g\eta =$	4, 983627	5, 004612

Ducatur nunc ex sole recta $S\eta$, & cum in triangulo $Sg\eta$ dentur latera Sg , $g\eta$ cum angulo intercepto $Sg\eta = 91^\circ, 22', 52''$ erit angulorum reliquorum summa $= 88, 37, 8$, & semifumma $= 44^\circ, 18', 34''$ unde per trigonometriam reliqui anguli reperiuntur, quibus

inventis erit $S\eta = \frac{Sg \cdot \sin Sg\eta}{\sin S\eta g}$.

	A.	B.
$A \ l Sg =$	4, 992721	4, 992721
subtr. $l g\eta =$	4, 983627	5, 004612
$l \text{ tang. anguli.}$	10, 009094	10, 011891
subtrahatur 45°	$45^\circ, 36', -\frac{1}{2}''$	$45^\circ, 47' 3'' . 6$
rest. ang.	$0, 36, -\frac{1}{2}$	$0, 47, 3 . 6$
$l \text{ tang.} =$	8, 019943	8, 136401
$l \text{ tang. } \frac{1}{2} \text{ summa.}$	9, 989530	9, 989530
$l \text{ tang. } \frac{1}{2} \text{ diff.}$	8, 009473	8, 125931
$\frac{1}{2} \text{ diff.} =$	$0, 35, 8$	$0, 45, 56$
$\frac{1}{2} \text{ summa} =$	$44, 18, 34$	$44, 18, 34$
$S\eta g =$	$44, 53, 42$	$43, 32, 38$
$g S\eta =$	$43, 43, 26$	$45, 4, 30$

Porro

Hypoth.

	A	B
Porro est $l S g =$	4, 992721	4, 992721
$l \sin S g \eta =$	9, 999874	9, 999874
	4, 992595	4, 992595
subtr. $l \sin S \eta g =$	9, 848687	9, 838162
	5, 143908	5, 154433
$l S \eta =$		
& $S \eta =$	139287	142703

Quia nunc in triangulo $GS\eta$ ad η rectangulo dantur latera

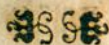
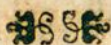
$S\eta$ & $G\eta$, erit $\text{tang } GS\eta = \frac{G\eta}{S\eta}$ & $GS = \frac{S\eta}{\text{cof } GS\eta}$.

A $l G \eta =$	4, 483596	4, 504581
subtr. $l S \eta =$	5, 143908	5, 154433
$l \text{ tang } GS\eta =$	9, 339688	9, 350148
II. Lat. hel. $GS\eta =$	12, 19,55	12, 37,23
subtr. $l \text{ cof } GS\eta =$	9, 989861	9, 989374
a $l S \eta =$	5, 143908	5, 154433
II. Dist. Com. a $\odot l S G =$	5, 154047	5, 165059

Invento puncto G, sint F & H loca cometæ vera in prima ac tertia observatione, & ducta corda FH secet SG in O. Ostendi autem in dissertatione mea fore intervallum $GO =$

$\frac{2c^3 \sin \alpha \tau \cdot \sin \beta \tau}{SG^2 \text{cof}(\alpha - \beta) \tau}$, ubi τ denotat motum terræ semidiur-

num medium $29', 34'' \cdot 098$, ita ut in minutis secundis sit $\tau = 1774, 098$, & $l \tau = 3, 248977$, hinc ob litterarum α & β valores ante datos reperiuntur anguli $\alpha \tau$ & $\beta \tau$ hoc modo:



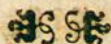
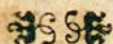
	$l\tau =$	3, 248977	
add.	$l\alpha =$	1, 320163	
	$l\beta =$	1, 178096	
	$l\alpha\tau =$	4, 569140	
	$l\beta\tau =$	4, 427073	
unde	$\alpha\tau =$	37080'' =	10°, 18', 0''
	$\beta\tau =$	26734 =	7, 25, 34
	$(\alpha - \beta)\tau =$	10346 =	2, 52, 26

Cum igitur c denotet distantiam folis a terra mediam = 100000, valor sagittæ GO sequenti modo definietur.

	A	B	
add.	$l\sin \alpha\tau =$	9, 252373	
	$l\sin \beta\tau =$	9, 111422	
		8, 363795	
fubtr.	$l\cos (\alpha - \beta)\tau =$	9, 999453	
		8, 364342	
add.	$l2c^3 =$	15, 301030	
		13, 665372	13, 665372
fubtr.	$2lSG =$	10, 308094	10, 330118
	$lGO =$	3, 357278	3, 335254
add.	$l\cos GS\eta =$	9, 989861	9, 989374
	prodibit $l\eta o =$	3, 347139	3, 324628
	unde $\eta o =$	2224	2112
	fubtr. ab $S\eta =$	139287	142703
	remanebit $So =$	137063	140591

demisso scilicet ex puncto O in planum eclipticæ perpendicularo Oo. Nunc fecet recta $S\eta$ reliquas cometæ longitudines in μ & ν , ad quæ puncta inveniendâ in triangulo $Sf\mu$ primum dantur:

$lSf =$



	A	B
$ISf =$	4, 992903	4, 992903
ang. $Sf\mu =$	126, 55, 59	126, 55, 59
cujus deinc.	53, 4, 1	53, 4, 1
Ob ang. $gS\eta =$	43, 43, 26	45, 4, 30
subtr. $fSg =$	21, 18, 4	21, 18, 4
remanebit $fS\mu =$	22, 25, 22	23, 46, 26
qui ablatas ab $Sfk =$	53, 4, 1	53, 4, 1
relinquet $S\mu f =$	30, 38, 39	29, 17, 35

Ob datos ergo omnes angulos erit $f\mu = \frac{Sf. \sin fS\mu}{\sin S\mu f}$ &

$S\mu = \frac{Sf. \sin Sf\mu}{\sin S\mu f}$, unde calculus dabit

	A	B
$ISf =$	4, 992903	4, 992903
subtr. $1/\sin S\mu f =$	9, 707318	9, 689554
	5, 285585	5, 303349
add. $\left\{ \begin{array}{l} 1/\sin fS\mu = \\ 1/\sin Sf\mu = \end{array} \right.$	9, 581424 9, 902730	9, 605443 9, 902730
	$1/f\mu =$	4, 867009
	$IS\mu =$	4, 908792
	5, 188315	5, 206079
Ergo $f\mu =$	73622	81057
$S\mu =$	154282	160723
subtr. $So =$	137063	140591
restabit $o\mu =$	17219	20132

simili modo in triangulo Sbv data reperiuntur.

$ISb =$	4, 993032	4, 993032
ang. $Sbv =$	68, 47, 38	68, 47, 38
Ejus deinceps:	111, 12, 22	111, 12, 22
Deinde ob $gS\eta =$	43, 43, 26	45, 4, 30
add. $gSb =$	15, 21, 19	15, 21, 19

	A	B
erit bSv =	59, 4, 45	60, 25, 49
qui ablati ab externo =	III, 12, 22	III, 12, 22
relinquit Svb =	52, 7, 37	50, 46, 33

Ob datos ergo omnes angulos cum latere Sb erit bv =

$$\frac{Sb. \text{ fin } bSv}{\text{fin } Svb} \& Sv = \frac{Sb. \text{ fin } Sbv}{\text{fin } Svb} \cdot \text{Ergo}$$

A	lSb =	4, 993032	4, 993032
subtr. l	$\text{fin } Svb$ =	9, 897282	9, 889121
		5, 095750	5, 103911
add.	$l \text{ fin } bSv$ =	9, 933425	9, 939397
	$l \text{ fin } Sbv$ =	9, 969548	9, 969548
	lbv =	5, 029175	5, 043308
	lSv =	5, 065298	5, 073459
Ergo	bv =	106949	110486
	Sv =	116225	118429
subtr. ab	So =	137063	140591
remanebit	ov =	20838	22162

Nunc per punctum o duci debet linea recta $\zeta o \theta$, cujus partes ζo & θo sint in ratione temporum $\alpha : \beta$. Produca-
tur ergo ov usque ad i , ut sit $oi : vo = \alpha : \beta$. seu $oi = \frac{\alpha}{\beta} \cdot ov$, tum ducatur recta $i\zeta$ parallela ipsi bv , eritque recta
 $\zeta o \theta$ recta quaesita.

Ad	lov =	4, 318856	4, 345609
add.	$l\alpha : \beta$ =	0, 142067	0, 142067
	loi =	4, 460923	4, 487676
Ergo	oi =	28902	30738
subtr.	$o\mu$ =	17219	20132
remanebit	μi =	11683	10606

Nunc

A B

Nunc in triangulo $\mu\zeta i$ dantur omnes anguli cum latere μi

$l \mu i$	\equiv	4, 067565		4, 025551
ang. $\zeta \mu i$	\equiv	30, 38, 39		29, 17, 35
$\mu \zeta i$	\equiv	21, 28, 58		21, 28, 58
$180 - \mu i \zeta$	\equiv	52, 7, 37		50, 46, 33

Erit ergo $\zeta \mu = \frac{\mu i \cdot \sin \mu i \zeta}{\sin \mu \zeta i}$ & $\zeta i = \frac{\mu i \cdot \sin \zeta \mu i}{\sin \mu \zeta i}$.

A	$l \mu i$	\equiv	4, 067565		4, 025551
subtr.	$l \sin \mu \zeta i$	\equiv	9, 563743		9, 563743
			4, 503822		4, 461808
add.	$\left\{ \begin{array}{l} l \sin \mu i \zeta \\ l \sin \zeta \mu i \end{array} \right.$	\equiv	9, 897282		9, 889121
		\equiv	9, 707318		9, 689554
	$l \zeta \mu$	\equiv	4, 401104		4, 350929
	$l \zeta i$	\equiv	4, 211140		4, 151362
Ergo	$\zeta \mu$	\equiv	25183		22435
add.	$f \mu$	\equiv	73622		81057
erit	$f \zeta$	\equiv	98805		103492

Jam in triangulo $o i \zeta$ dantur duo latera cum angulo intercepto $o i \zeta$

A	$l o i$	\equiv	4, 460923		4, 487676
subtr.	$l \zeta i$	\equiv	4, 211140		4, 151362
	$l \text{ tang:}$		10, 249783		10, 336314
	ang:		60, 38, 13		65, 15, 3.8
	subtr.		45		45
			15, 38, 13		20, 15, 3.8
summa ang:			52, 7, 37		50, 46, 33
femi summa.			26, 3, 48.5		25, 23, 16.5
$l \text{ tang. femif:}$			9, 689401		9, 676306
$l \text{ tang. ang.}$			9, 447002		9, 566955

O 3

$l \text{ tang}$

	A	B
<i>l</i> tang semid:	9, 136403	9, 243261
femi diff.	7, 47, 43	9, 55, 52
femi summa	26, 3, 48	25, 23, 16
$o\zeta i =$	33, 51, 31	35, 19, 8
$\zeta o i =$	18, 16, 5	15, 27, 24

Porro est $o\zeta = \frac{oi \cdot \sin oi\zeta}{\sin oi\zeta}$ unde invenitur hoc modo

Ad <i>loi</i> =	4, 460923	4, 487676
add. <i>l</i> sin <i>oi</i> ζ =	9, 897282	9, 889121
	4, 358205	4, 376797
subtr. <i>l</i> sin <i>o</i> ζ <i>i</i> =	9, 745968	9, 762022
<i>lo</i> ζ =	4, 612237	4, 614775

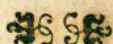
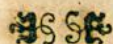
si itaque corda $\theta\zeta$ producatur in *n* ob $b\theta n = o\zeta i$ erit
ang. $b\theta n =$ | 33, 51, 31 | 35, 19, 8

Nunc ob triangula $\nu o\theta$ & $io\zeta$ similia erit $\theta\nu = \frac{\beta}{\alpha} \cdot \zeta i$ &

$\theta o = \frac{\beta}{\alpha} \cdot o\zeta$, unde sequenti modo invenientur

A <i>l</i> ζ <i>i</i> =	4, 211140	4, 151362
subtr. <i>l</i> α:β =	0, 142067	0, 142067
<i>l</i> θ <i>ν</i> =	4, 069073	4, 009295
θ <i>ν</i> =	11724	10216
subtr. a <i>bν</i> =	106949	110486
erit <i>bθ</i> =	95225	100270
A <i>lo</i> ζ =	4, 612237	4, 614775
subtr. <i>l</i> α:β =	0, 142067	0, 142067
<i>l</i> θ <i>o</i> =	4, 470170	4, 472708
At est <i>o</i> ζ =	40948	41188
& <i>o</i> θ =	29524	29696
unde ζθ =	70472	70884

Inventis



Inventis punctis ζ & θ ducantur rectæ $S\zeta$ & $S\theta$, ad quas
inveniendas consideretur primum triangulum $Sf\zeta$, in quo
ob data latera Sf & $f\zeta$ cum angulo intercepto $Sf\zeta$ inveni-
entur reliqua hoc modo.

subtr. $ISf =$	4, 992903	4, 992903
ab $I f\zeta =$	4, 994779	5, 014906
l tang:	10, 001876	10, 022003
ang:	45, 7, 25.5	46, 27, 2.8
	45,	45,
	0, 7, 25.5	1, 27, 2.8
summa angul.	53, 4, 1	53, 4, 1
femi summa	26, 32, 0.5	26, 32, 0.5
l tang. semif.	9, 698371	9, 698371
l tang. ang.	7, 334519	8, 403571
l tang. semid:	7, 032890	8, 101942
femi diff:	0, 3, 42	0, 43, 28
femi summa	26, 32, 0	26, 32, 0
$fS\zeta =$	26, 35, 42	27, 15, 28
$S\zeta f =$	26, 28, 18	25, 48, 32

Jam erit $S\zeta = \frac{Sf \cdot \sin Sf\zeta}{\sin S\zeta f}$, hinc fiet

add. $ISf =$	4, 992903	4, 992903
add. $l S\zeta f =$	9, 902730	9, 902730
	4, 895633	4, 895633
subtr. $l \sin S\zeta f =$	9, 649096	9, 638859
$IS\zeta =$	5, 246537	5, 256774

Simili modo in triangulo $Sb\theta$ ob data latera Sb , $b\theta$ cum
angulo intercepto invenietur:

A $ISb =$

	A	B
A lSb =	4, 993032	4, 993032
subtr. $l\theta$ =	4, 978751	5, 001171
l tang:	10, 014281	-10, 008139
anguli =	45, 56, 30.7	45, 32, 12.6
subtr. =	45	45
	0, 46, 30.7	0, 32, 12.6
summa ang:	III, 12, 22	III, 12, 22
femi summa =	55, 36, 11	55, 36, 11
l tang femi sum: =	10, 164540	10, 164540
l tang. ang: =	8, 131313	7, 971728
l tang. femid: =	8, 295853	8, 136268
femidiff. =	I, 7, 56	0, 47, 3
femi summa =	55, 36, 11	55, 36, 11
$bS\theta$ =	54, 28, 15	56, 23, 14
$S\theta b$ =	56, 44, 7	54, 49, 8

Deinde cum fit $S\theta = \frac{Sb. \text{ fin } S\theta\theta}{\text{fin } S\theta b}$ fiet

Ad lSb =	4, 993032	4, 993032
add. $l \text{ fin } S\theta\theta$ =	9, 969548	9, 969548
	4, 962580	4, 962580
subtr. $l \text{ fin } S\theta b$ =	9, 922281	9, 912399
$lS\theta$ =	5, 040299	5, 050181

Ex his longitudo Cometæ heliocentrica ad tempora trium observationum determinabitur hoc modo.

Cum fit $fS\zeta$ =	26, 35, 42	27, 15, 28
Long. terræ ad I.	2, 21, 30, 14	2, 21, 30, 14
I. Long. Cometæ helioc.	I, 24, 54, 32	I, 24, 14, 46
subtr. $gS\eta$ =	I, 13, 43, 26	I, 15, 4, 30
a Long. terræ ad II.	3, 12, 48, 18	3, 12, 48, 18

II. Long

	A	B
II. Long. Cometæ helioc. =	1, 29, 4, 52	1, 27, 43, 48
Porro $b\vartheta$ =	1, 24, 28, 15	1, 26, 23, 14
Long. terræ ad III	3, 28, 9, 37	3, 28, 9, 37
III. Long. Cometæ helioc. =	2, 3, 41, 22	2, 1, 46, 23
Hinc erit ang. $\zeta\vartheta$ =	8, 46, 50	7, 31, 37

Cum igitur longitudo cometæ a prima ad tertiam observationem crescat, manifestum est, verum cometæ motum fuisse directum, etiamsi ex terra retrogradus apparuerit.

Deinde etiam positio rectæ $\zeta\theta$ respectu linearum $S\zeta$ & $S\theta$ cognoscetur, hac linea ultra θ in n producenda

Cum enim sit $b\vartheta n$ =	33, 51, 31	35, 19, 8
subtr. ab $S\vartheta b$ =	56, 44, 7	54, 49, 8
erit $S\vartheta n$ =	22, 52, 36	19, 30, 0
subtr. $\vartheta S\zeta$ =	8, 46, 50	7, 31, 37
prodit ang. $S\zeta n$ =	14, 5, 46	11, 58, 23

Ex latitudinibus nunc geocentricis, inveniuntur perpendiculara $F\zeta$ & $H\theta$, cum veris cometæ a terra distantiis Ff , Hb : Erit

enim $F\zeta = f\zeta \cdot \text{tang. lat. I.}$ $Ff = \frac{f\zeta}{\text{cof. lat. I.}}$: atque $H\theta = b\theta$
 tang. lat. III. & $Hb = \frac{b\theta}{\text{cof. lat. III.}}$

$1f\zeta$ =	3, 994779	5, 014006
add. 1 tang. lat. I	9, 433580	9, 433580
subtr. 1 cof. lat. I	9, 984569	9, 984569
erit $1F\zeta$ =	4, 428359	4, 448486
& $1Ff$ =	5, 010210	5, 030337
Hinc fit $F\zeta$ =	26813	28085
I. Dist. Com. a terra Ff =	102379	107235

	A	B
Porro $lb\vartheta$ =	4, 978751	5, 001171
add. \int tang lat. III =	9, 527485	9, 527485
subtr. \int col lat. III =	9, 976656	9, 976656
erit $\int H\vartheta$ =	4, 506236	4, 529656
& $\int Hb$ =	5, 002095	5, 024515
Hinc fit $H\vartheta$ =	32080	33780
III. Dist. Com. a terra Hb =	100484	105807
II. Dist. Com. a terra Gg =	101000	106000

Cognitis nunc perpendiculis $H\vartheta$ & $F\zeta$, producat^r recta HF , donec cum $\vartheta\zeta$ prolongata concurrat in N , eritque recta SN linea nodorum cometæ: erit autem $\frac{H\vartheta - F\zeta}{\zeta\vartheta}$

$$= \text{tang } HN\vartheta \text{ \& } \vartheta N = \frac{H\vartheta}{\text{tang } HN\vartheta} : \text{Ergo}$$

A $H\vartheta$ =	32080	33780
subtr. $F\zeta$ =	26813	28085
erit $H\vartheta - F\zeta$ =	5267	5695
& $\int (H\vartheta - F\zeta)$ =	3, 721563	3, 755494
subtr. $\int \zeta\vartheta$ =	4, 848017	4, 850548
\int tang $HN\vartheta$ =	8, 873546	8, 904946
subtr. a $\int H\vartheta$ =	4, 506236	4, 528656
$\int \vartheta N$ =	5, 632690	5, 623710

Consideretur nunc triangulum $S\vartheta N$, in quo cum dentur latera $S\vartheta$. ϑN cum angulo intercepto, reperietur angulus ϑSN .

A $\int \vartheta N$ =	4, 632690	5, 623710
subtr. $\int S\vartheta$ =	5, 040299	5, 050181

\int tang.

	A	B
l tang.	10, 592391	10, 573529
ang.	75, 39, 39	75, 3, 7
subtr.	45	45
summa ang: S ϑ =	30, 39, 39	30, 3, 7
femi summa =	22, 52, 36	19, 30, 0
l tang semif: =	11, 26, 18	9, 45, 0
l tang ang: =	9, 306063	9, 235102
l tang semif: =	9, 772930	9, 762348
Ergo semif: =	9, 078993	8, 997450
semif: =	6, 50, 23	5, 40, 38
Ang. ϑ SN =	11, 26, 18	9, 45, 0
III. Long. helioc. puncti ϑ =	18, 16, 41	15, 25, 38
Longit. Nodi Ascend: Ω =	2, 3, 41, 22	2, 1, 46, 23
	1, 15, 24, 41	1, 16, 20, 45

Demittatur nunc ex ϑ in lineam nodorum SN perpendicularum ϑP , ductaque HP erit angulus HP ϑ æqualis inclinationi orbitæ cometæ ad Eclipticam; Fiet autem $\vartheta P = S\vartheta$

sin ϑ SN & tang. HP $\vartheta = \frac{H\vartheta}{\vartheta P}$

Ad $1S\vartheta =$	5, 040299	5, 050181
add. $1 \sin \vartheta$ SN =	9, 496415	9, 424905
$1\vartheta P =$	4, 536714	4, 475086
a $1H\vartheta =$	4, 506236	4, 528656
l tang HP $\vartheta =$	9, 969522	10, 053570
Ergo ang. HP $\vartheta =$	42, 59, 28	48, 31, 29
ideoque		
Inclinatio Orbitæ Cometæ ad Eclipticam =	42, 59, 28	48, 31, 29

Determinemus nunc quoque latitudines cometæ heliocentri-

cas; quæ erunt: $\text{tang. FS}\zeta = \frac{F\zeta}{S\zeta}$ & $\text{tang HS}\vartheta = \frac{H\vartheta}{S\vartheta}$.

Distantiæ vero cometæ a Sole erunt $SF = \frac{S\zeta}{\text{cof FS}\zeta}$ & $SH = \frac{S\vartheta}{\text{cof HS}\vartheta}$.

	A /F ζ =	4, 428359	4, 448486
	subtr. /S ζ =	5, 246537	5, 256774
	/ tang. FS ζ =	9, 181822	9, 191712
I. Lat. helioc. FS ζ =		8, 38, 32	8, 50, 18
	A /S ζ =	5, 246537	5, 256774
	subtr. / cof FS ζ =	9, 995040	9, 994813
I. Dist. Com. a Sole /SF =		5, 251497	5, 261961
	A /H ϑ =	4, 506236	4, 528656
	subtr. /S ϑ =	5, 040299	5, 050181
	/ tang HS ϑ =	9, 465937	9, 478475
III. Lat. helioc. HS ϑ =		16, 17, 51	16, 44, 54
	A /S ϑ =	5, 040299	5, 050181
	subtr. / cof HS ϑ =	9, 982188	9, 981175
III. Dist. Com. a Sole. /SH =		5, 058111	5, 069006

Determinemus nunc quoque elongationes cometæ heliocentri-
cas a nodo ascendente seu linea SN, eritque $\text{cof FSN} = \text{cof FS}\zeta \cdot \text{cof}\zeta\text{SN}$ & $\text{cof HSN} = \text{cof HS}\vartheta \cdot \text{cof}\vartheta\text{SN}$.

	A ϑ SN =	18, 16, 41	15, 25, 38
	subtr. ϑ S ζ =	8, 46, 50	7, 31, 37
	remanet ζ SN =	9, 29, 51	7, 54, 1
	/ cof FS ζ =	9, 995040	9, 994813
	/ cof ζ SN =	9, 994006	9, 995858

/ cof FSN =

	A	B
$l \text{ cof FSN} =$	9, 989046	9, 990671
Ergo ang. FSN =	12, 48, 52	11, 49, 59
$l \text{ cof HS}\theta =$	9, 982188	9, 981175
$l \text{ cof } \theta\text{SN} =$	9, 977516	9, 984063
$l \text{ cof HSN} =$	9, 959704	9, 965238
Ergo ang. HSN =	24, 18, 6	22, 37, 11
subtr. FSN =	12, 48, 52	11, 49, 59
Erit ang. FSH =	11, 29, 14	10, 47, 12

Quoniam igitur duo habemus puncta cometæ in orbita vera, nempe F & H, quorum distantia a foco S una cum angulo FSH sunt cognitæ, hinc naturam orbitæ determinare poterimus. Quia vero $SH < SF$ apparet cometam his observationum temporibus ad suum Perihelium accessisse. Sit igitur Fig. 10.

AHF vera orbita cometæ, circa focum S, quem sol occupat, descripta, cujus vertex seu perihelium sit in A. Sit distantia perihelii a sole $AS = a$. applicata ex foco S ad axem normalis seu semilatus rectum $SB = b$, anomalia vera seu angulus $ASH = v$; tum vero ponantur cognita $SH = y$; $SF = z$; & angulus $FSH = \phi$. atque tempus, quo cometa spatium FH percurrit, in diebus expressum sit $= T$. Ex his primum in-

venitur semilatus rectum $b = \frac{y^2 z^2}{4m^2 T^2} (\sin \phi)^2 + \frac{Vyz}{3} (\sin \phi)^2$ existente $m = 271989,735$ & $l m = 5,4345525$. hincque

$l 2 m = 5,7355825$. Deinde fit $\text{tang } v = \cot \phi - \frac{(z-b)y}{(y-b)z \sin \phi}$.

tandemque $a = \frac{by \cos v}{b-y+y \cos v}$. Ponatur postea $\frac{2a-b}{b} = n$;

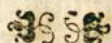
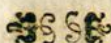
tangensque anguli $\frac{1}{2} v = t$ fietque, si orbita proxime ad parabolam accedat, tempus quo cometa a loco H in perihelium A pervenit

$$\frac{aa}{m\sqrt{b}} \left(t + \frac{1}{3}t^3 - \frac{2}{3}nt^5 + \frac{3}{7}n^2t^7 - \frac{4}{9}n^3t^9 + \&c. \right) + \frac{3}{5}n^2t^5 - \frac{4}{7}n^3t^7 + \frac{5}{9}n^4t^9 - \&c.)$$

quod tempus erit expressum in diebus, dieique partibus decimalibus. Quia igitur tempus tertiæ observationis, quo cometa in puncto H hæsit, cognitum est, hinc momentum, quo per perihelium transit cognoscitur.

	A.	B.
Erit ergo $ly =$	5, 058111	5, 069006
$lz =$	5, 251497	5, 261961
$lyz =$	10, 309608	10, 330967
$T = \alpha + \beta =$	35, 9702	
$lT =$	1, 555941	
$\Phi =$	11, 29, 14	10, 47, 12
$l \sin \Phi =$	9, 299178	9, 272196
$lT^2 =$	3, 111882	
$l4m^2 =$	11, 471165	
$l4m^2T^2 =$	14, 583047	
$ly^2z^2 =$	20, 619216	20, 661934
add. $2l \sin \Phi =$	8, 598356	8, 544392
	19, 217572	19, 206326
subtr. $l4m^2T^2 =$	14, 583047	14, 583047
l Partis prior. $=$	4, 634525	4, 623279
$lVyz =$	5, 154804	5, 165484
add. $2l \sin \Phi =$	8, 598356	8, 544392
	3, 753160	3, 709876
subtr. $l3 =$	0, 477121	0, 477121

l part.

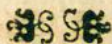
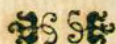


	A	B
<i>l</i> part. post. =	3, 276039	3, 232755
Pars prior =	43105	42003
Pars post. =	1888	1709
<i>b</i> =	44993	43712
<i>y</i> =	114317	117221
<i>z</i> =	178442	182794
<i>y</i> - <i>b</i> =	69324	73509
<i>z</i> - <i>b</i> =	133449	139082
A <i>l</i> (<i>z</i> - <i>b</i>) =	5, 125316	5, 143270
subtr. <i>l</i> (<i>y</i> - <i>b</i>) =	4, 840884	4, 866341
add. <i>l</i> $\frac{y}{z}$ =	0, 284432	0, 276929
	9, 806614	9, 807045
	0, 091046	0, 083974
subtr. <i>l</i> sin Φ =	9, 299178	9, 272196
<i>l</i> part. subtr. =	0, 791868	0, 811778
Pars subtr. =	6, 19253	6, 48303
a cot Φ =	4, 92077	5, 24883
- tang <i>v</i> =	1, 27176	1, 23420
Ergo 180 - <i>v</i> =	51, 49, 18	50, 59, 3
& anomalia vera <i>v</i> =	128, 10, 42	129, 0, 57
ideoque ang ASH =	4 ^s , 8, 10, 42	4, 9, 0, 57
add. HSN =	24, 18, 6	22, 37, 11
Dist. Perihelii a Nodo Ω : =	5, 2, 28, 48	5, 1, 38, 8
Dist ϑ a perihelio =	27, 31, 12	28, 21, 52
<i>l</i> - cos <i>v</i> =	9, 791067	9, 799021
<i>l</i> <i>y</i> =	5, 058111	5, 069006
<i>l</i> - <i>y</i> cos <i>v</i> =	4, 849178	4, 868027
add. <i>l</i> <i>b</i> =	4, 653145	4, 640601
<i>l</i> - Numer: =	9, 502323	9, 508628

- *y* cos *v*

	A	B
$-y \text{ cof } v$ ==	70661	73795
add. $y - b$ ==	69324	73509
$-b + y - y \text{ cof } v$ ==	139985	147304
$l - \text{Denom.}$ ==	5, 146081	5, 168214
$a \ l - \text{Num.}$ ==	9, 502323	9, 508628
$l \ a$ ==	4, 356242	4, 340414
Dist. Perih. a Sole a ==	22711	21898
hinc $2 \ a$ ==	45422	43796
b ==	44993	43712
$2 \ a - b$ ==	429	84
$l (2a - b)$ ==	2, 632458	1, 924280
subtr. $l \ b$ ==	4, 653145	4, 640601
$l \ n$ ==	7, 979313	7, 283679
$l \ a \ a$ ==	8, 712484	8, 680828
subtr. $l \ V \ b$ ==	2, 326572	2, 320300
	6, 385912	6, 360528
subtr. $l \ m$ ==	5, 434553	5, 434553
$l \frac{a \ a}{m \ V \ b}$ ==	0, 951359	0, 925975
Ob v ==	128, 10, 42	129, 0, 57
erit $\frac{1}{2} \ v$ ==	64, 5, 21	64, 30, 28
& $l \ t$ ==	0, 313536	0, 321655
$l \ t^2$ ==	0, 627072	0, 643310
$l \ t^3$ ==	0, 940608	0, 964965
$l \ t^5$ ==	1, 567680	1, 608275
$l \ t^7$ ==	2, 194752	2, 251585
$l \ t^9$ ==	2, 821824	2, 894895
$l \ n \ t^5$ ==	9, 546993	8, 891954
$l \ n^2 \ t^5$ ==	7, 526306	6, 175633

$l \ n^2 \ t^7 =$



	A	B
$ln^2 t^7$ ==	8, 153378	6, 818943
$ln^3 t^7$ ==	6, 132691	4, 102622
$ln^3 t^9$ ==	6, 759763	4, 745932
Ergo t ==	2, 05843	2, 09727
$+\frac{1}{3}t^3$ ==	2, 90728	3, 07499
	4, 96571	5, 17226
subt. $\frac{2}{3}n^2 t^5 + \frac{4}{7}n^3 t^7 + \frac{4}{3}n^3 t^9$ ==	0, 14126	0, 03119
	4, 82445	5, 14107
add. $\frac{3}{3}n^2 t^5 + \frac{3}{7}n^2 t^7 + \&c.$ ==	811	9
$t + \frac{1}{3}t^3 + \&c.$ ==	4, 83256	5, 14116
$l(t + \frac{1}{3}t^3 + \&c.)$ ==	0, 684177	0, 711062
add. $l \frac{aa}{m\sqrt{b}}$ ==	0, 951359	0, 925975
l temp. ==	1, 635536	1, 637037
Temp. ==	43, 205	43, 355
feu	43 ^d , 4 ^b , 55 ⁱ	43 ^d , 8 ^b , 31 ⁱ
At tertia Observ. Jan.	18, 7, 57	18, 7, 57
Cometa in Perih. Mart.	1, 12, 52	1 ^d , 16, 28

Orbita ergo Cometæ sequentibus sex momentis determinabitur :

Pro hypoth. Gg	101000	106000
1. Distantia Perihelii		
a Sole feu a	22711	21898
& la	4, 356242	4, 340414
2. Semilatus rectum		
orbitæ feu b	44993	43712
& lb	4, 653145	4, 640601

	A	B
3. Cometa per perihelium transiit A. 1744 Mense Martio Temp. medio Berol.	1 ^d , 12 ^b , 52 ^f	1 ^d , 16 ^b , 28 ^f
4. Distantia Perihelii a nodo ascendente Ω =	152° 28' 48"	151° 38' 8"
Hinc a Perihelio ad nodum descendentem ☿ =		
est anomalia vera =	27, 31, 12	28, 21, 52
5. Longitudo heliocentri- ca Nodi ascend. longitudo heliocentrica nodi descendentis =	1 ^s , 15° 24' 41"	1 ^s , 16° 20' 45"
6. Inclinatio Orbitæ Come- tæ ad Eclipticam	42° 59' 28"	48° 31' 29"

Mox autem apparebit veram Cometæ orbitam intra hos duos limites tam parum a se invicem discrepantes contineri.

Computetur ergo ex utroque limite locus cometæ ad tempus observationis factæ d. 18 Febr. quæ adhuc ante appulsum ad perihelium contigit. Quæraturn igitur primo interval- lum temporis inter transitum cometæ per perihelium & mo- mentum observationis, idque in diebus, dieique partibus deci- malibus exprimatur, quod deinde vocetur = T.

Perihel. Cometæ Mart.	1 ^d , 12 ^b , 52 ^f	1 ^d , 16 ^b , 28 ^f
subtrahatur Febr.	18, 6, 43	18, 6, 43
	12, 6, 9	12, 9, 45
Ergo est T =	12, 25 62	12, 40 62
& 1/T =	1, 088355	1, 093639

Ponatur

Ponatur anomalia vera huic tempori respondens = v ,
 fitque tang. $\frac{1}{2} v = t$, erit $T = \frac{a a}{m \sqrt{b}} \left(t + \frac{1}{3} t^3 - \frac{2}{5} n t^5 + \frac{3}{7} n^2 t^7 - \frac{2}{9} n^3 t^9 + \dots \right)$

Quoniam orbita parum a parabola discrepat, quaratur
 ex tabula motus in parabola θ , ut fit $\theta + \frac{1}{3} \theta^3 = \frac{m \sqrt{b}}{a a} T$
 feu areae parabolicae, quo valore ipsius θ invento erit
 $\theta + \frac{1}{3} \theta^3 = t + \frac{1}{3} t^3 - \frac{2}{5} n t^5 + \frac{3}{7} n^2 t^7 - \frac{2}{9} n^3 t^9 + \dots$ &c.

& quia t vehementer parum a θ discrepat, ponatur $t = \theta + q$
 erit $q = \theta + \theta \theta q - \frac{2}{5} n \theta^5 + \frac{3}{7} n^2 \theta^7 - \frac{2}{9} n^3 \theta^9 + \dots$ &c. ideoque fiet proxi-
 me $q = \frac{(\frac{2}{5} n - \frac{3}{5} n^2) \theta^5 - (\frac{3}{7} n^2 - \frac{4}{7} n^3) \theta^7 + (\frac{4}{9} n^3 - \frac{5}{9} n^4) \theta^9 - \dots}{t + \theta \theta}$

Ita ergo calculus instituat:ur :

	A	B
A l T =	1, 088355	1, 093639
subtr. l $\frac{a a}{m \sqrt{b}}$ =	0, 951359	0, 925975
l $(\theta + \frac{1}{3} \theta^3)$ =	0, 136996	0, 167664
Ergo 2 A tang θ =	91°, 3', 20"	93°, 41', 55"
& A tang θ =	45°, 31, 40	46, 50, 57
& l θ =	0, 008001	0, 028052
l θ^2 =	0, 016002	0, 056104
l θ^5 =	0, 040005	0, 140260
l n =	7, 979313	7, 283679
l n θ^5 =	8, 019318	7, 423939
l n^2 θ^5 =	5, 998631	4, 707618
	Q ₂	l n^2 θ^7 =

	A	B
$ln^2 \theta^7$ ==	6, 014633	4, 763722
$ln^3 \theta^7$ ==	3, 977946	
$+\frac{2}{3} n \theta^5$ ==	0, 004182	0, 001062
$-\frac{3}{3} n^2 \theta^5$ ==	59	3
	0, 004123	0, 001059
$-\frac{3}{7} n^2 \theta^7$ ==	44	3
Numerator ==	0, 004079	0, 001056
θ^2 ==	1, 037535	1, 137900
Denom $1 + \theta^2$ ==	2, 037535	2, 137900
l Numerat. ==	7, 610554	7, 023664
l denom. ==	0, 309104	0, 329987
$l q$ ==	7, 301450	6, 693677
q ==	0, 002002	0, 000494
θ ==	1, 018595	1, 066725
r ==	1, 020597	1, 067219
Ergo $\frac{1}{2} v$ ==	45, 35, 2	46, 51, 45
Anomalia vera v ==	91, 10, 4	93, 43, 30
Perihelium a Nodo ascend. ==	152, 28, 48	151, 38, 8
Dist. Cometæ a Nodo ==	61, 18, 44	57, 54, 38

Porro distantia cometæ a Sole est $= \frac{b}{1 + \frac{b-a}{a} \cos v}$.

Ergo $a b$ ==	44993	43712
subtr. a ==	22711	21898
$b-a$ ==	22282	21814
$l(b-a)$ ==	4, 347954	4, 338735
subtr. $l a$ ==	4, 356242	4, 340414
erit $l \frac{(b-a)}{a}$ ==	9, 991712	9, 998321
add. $l - \cos v$ ==	8, 309196	8, 812697

$l a - b$

	A	B
$l \frac{a-b}{a} \cos v =$	8, 300908	8, 811018
$- \frac{b+a}{a} \cos v =$	0, 019994	0, 064717
Denomin.	0, 980005	0, 935282
$l b =$	4, 653145	4, 640601
$l \text{ Denom.} =$	9, 991228	9, 970942
$l \text{ Dist. Com. a Sole} =$	4, 661917	4, 669659

Resolvendum nunc est triangulum sphericum ΩCc , in quo Fig. 11
 est $C\Omega$ distantia cometæ a nodo ascendente, & angulus Ω
 inclinatio orbitæ ad Eclipticam. Erit vero $\sin Cc = \sin \Omega C$.
 $\sin \Omega$ & $\text{tang } \Omega c = \text{tang } \Omega C \cdot \cos \Omega$.

$\Omega C =$	61, 18, 44	57, 54, 38
ang. $\Omega =$	42, 59, 28	48, 31, 29
$l \sin \Omega C =$	9, 943122	9, 927995
$l \sin \Omega =$	9, 833710	9, 874621
$l \text{ tang } \Omega C =$	9, 776832	9, 802616
$l \cos \Omega =$	10, 261847	10, 202702
$l \text{ tang } \Omega C =$	9, 864190	9, 821052
$l \sin Cc =$	10, 126037	10, 023754
Ergo lat. helioc. $Cc =$	36, 44, 20	39, 24, 10
& $\Omega C =$	1, 23, 12, 0	1, 16, 34, 0
addatur longitudo $\Omega =$	1, 15, 24, 41	1, 16, 20, 45
Long. helioc. Cometæ $=$	3, 8, 36, 41	3, 2, 54, 45
Long. helioc. terræ $=$	4, 29, 30, 40	1, 29, 30, 40
Ang. $TS c =$	1, 20, 53, 59	1, 26, 35, 55
summa ang. $=$	129, 6, 1	123, 24, 5
femi summa $=$	64, 33, 0	61, 42, 2
$l SC =$	4, 661917	4, 669659
$l \sin CS c =$	9, 776824	9, 802615
$l \cos CS c =$	9, 903833	9, 888012

Fig. 12.

Q3

$l Cc =$

	A	B
$l Cc =$	4, 438741	4, 472274
$l Sc =$	4, 565750	4, 557671
a $l ST =$	4, 995309	4, 995309
$l tang: =$	10, 429559	10, 437638
ang:	69, 35, 57	69, 56, 42
subtr.	45	45
	24, 35, 57	24, 56, 42
$l tang:$	9, 660692	9, 667583
$l tang \frac{1}{2} summa:$	10, 322480	10, 268869
$l tang semi diff:$	9, 983172	9, 936452
semi diff:	43, 53, 25	40, 49, 25
semi summa:	64, 33, 0	61, 42, 2
ang. $STc =$	20, 39, 35	20, 52, 37
Addatur longitudo Solis	10, 29, 30, 40	10, 29, 30, 40
Longitudo Cometæ Geoc.	11, 20, 10, 15	11, 20, 23, 17

Cum igitur longitudo cometæ observata fit:

$11^{\circ}, 19', 57'', 0''$ vera orbita extra hos limites cadere videtur, ita ut statui deberet $Gg = 96000$. Videamus ergo quoque

latitudinem, est autem $Tc = \frac{Sc \sin TSc}{\sin STc}$.

$l Sc =$	4, 565750	4, 557671
sub $l \sin STc =$	9, 547550	9, 551890
	5, 018200	5, 005781
add $l \sin TSc =$	9, 889887	9, 921600
$l Tc =$	4, 908087	4, 927381
a $l Cc =$	4, 438741	4, 472274
$l tang lat:$	9, 530654	9, 544893
Lat. Geocentrica:	$18^{\circ}, 44', 50''$	$19^{\circ}, 19', 30''$

Cum

Cum igitur latitudo geocentrica esset observata $19^{\circ}, 10', 56''$, orbita vera intra limites hosce contineri deberet: Videtur autem latitudini plus fidi oportere, quam longitudini; si autem utrique æqualiter fidere velimus, aberrationesque in utramque æqualiter distribuere, tum hypothelis A veram orbitam cometæ præbere esset censenda. Quoniam vero quoque error in observationibus tribus assumtis inesse potest, qui etiamsi sit minimus, tamen notabile discrimen in orbitam inferat, plus affirmare non licet, quam hos duos limites proxime ad veritatem accedere.

Interim tamen hoc tuto concludi posse videtur, orbitam cometæ neque hyperbolam esse, neque parabolam, sed elliptin vehementer oblongam: unde statum habebit tempus periodicum. Erit enim distantia aphelii a sole $= \frac{a b}{2 a - b}$,

tum semi axis transversus $= \frac{a a}{2 a - b} = e$

	A	B
Ergo $a 2 l a =$	8, 712484	4, 680828
subtr. $l(2 a - b) =$	2, 632458	1, 924280
$l e$	6, 080026	6, 756548
$l \sqrt{e}$	3, 040013	3, 378274
unde $l e \sqrt{e} =$	9, 120039	10, 134822
subtr. $l c \sqrt{c} =$	7, 500000	7, 500000
Hinc tempus periodicum Cometæ prodiret annorum:	1, 620039	2, 634822
	41, $\frac{60}{100}$	431, $\frac{34}{100}$

Cometa denique in suo perihelio propius ad solem accessit, quam Mercurius, dum in suo perihelio versatur. Hoc enim tempore

tempore distantia mercurii a sole est = 30740, & quia medium inter utramque hypothesin fumendo distantia Cometæ in perihelio erat circiter 22000, illa ad hanc rationem proxime habebit ut 7 ad 5.

Definiamus vero adhuc tempus, quo cometa per suum nodum descendentem transierit; quo tempore erat ejus anomalia vera.

	A	B
	$v = 27^{\circ}, 31', 12'' $	$28^{\circ}, 21', 52''$

Cum autem angulus $\frac{1}{2}v$ fiat satis parvus, valor ipsius $t + \frac{1}{3}t^3 + \&c.$ proxime ex hypothesi parabolæ reperietur fietque.

$l (t + \frac{1}{3}t^3 + \&c.) =$	9, 397478	9, 411748	
add $l \frac{a^2}{m\sqrt{b}} =$	0, 951359	0, 925975	
	0, 348837	0, 337723	
Tempus a Perihelio in diebus =	2, 2327	2, 1764	
seu =	$2^d, 5^b, 45^l$	$2^d, 4^b, 13^l$	
Addatur temp. Perih.			
Mart.	1, 12, 52	1, 16, 28	
Cometæ per nodum descendentem transiit			
A. 1744 Martio	$3^d, 18^b, 37^l$	$3^d, 20^b, 41^l$	

Quare cometa die quarto mensis martii circa ortum solis per eclipticam austrum versus est transgressus; motus ergo circa solem fuit celerrimus, quia duobus diebus fere 30 gradus in orbita sua absolvit. Tempus quo Cometa per nodum ascendentem transiit tam accurate defini non potest, quia ob ingentem anomaliã verã 151°, minimus error in orbita ingens discrimen producere valet. Interim ex limite B colligitur cometa per nodum ascendentem transiisse. A. 1743. Mensis Augusti die septimo.

Quan-

Quāquam orbita cometæ hoc modo inventa parum a veritate discrepat, tamen per easdem, quibus usus sum observationes multo accuratius potest determinari eo modo, quem exposui in Miscell. Berol. Volumine VII. ubi ostendi, quemadmodum, si orbita cometæ jam fere sit cognita, ea per observationes corrigi debeat. Fingamus ergo orbitam a veritate parum discrepantem parabolicam; quæ contineatur his conditionibus

	Orbita ficta	fitque orbita vera
Perihel. a sole	22000	22000 - α
ratio $b : a$	2 : 1	$2 - \frac{\beta}{10000} : 1$
Com. in Perih. Mart.	$1^d, 6^b, 0'$	$1^d, 6^b, \gamma'$
Dist. Perih. a Ω	151°	$151^\circ, \delta'$
Long. hel. Ω	$1^s, 16^\circ$	$1^s, 16^\circ - \epsilon'$
Incl. Orbitæ	45°	$45^\circ + \zeta$

Ut jam valores litterarum $\alpha, \beta, \gamma, \delta, \epsilon$ & ζ determinem, sex constituo hypotheses, quarum qualibet unica conditione ab orbita ficta discrepet. sintque :

Hyp. I	Hyp. II	Hyp. III	Hyp. IV	Hyp. V	Hyp. VI
22000	22000	22000	22000	21000	22000
2 : 1	2 : 1	2 : 1	2 : 1	2 : 1	$2 - \frac{5000}{10000} : 1$
$1^d, 6^b$	$1^d, 6^b$	$1^d, 6^b$	$1^d, 18^b$	$1^d, 6^b$	$1^d, 6^b$
151°	151°	152°	151°	151°	151°
$1^s, 16^\circ$	$1^s, 15^\circ$	$1^s, 16^\circ$	$1^s, 16^\circ$	$1^s, 16^\circ$	$1^s, 16^\circ$
50°	45°	45°	45°	45°	45°

His constitutis eligo quatuor observationes omni cura insti-

tutas, ad earumque tempora ex ficta orbita atque ex hypothese-
 bus investigo longitudinem & latitudinem geocentricam come-
 tæ; atque ex discrimine singularum hypotheseum ab orbita ficta
 colligi poterit locus cometæ, quem orbita vera esset datura;
 qui cum observato comparatus dabit æquationem. Quoniam
 vero tantum sex opus est æquationibus, ex quatuor illis obser-
 vationibus duas latitudines rejiciamus, quippe quæ per reliqua
 sponte determinantur. Hoc modo cum absolvisssem calculum
 satis molestum, quem ob prolixitatem hic prætermitto, sex se-
 quentes æquationes sum adeptus:

I. Ex longitudine Dec. 13^d, 8^b, 40' observata:

$$483\zeta + 9383\varepsilon - 6366\delta - 46\gamma + 335\alpha + 4220\beta - 41000 = 0$$

II. Ex longitudine Jan. 3^d, 6^b, 17' observata

$$1550\zeta + 6116\varepsilon - 3716\delta - 130\gamma + 179\alpha + 3620\beta - 124000 = 0$$

III. Ex latitudine Jan. 3^d, 6^b, 17' observata

$$1260\zeta - 1566\varepsilon + 6866\delta - 88\gamma - 495\alpha - 1380\beta - 421000 = 0$$

IV. Ex longitudine Jan. 18^d, 7^b, 57' observata

$$1517\zeta + 3883\varepsilon - 1233\delta - 188\gamma + 63\alpha + 2640\beta - 156000 = 0$$

V. Ex latitudine Jan. 18^d, 7^b, 57' observata

$$1257\zeta - 1566\varepsilon + 5583\delta - 86\gamma - 459\alpha - 1100\beta - 378000 = 0$$

VI. Ex longitudine Febr. 18^d, 6^b, 43' observata

$$1140\zeta - 1817\varepsilon + 1733\delta - 544\gamma - 250\alpha + 560\beta - 131000 = 0$$

Ex his sex æquationibus orientur sex sequentes valores ipsius ζ .

$$0 = \zeta$$

$$0 = \zeta + 19,426\epsilon - 13,180\delta - 0,0952\gamma + 0,6936\alpha + 8,737\beta - 84,886$$

$$0 = \zeta + 3,946\epsilon - 2,397\delta - 0,0838\gamma + 0,1154\alpha + 2,335\beta - 80,000$$

$$0 = \zeta - 1,243\epsilon + 5,449\delta - 0,0705\gamma - 0,3930\alpha - 1,100\beta - 334,127$$

$$0 = \zeta + 2,559\epsilon - 9,813\delta - 0,1239\gamma + 0,0415\alpha + 1,740\beta - 102,834$$

$$0 = \zeta - 1,246\epsilon + 4,442\delta - 0,0684\gamma - 0,3651\alpha - 0,875\beta - 300,716$$

$$0 = \zeta - 1,594\epsilon + 1,520\delta - 0,4772\gamma - 0,2193\alpha + 0,291\beta - 114,912$$

subtrahantur singulae æquationes a prima eritque

$$0 = 15,480\epsilon - 10,783\delta - 0,0114\gamma + 0,5782\alpha + 6,402\beta - 4,886$$

$$0 = 20,699\epsilon - 18,629\delta - 0,0247\gamma + 1,0866\alpha + 9,837\beta + 249,241$$

$$0 = 16,867\epsilon - 12,367\delta + 0,0287\gamma + 0,6521\alpha + 6,997\beta + 17,948$$

$$0 = 20,672\epsilon - 17,622\delta - 0,0268\gamma + 1,0587\alpha + 9,612\beta + 215,830$$

$$0 = 21,020\epsilon - 14,700\delta + 0,3820\gamma + 0,9189\alpha + 8,246\beta + 30,026$$

hinc oriuntur quinque valores pro ϵ .

$$0 = \epsilon - 0,6966\delta - 0,0007\gamma + 0,0373\alpha + 0,4135\beta - 0,3156$$

$$0 = \epsilon - 0,9013\delta - 0,0012\gamma + 0,0526\alpha + 0,4776\beta + 12,0587$$

$$0 = \epsilon - 0,7332\delta + 0,0017\gamma + 0,0387\alpha + 0,4148\beta + 1,0641$$

$$0 = \epsilon - 0,8525\delta - 0,0013\gamma + 0,0512\alpha + 0,4650\beta + 10,4410$$

$$0 = \epsilon - 0,6993\delta + 0,0182\gamma + 0,0437\alpha + 0,3923\beta + 1,4284$$

Subtrahantur ab ultimo omnes reliqui, atque orientur quatuor sequentes æquationes.

$$0 = 0,0189\gamma - 0,0027\delta + 0,0064\alpha - 0,0212\beta + 1,7440$$

$$0 = 0,0194\gamma + 0,2020\delta - 0,0089\alpha - 0,0853\beta - 10,6303$$

$$0 = 0,0165\gamma + 0,0339\delta + 0,0050\alpha - 0,0225\beta + 0,3643$$

$$0 = 0,0195\gamma + 0,1532\delta - 0,0075\alpha - 0,0727\beta - 9,0126$$

invenientur ergo quatuor valores pro γ .

$$0 = \gamma - 0,1428 \delta + 0,3386 a - 1,1217 \beta + 92,275$$

$$0 = \gamma + 10,4124 \delta - 0,4587 a - 4,4890 \beta - 547,950$$

$$0 = \gamma + 0,2054 \delta - 0,3030 a - 1,3636 \beta + 22,078$$

$$0 = \gamma + 7,8564 \delta - 0,3846 a - 3,7282 \beta - 162,485$$

Subtrahantur prima ac tertia a secunda itemque prima a quarta.

$$0 = 10,5552 \delta - 0,7973 a - 3,3673 \beta - 640,225$$

$$0 = 10,2070 \delta - 0,7617 a - 3,1254 \beta - 570,028$$

$$0 = 7,9992 \delta - 0,7232 a - 2,6065 \beta - 554,460$$

Unde tres valores ipsius δ deducuntur:

$$\delta = 0,07554 a + 0,31902 \beta + 60,655$$

$$\delta = 0,07462 a + 0,30620 \beta + 55,846$$

$$\delta = 0,09041 a + 0,32585 \beta + 69,315$$

subtrahatur medius ab utroque, eritque:

$$0 = 0,00092 a + 0,01282 \beta + 4,809$$

$$0 = 0,01579 a + 0,01965 \beta + 13,469$$

hincque bini valores pro β nascuntur:

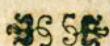
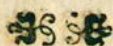
$$\beta = -0,07176 a - 375,118$$

$$\beta = -0,80356 a - 685,492$$

subtrahatur posterior a priori eritque

$$0,73180 a + 310,374 = 0$$

Hinc



unde	$\alpha = -424, 125$	$l - \alpha = 2, 627493$
hincque	$\beta = -344, 680$	$l - \beta = 2, 537416$
	$\delta = -81, 345$	$l - \delta = 1, 910331$
	$\gamma = -346, 889$	$l - \gamma = 2, 540190$
	$\epsilon = +101, 755$	$l + \epsilon = 2, 007555$
	$\zeta = +311, 44$	$l + \zeta = 2, 493374$

Hinc ergo ob β negativum fiet orbita cometae hyperbola sequentibus sex conditionibus determinata.

Distantia perihelii a Sole $a =$	22424
ratio $b : a =$	$2 + \frac{2}{100000} : 1$
Ergo semilatus rectum $b =$	45619
Cometa per Perihelium transiit A. 1744. Mart.	$1^d, 0^b, 14'$
Dist. Perihelii a Ω	$149^\circ, 39'$
Long. helioc. Nodi Ω	$1', 17^\circ, 41'$
Inclinatio orbitae	$50^\circ, 11'$

Patet autem has determinaciones maxime pendere a bonitate observationum, in quibus si vel minimum esset aberratum, orbita, quæ hic prodiit hyperbola, facile in ellipsin transmutari potuisset. Tum vero calculus quoque summa cura institui debet, ita ut in locis, quæ singulæ hypotheses præbent, ne minuta quidem secunda negligantur. Tantum laborem autem, nisi in observationibus tantam fiduciam collocare liceat, suscipere operæ non est pretium. Quare mihi quidem methodum ostendisse sufficiat, cujus ope, si ac-

curatissimæ observationes suppetant, veræ orbitæ natura investigari queat; quod negotium aliis expediendum relinquo.

Quoniam ergo ob defectum plurium observationum factis exactarum circa orbitæ naturam, utrum sit in se rediens an in infinitum excurrens, nihil concludere licet, finem huic dissertationi imponam, postquam quædam de hujus cometæ cursu tam observato quam futuro monuero. Primum igitur iste cometa neque eclipticam neque æquatorem trajecisse visus est, sed quamdiu apparuit tam latitudinem quam declinationem habuit borealem, interim tamen si ad ejus tempus periodicum spectemus, quod si ullum est, plurimum seculorum esse debet. Semestre tantum spatium in hemisphærio boreali est versatus, reliquo vero tot annorum spatio perpetuo in regione cœli australi est commoratus. Deinde a 7 die Augusti, quo per nodum ascendentem transit usque ad Februarii diem 25 ab ecliptica recessit, hinc vero cursu satis celeri jam die Martii 4to per nodum descendentem est transgressus, quæ ingens anomalia certe cum nulla alia theoria, præter Neutronianam, consistere potest. Sub finem ergo apparitionis ejus via apparens vehementer a circulo cœli maximo deflexit: unde manifestum est, hunc cometam non in plano per centrum terræ transeunte esse motum. Cum in nodo descendente ver-

faretur

faretur, soli quidem propior fuit quam Mercurius, ab hoc vero tam parum fuit remotus, ut, si vim attractivam pro ratione molis habuerit, notabilis perturbatio in motu mercurii oriri debuisset: hoc enim tempore longitudo Cometæ heliocentrica erat, in Scorpii gradu 15, Mercurius vero in ejusdem signi gradu 26 hærebat; atque corpus cometæ, si diametrum apparentem eo tempore, quo in distantia solis a nobis erat remotus, statuamus 1', plusquam tricies corpus terræ superavit. Quamobrem operæ pretium erit investigare, utrum mercurius adhuc in motu suo cum tabulis astronomicis consentiat, an vero perturbationem a cometa sit passus.

Post Februarii diem ultimum, quo cometa adhuc ante solis ortum erat conspicuus, penitus evanuit, cum ob solis vicinitatem, tum ob diminutam ejus latitudinem borealem. Quia enim post diem Martii quartum in hemisphærium australe processit, ante ortum solis non amplius supra horizontem nostrum ascendit. Quibus autem in cæli locis postea verferetur, ex his inventis satis accurate indicari poterit. Sic Aprilis die 15 iterum erit directus, & apparebit in 8vo Arietis gradu cum latitudine australi 30° fere, & cum distantia a terra futura sit paulo major quam solis, incolis terræ australibus adhuc erit conspicuus; qui post quartum diem martii hunc cometam ante solis ortum eximio splendore

splendore videre debuerunt. Quaresi in his regionibus commorarentur Astronomi, diu adhuc post nos eundem cometam observare potuissent. Atque si eum exquisitis tubis prosequerentur, fortasse ultra mensem Julium conspicerent possent, namque primo die Julii ejus longitudo esse debet $\sphericalangle 27^\circ$, cum latitudine australi 48° , sexto autem die septembris longitudo iterum erit $\sphericalangle 3^\circ$, cum latitudine 53° , ejus vero distantia a terra se habebit ad distantiam solis ut $2\frac{1}{2}$ ad 1, unde nisi per bona telescopia vix spectari poterit. Hujusmodi autem observationes in regionibus terræ australibus factæ maxime essent optandæ, cum ex iis facile omnia, quæ adhuc circa ejus orbitæ cognitionem desiderantur, deduci ac suppleri possent. Utinam hoc tempore in capite bonæ spei idoneus astronomiæ cultor commoraretur, a quo istud supplementum expectare liceret.



Addita-